PRODUCTIVITY SPILLOVERS FROM FOREIGN DIRECT INVESTMENT IN DEVELOPING COUNTRIES: A META-REGRESSION ANALYSIS

by

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This Draft: April 2006

Abstract: This paper reviews the empirical literature on technology spillovers from foreign direct investment (FDI) in developing countries. The sample includes 32 studies that model the contribution of FDI presence to local productivity in the host country through spillover effects such as those associated with technology transfer and superior managerial know-how. In our quantitative meta-analysis, study estimates of spillover effects are regressed on a number of study characteristics in order to determine what aspects of study design and data characteristics explain the magnitude, significance, and direction of spillovers from FDI. The meta-regression results suggest that spillover effects are more pronounced when studies measure the effect of FDI spillovers on output, and are more likely to be significant and positive for Asian countries. Results also highlight the possibility that the documented spillover effects from FDI in developing countries may be partly a product of model misspecification.

Keywords: Foreign Direct Investment, Spillovers, Productivity, Developing Countries
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* Corresponding author. The authors wish to thank seminar participants from the Department of Economics at the University of Arkansas for helpful comments and suggestions.

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Abstract: This paper reviews the empirical literature on technology spillovers from foreign direct investment (FDI) in developing countries. The sample includes 32 studies that model the contribution of FDI presence to local productivity in the host country through spillover effects such as those associated with technology transfer and superior managerial know-how. In our quantitative meta-analysis, study estimates of spillover effects are regressed on a number of study characteristics in order to determine what aspects of study design and data characteristics explain the magnitude, significance, and direction of spillovers from FDI. The meta-regression results suggest that spillover effects are more pronounced when studies measure the effect of FDI spillovers on output, and are more likely to be significant and positive for Asian countries. Results also highlight the possibility that the documented spillover effects from FDI in developing countries may be partly a product of model misspecification.

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I. Introduction

Developing country governments often provide investment incentives targeting foreign firms in an effort to attract foreign direct investment (FDI), boost capital formation and enhance the quality of capital stock in their economies. FDI is often seen as vehicle for increases in productivity and consequently as a driver for economic growth. Specifically, foreign presence in a given sector is often associated with the transfer of superior technical and managerial know-how, better organizational practices, etc., that not only improves the productivity of firms that are recipients of FDI, but also spills over into the surrounding economy through worker turnover and/or demonstration effects (Damijan, *et al*., 2003; Vahter, 2004). Not surprisingly, developing countries go to great lengths to provide investment incentives targeted at foreign firms. According to 2005 *World Investment Report*, no fewer than 2156 regulatory changes in investment regimes were introduced by 102 countries between 1991 and 2004, of which 93% were more favorable to FDI and only 7% were less favorable to FDI (UNCTAD, 2005).[1]

Because of the possibility of spillover effects from FDI, empirical studies that model the productivity gains from foreign presence often include gains to domestic firms that are not direct recipients of foreign investment. However, the evidence on whether FDI is the source of positive (or negative) productivity spillover effects is decidedly mixed (for a good overview see Fan, 2003). Studies using data from industrialized countries are, on average, more likely to find positive intra-sectoral spillovers from FDI (Liu *et al*., 2000; Globerman, 1979; Driffield, 2001). For developing countries however, data is often incomplete and historically there have been few studies of productivity spillovers from FDI. More recently, the increasing availability of better datasets for a larger number of countries has produced a significant increase in the number of such studies but the results across countries remain inconclusive.

In an attempt reconcile the mixed evidence, Gorg and Strobl (2001) provide the only meta-analysis of technology spillover effects from FDI using 21 studies of intra-industry spillovers in both

[1] In 2004, developing countries as a group showed the most significant reduction in their average corporate tax rate: from 29.7% to 26.5% (UNCTAD, 2005).

industrialized and developing countries. In addition to concerns about publication bias, the authors find that study design, data characteristics, and the choice of foreign presence measure significantly determine whether these studies fail or succeed in documenting spillover effects. However, due to pooling of the results from both developed and developing countries in the meta-regression, it is difficult to discern whether the evidence, on average, supports the existence of productivity spillovers in developing countries. This is important to distinguish because industrialized countries may accrue benefits from FDI that are not apparent for developing countries. For example, Meyer (2004) points out that the greater the size of the technology gap between MNE affiliates and domestic firms, the less beneficial FDI is for the host country. If this is the case, then FDI in developing countries may not result in findings of positive spillovers similar to those in studies of industrialized countries.

The objective of this paper is to provide a critical analysis of the results of studies that only consider productivity spillover effects in developing countries. Such an analysis is possible due to the significant expansion of this literature in recent years. Specifically, we survey 32 studies which collectively contribute a total of 141 observations of technology spillovers from FDI in developing countries. Further, we collect information on various study characteristics such as the choice of productivity measures used, the type of data employed, the inclusion (or omission) of factors that facilitate spillover absorption, as well as the inclusion (or omission) of control variables such as industry and time effects. These study characteristics then serve as explanatory variables in our meta-analysis. We estimate three specifications designed to analyze the statistical significance, the positive or negative sign, and the magnitude of the empirical estimates measuring the contribution of FDI to local productivity in the studies. Given the nature of our sample, we also conduct a publication bias test to further explore whether misspecification is present.

Our meta-regression results suggest that findings of significant FDI spillovers are highly sensitive to model specification and data type. Specifically, studies that use more recent data or that include a measure of sector research and development (R&D) intensity as a control variable are, on average, less likely to find statistically significant spillover effects. On the other hand, higher statistical significance of estimated spillover effects is associated with the use of output share as a measure of foreign presence, or the inclusion of labor quality as a control variable. In addition, higher statistical significance of documented spillover effects is, on average, significantly more likely in studies using data from Asian countries. Our results however indicate that specification error (omitted variable bias in particular) may be a problem in the surveyed literature.

Findings of positive spillover effects are more likely to obtain in studies with more recent data or analyses with higher degrees of freedom. Negative spillover effects are most commonly documented in estimations that use output share as a measure of foreign presence or use data aggregated at the firm level instead of the industry level. There is also evidence that labor quality is inversely associated with spillover absorption. With respect to the magnitude of spillover effects our analysis reveals one statistically significant commonality: studies using larger datasets affording higher degrees of freedom generate findings of a relatively smaller magnitude of FDI spillovers. Overall, we find that the evidence of intra-sectoral spillovers from FDI in developing countries is weak, at best. This result is further strengthened by our test for publication bias. We find support for the existence of publication bias in our sample indicating that such bias may affect the empirical results of the studies. More importantly and in view of the above results it may alternatively suggest that, on average, intra-sectoral FDI spillovers do not exist in developing countries.

The remainder of the paper is organized as follows. Section II provides a review of the literature that addresses the role of FDI in technology transfer to domestic firms in developing countries. Section III discusses sample construction and outlines the methodology and empirical specifications. Section IV discusses empirical results and Section V concludes.

II. Literature Review

A. Intra-Sectoral Productivity Spillovers: Method of Analysis and Data Characteristics

While the determinants of international production patterns and FDI are quite varied (see Blonigen, 2005 for a good review of this literature) it is generally accepted that MNEs will choose production in foreign markets over exports when they possess distinct technological advantages (or firm-specific assets) that enable them to overcome the fixed costs associated with operating in a foreign country. Foreign-owned firms are therefore expected to have higher productivity compared to their domestic counterparts that are not recipients of FDI. This benefit of FDI that occurs within the foreign-owned firms is often referred to in the literature as the own-firm productivity effect of FDI (Vahter, 2004). Technological advantages apparent in foreign-owned firms raise the question whether the presence of these firms in a given sector benefits other domestic firms in the industry through the dissemination of improved technology, knowledge of more efficient productive processes, or management expertise. If such gains to domestic firms exist, then they are considered to be positive spillovers from FDI (Fan, 2003), as their presence is independent of the capital transferred by the MNE or efficiencies achieved within the foreign-owned firm.

Some of the earliest evidence on spillovers from FDI comes from case studies (see for example Mansfield and Romeo, 1980). Caves (1974), provides perhaps the first empirical model that estimates the effects of FDI on domestic labor productivity.[2] Using sectoral level data from Canada and Australia, the author finds evidence of positive spillovers from foreign presence in a manufacturing sector. More recently, evidence of positive intra-sectoral spillovers from FDI has also been documented in other industrialized countries such as the United Kingdom (Haskel *et al*., 2002). With respect to developing countries, empirical studies typically measure the effect of FDI on productivity of domestic firms within a given sector by regressing some productivity measure on a variable that captures foreign presence in that sector and a set of explanatory variables assumed to affect productivity in that sector. It should be noted that this approach does not address how spillovers are transmitted or disseminated; rather, it focuses on whether spillover effects are present or not. Estimates of intra-industry productivity spillover effects are thus obtained by estimating an equation of the general form:

[2] A related body of literature has devoted attention to the analysis of whether foreign-owned firms pay higher wages. In this context, studies have sought to document whether average wage levels in the host economy increase as a result of foreign presence in local sectors, and whether there is a tendency for local firms to follow suit and increase wages. For a good overview of this literature see Lipsey and Sjöholm (2005).

$$Productivity\ Measure = \delta_0 + \sum_{j=1}^{k-1} \delta_j X_j + \delta_\kappa\ Foreign\ Presence + \varepsilon \qquad (1)$$

The dependent variable in Equation (1) is usually either a measure sector output (Aitken and Harrison, 1999), or labor productivity (Blomström and Sjöholm, 1999), or total factor productivity (Chuang and Lin, 1999). Some studies have also used an efficiency index as a productivity measure, whereby the most technologically advanced firm in a sector represents a technology horizon, and the convergence of the remaining firms in the sector to this horizon is a measure of improved technology in the sector (Aslanoglu, 2000; Blomström, 1986).

The parameter of interest in Equation (1) is the estimated coefficient on the measure of foreign presence, $\hat{\delta}_k$, which serves to capture the contribution of foreign presence in a sector to the productivity of that sector's domestic firms. While authors vary in their selections of measures of foreign presence in a sector, three measures of foreign presence have generally been used in the literature: share of total sector employment by foreign-invested firms, share of total sector capital held by foreign-invested firms, and share of total sector output produced by foreign-invested firms. In some cases, the selection is made on the basis of data availability and reliability, and the choice is not necessarily made on the basis of theory. Table 1 summarizes the dependent variable and foreign presence measure used by the studies that contribute to our sample.

Two important differences across studies that use the empirical approach generalized in Equation (1) relate to: (i) the threshold for foreign equity chosen to define a firm "foreign-invested firm"; and (ii) the types of data used to estimate spillover effects (cross section versus panel). With respect to the first, studies range from formal country classifications to seemingly arbitrary threshold levels. For example, in some cases, such as China studies, the equity threshold is given by the government definition of foreign-invested firm, providing an easy benchmark for authors to follow (Sadik and Bolbol, 2001; Buckley *et al*., 2002; Huang, 2004). In other cases, studies include a firm with any level of foreign equity as "foreign" (for example, Konings, 1999; Damijan *et al*., 2003). These studies employ the share of all such firms in the capital, output or employment in a sector as a measure of foreign presence. Other studies consider firms to be foreign-invested firms if they have foreign equity above thresholds ranging from 5% to 50% (see for example Khawar (2003) and Vahter (2004), respectively). As one might expect, this kind of variability will, of course, affect how the effects of FDI on domestic firms are measured.

Furthermore, since improvements in productivity in the firms that are recipients of FDI may exist in conjunction with potential spillovers it is important for empirical studies to properly control for this possibility. However the disparity in how "foreign" versus "domestic" is defined in the literature leads to concerns that some studies may not properly control for own-firm effects in modeling FDI spillovers. For example, firms with 20% foreign equity are recipients of FDI and may benefit from this investment through direct technology transfer from the parent firm, as well as gains from managerial improvements. However, some studies do not define such a firm as foreign-invested (see for example Djankov and Hoekman, 2000). Thus improvements that may occur within such a (low equity) foreign-invested firm are really own-firm effects of FDI, may be interpreted as spillovers along with other indirect gains of FDI to firms that are not foreign-invested.

Significant variability also exists with respect to the types of data and level of aggregation used in the literature. In some countries, such as China, economic census data identify the degree of foreign ownership in local firms, and also identify firms based on the degree and type of foreign equity participation. In such cases, it is possible to aggregate industry level data by ownership type, and to compare the attributes of the firms of different ownership types within an industry. Consequently, it is possible to empirically investigate whether or not there are unique attributes of FDI versus domestic investment. In studies using firm-level data, some samples include the firms that are recipients of FDI and some do not include such firms (see for example Konings (1999) and Liu *et al*. (2001) respectively). Those that do so, employ a variable to control for the presence of the foreign-invested firms and the concurrent own-firm effects of FDI (Vahter, 2004). While there is no uniformity in terms of how this variable is constructed, roughly equal proportions of the studies based on firm-level data use a dummy variable for whether or not the firm has the chosen threshold for foreign equity, or use a variable that corresponds to the percentage of foreign equity in the firm.

In general, more recent studies, such as Damijan *et al*. (2003) and Sinani and Meyer (2004), employ data that are aggregated at the firm level while older studies, such as Blomström and Persson (1983) and Kokko (1994), tend to use data that are aggregated at the industry level. Recent analyses have also more frequently used panel data rather than cross sectional data. The selection of industry-level data is most likely motivated by limitation of data availability; for instance, China only publishes firm-level national data irregularly, so that any panel analysis must rely upon data aggregated at the industry level (Tian *et al*., 2004).

B. Factors Facilitating Spillover Absorption

In addition to a measure of foreign presence in Equation (1) above, the inclusion of the (k-1) explanatory variables is premised on the assumption that spillovers from FDI do not occur in isolation from economic factors that may facilitate spillover absorption. Such variables usually include host country conditions such as education attainment of the labor force, domestic expenditure on research and development (R&D), quality of infrastructure, and sector characteristics such as industry concentration, among others.

For example, Kathuria (2002) uses a productivity model that includes a variable controlling for the interaction between R&D intensity and foreign-invested firm output share. The coefficient for this variable is positive and statistically significant, indicating that FDI and R&D intensity mutually facilitate productivity growth. Kinoshita (2000) also includes such an interaction term, also generating a positive coefficient. Interestingly, however, the coefficient on the foreign presence variable is negative in both of Kathuria's (2002) models, and in three out of four of Kinoshita's (2000) models that include this interaction term. This indicates that, R&D facilitates spillover absorption, but a certain intensity threshold must be met in order for a firm to benefit from spillovers from FDI; otherwise, domestic firms will actually suffer productivity losses from foreign sectoral presence.

The productivity model used by Sinani and Meyer (2004) includes an interaction term between foreign presence and human capital. While human capital contributes to productivity, the interaction term coefficient is negative in all three models employed by the author, indicating that human capital and FDI do not mutually facilitate productivity among domestic firms. The authors postulate that this is due to the fact that foreign-invested firms attract and retain the most skilled workers by paying significantly higher wages than domestic firms.

Given our focus on developing countries, the relationship between FDI spillovers and the technology gap between domestic and foreign-invested firms is of particular importance. Chuang and Hsu (2004) measure technology gap by taking the difference between output per worker for foreign-invested and domestic firms in different sectors in their sample. Those sectors with a higher than average output difference are classed as high-technology gap, and others as low-technology gap sectors. The authors find that, while spillovers are significant for both groups of sectors, they are of much greater magnitude for the low-technology gap sectors. This indicates that the greater the technological capacity of domestic firms, the more easily such firms can absorb technology spillovers from FDI.

Kokko (1994) likewise distinguishes between high- and low-technology gap sectors, and finds positive spillovers for the low-technology gap sectors, but statistically insignificant results for the high-technology gap sectors. The author postulates that in high-technology gap sectors, due to overwhelming productivity advantages, foreign-invested firms have taken the bulk of the market, and forced domestic firms into narrow niches in which operation of the foreign-invested firms is not profitable. While, on average, studies find that the degree of technology gap is negatively associated with spillover absorption, Sjöholm (1999a) finds that FDI spillovers are greater in sectors with a high-technology gap in Indonesia. The author notes, however, that this result may be due to the restrictive FDI policies of the local government in certain sectors.

III. Sample Construction and Empirical Methodology

A. Sample Construction

A thorough search of studies concerning technology spillovers from FDI in developing countries was conducted using electronic databases of published and working papers such as *EconLit*, the *Social Science Research Network*, as well as Google searches using key words such as "*productivity*", "*technology*", "*spillovers*", and "foreign direct investment" (or "*FDI*"). While it is our goal to obtain as broad a sample as possible, some FDI spillover studies are not suitable for inclusion in the meta-regression, and are therefore excluded. For example, we do not consider studies that focus on inter-sector spillovers (we found four such studies).[3] Some studies disaggregate their data and results in such a way that they could not be included in the meta-regression without adding more explanatory variables for relatively few observations. For instance, Fan (1999), presents results for the state sector and the non-state sector in China separately, but does not present results for the overall national economy. In a study of spillovers in China, Huang (2004) separately models the spillovers from FDI from Hong Kong, Macao, and Taiwan, and the spillovers from FDI from all other sources, but does not present results for the FDI spillovers from all sources. The main criteria for inclusion in the meta-regression is that the FDI source not be disaggregated by region, that results be reported for the economy without respect to ownership category, and that the study pertain to intra-sector spillovers.

In constructing the sample, consideration was given to both published and working papers. Stanley (2001) points out that a broad representation of results for meta-analysis is desirable to control for publication bias which may arise when published papers tend to present more statistically significant results than those that are not published (for an good overview of publication bias also see Stanley, 2005).

[3] Inter-sector (or vertical) spillovers from FDI operate through the foreign-owned firms' connections within a vertical chain of production and distribution (for a good discussion of inter-sector spillovers see Blalock, 2002). In general, studies that model vertical spillovers through forward or backward linkages use national economic sectoral input-output matrices to create proxies for FDI in the other sectors which supply, or are supplied by, the relevant sector, respectively (Kugler, 2000; Schoors and van der Tol, 2002; Smarzynska, 2002). Unfortunately, the literature on vertical spillovers from FDI is relatively limited, and there are very few econometric analyses which model these effects. Such limitations, combined with the analytical differences in modeling techniques between studies of inter- and intra-sectoral productivity spillover effects, make it inappropriate to pool cumulative study results from both types of studies for use in this meta-analysis.

In fact, in their meta-analysis of FDI spillovers in both developing and industrialized countries, Gorg and Strobl (2001) find evidence of publication bias highlighting the importance of incorporating a broad range of studies, including those that may contain misspecification (such as unpublished works). For the purposes of the meta-analysis, potential specification errors in studies may be coded in order to account for these problems when selecting the appropriate explanatory variables for the effect size in question (Wolf, 1986). By doing so, the nature of the adverse effect on reported results of misspecification can be identified.

The data consist of 141 regression results from 32 studies of FDI spillovers in developing countries of which 27 are published papers and 5 are working papers. In collecting the data, study observations were not scored for quality or otherwise assessed prior to being selected for inclusion in the dataset. Variable definitions and descriptive statistics are presented in Table 2. We collect data on the following four categories of study characteristics. First, we construct four dummy variables capturing the choice of productivity measure used as a dependent variable in each of the studies surveyed. Among the 141 study results of the sample, 81 are obtained using growth or level of output as the dependent variable, 39 use labor productivity, 13 use total factor productivity and 8 use an efficiency index.

Second, three dummies were created for each of the three measures of foreign presence discussed in the section above. In our sample, 47 estimates of spillover effects were obtained using share of total sector capital held by foreign-invested firms, 63 estimates used the share of total sector output produced by foreign-invested firms, and 31 estimates used the share of total sector employment by foreign-invested firms. We also code the sign, significance level, and magnitude of the estimated coefficient on the foreign presence measure, $\hat{\delta}_k$ in Equation (1). Of sample study results, 77 have positive foreign presence coefficients, and 64 have negative ones and the foreign presence coefficient is significant at the 5% level or better for 67 estimates. The average value of the log of the absolute value of the foreign presence coefficient is at a negative 2.65 suggesting that the actual estimates themselves are of fairly small magnitude although that may not be true of their economic interpretation as the dependent variable may be measured in billions of dollars (as in the case of output). The variable's standard deviation is 2.19. Finally, the average percentage of firm equity that must be foreign held for that firm to be classified as foreign-owned is 12.55% with a standard deviation of 16.19 %.

The third set of study characteristics for which information was gathered pertain to regression explanatory variables other than the measure of foreign presence. Specifically, 21 estimates come from studies that include sector R&D intensity (or expenditure) as an explanatory variable; 25 estimates were obtained from specifications which include labor quality as an explanatory variable; and in the case of 61 estimates, the empirical specifications did not include capital or capital per worker as an explanatory variable. In addition, inclusion of controls for industry (or sectoral) effects was true for only 38 of the 141 estimates while time dummies were included in the estimation of 54 observations.

The fourth and final category of dummies constructed to capture study characteristics pertain to the type of data used and the country or region for which the corresponding regression results were obtained. A large majority of the observations use panel data: 98 observations use panel data, and 43 use cross section data. Regarding the level of data aggregation, 110 observation use firm-level data, and 31 use sector-level data. The average year of the data used in the literature surveyed is mid-1990 with a standard deviation of a little over six and a half years. The average log of the square root of the degrees of freedom in the studies surveyed is 3.57 with a standard deviation of 1.02. Thirty-four observations are of Asian economies, 65 are of transition economies (members of the Council for Mutual Economic Assistance (CMEA) prior to its dissolution), and the remaining observations are of other developing countries.

In an effort to provide a first glance at how the choice of productivity and foreign presence measures determines the findings of significant spillover effects we compute composite test statistics for these variables. Following Djankov and Murrell (2002), normally distributed test statistics are obtained as follows:

(2) $$\left. \sum_{k=1}^{m} w_k t_k \middle/ \sqrt{\sum_{k=1}^{m} w_k^2} \right. \sim N(0,1)$$

where *m* denotes the number of observations in the sub-sample contributing to the computation of the composite t-statistic, *t* denotes the t-statistics corresponding to the estimated coefficients on the foreign presence variable, and *w* denotes the weight assigned to each t-statistic, such that each study is equally represented. For instance, if a study contributes four observations, the weight employed is 0.25, while if a study contributes one observation, the weight employed is 1. Results presented in Table 3 show that, across studies, use of labor productivity or total factor productivity as the study dependent variable is associated with more statistically significant findings of spillover effects than the use of output or an efficiency index. As regards the choice of foreign presence measure, capital share on average produces more statistically significant results than the use of output share or employment share. It is interesting to note that positive spillover results are, on average, more statistically significant than the negative results.

B. Empirical Methodology

We use meta-regression analysis as a way to provide a quantitative review of the literature on spillover effects in developing countries. This method is particularly useful to identify cumulative findings that are expressed across the sample of studies and draw out patterns in the research than cannot be obtained from the review of any one single study. As previously mentioned, the meta-analysis of productivity spillovers by Gorg and Strobl (2001) uses the results of 21 studies of FDI spillovers and includes studies of both developed and developing countries. For purposes of the meta-regression, the authors choose the t-statistic of the coefficient for foreign presence in the various studies as the dependent variable and a number of study characteristics as the explanatory variables. The authors find that the use of capital share as a measure of foreign presence is significantly associated with a lower t-statistic on the foreign presence coefficient, while the use of cross sectional data is significantly associated with a higher t-statistic.

Our approach departs from the methodology used by Gorg and Strobl (2001), in that we estimate three models designed to inform what study characteristics affect the significance, sign, and magnitude of the estimated spillover effects. Specifically, Equation (3) below provides a way of testing for the likelihood of significant FDI spillovers associated with certain study characteristics while Equation (4) supplements this analysis with information on what factors improve the likelihood that the documented spillover effects are positive or negative.

$$SIG_i = \alpha_0 + \alpha_1 \textit{ Productivity Measure} + \sum_{h=2}^{h=5} \alpha_h \textit{ (Foreign Presence Characteristics)}$$
$$+ \sum_{j=6}^{j=9} \alpha_j \textit{ (Data Characteristics)} + \sum_{l=10}^{l=15} \alpha_l \textit{ (Study Explanatory Variables)} + \varepsilon_i \qquad (3)$$

where $i = 1,\ldots 141$, indicates study observation and the dependent variable, SIG_i, takes on the value of 1 if the estimated coefficient on the foreign presence variables is statistically significant at the 5% level (or better), and zero otherwise. In our sample, 77 study results have foreign presence coefficients that are statistically significant at the 5% level (or better) and 74 have ones that are insignificant at that level. The productivity measure in Equation (3) is output of domestic firms in a sector, OUTPUT in Table 2. Foreign presence characteristics include share of total sector capital held by foreign-invested firms, K_share , and share of total sector output produced by foreign-invested firms, Out_share, the fraction of firm equity that must be held for classification as a foreign firm, FORDEF, and a dummy variable indicating if the estimated coefficient is positive or negative, POS. Study data characteristics in Equation (3) include PANEL, FIRM, AVGYR, LN_SQRT_DF, ASIA. These variables respectively capture whether the spillover estimate was obtained using panel or cross section, firm-level or industry-level data, the average year of the data in a given study, the log of the square roots degrees of freedom as a proxy for sample size and a regional dummy indicating whether the study was of an Asian economy or not.

To further examine what study characteristics contribute to the likelihood that the documented spillover effects are positive, we estimate equation (4) below:

$$\text{POS}_i = \beta_0 + \beta_1 \textit{ Productivity Measure} + \sum_{j=2}^{j=5} \beta_j \textit{ (Foreign Presence Measure)}$$

$$+ \sum_{k=6}^{k=9} \beta_k \textit{ (Data Characteristics)} + \sum_{l=10}^{l=15} \beta_l \textit{ (Study Explanatory Variables)} + \varepsilon_i \qquad (4)$$

The dummy dependent variable, POS_i, takes on the value of 1 if the estimated coefficient on foreign presence variables is positive, and zero otherwise. The covariates in Equation (4) are as already defined for Equation (3) with the exception of POS among the foreign presence characteristics which is now replaced which SIG. Thus each of the dependent variables in Equations (3) and (4) also serves as a control variable in the model of the other.

We explore what study characteristics explain the magnitude of the estimated spillover effects by estimating the Weighted Least Squares (WLS) with study-specific fixed effects model in Equation (5) below:

$$\ln \left| \hat{\delta}_{ki} \right| = \gamma_0 + \gamma_1 \textit{ Productivity Measure} + \sum_{j=2}^{j=5} \gamma_j \textit{ (Foreign Presence Measure)}$$

$$+ \sum_{k=6}^{k=9} \gamma_k \textit{ (Data Characteristics)} + \sum_{l=10}^{l=15} \gamma_l \textit{ (Study Explanatory Variables)} + \varepsilon_i \qquad (5)$$

where $\hat{\delta}_{ki}$, is the log of the absolute value of the foreign presence coefficient and independent variables are again as defined above and in Table 2. Since Equation (5) uses estimated foreign presence coefficients as the dependent variable, the relative precision of these estimates must be taken into account. Specifically, since our dependent variable is measured with error, this introduces heteroscedasticity in the regression. Following Saxonhouse (1976), we correct for this problem by weighing each observation of the dependent and independent variables by the inverse of the standard error of the foreign presence variable, $1/\sigma_{FP}$.

In addition, to ensure that each study is equally represented in the meta-regression, Stanley (2001) prescribes that use of additional weights reflecting the number of observations that each study contributes. For instance, if a study contributes four observations, the weight employed is ($1/\sigma_{FP}$ * 0.25), while if a study contributes one observation, the weight employed is ($1/\sigma_{FP}$ * 1). This composite weight employed in the WLS estimation ensures that observations measured with less precision are given less weight in the estimation and that each study contributing to the sample of observations is weighted equally. Finally, we also estimate a WLS fixed effects specification in which an observation is calculated as the mean of all of the observations from a given study. This procedure results in 32 observations based on the results from 32 studies, and the weight employed is equal to ($1/\sigma_{FP}$).

The nature of our sample naturally raises the question of whether our data suffers from publication bias. This could be a problem if studies that are published are biased toward significant results, since journals may tend not to publish studies with insignificant results (Stanley, 2005). To test for publication bias we estimate the model in Equation (6) below:

$$\left| t_{\hat{\delta}_{ki}} \right| = \chi_0 + \chi_1 \, LN\_SQRT\_DF + u_i \qquad (6)$$

Equation (6) is premised on the reasonable expectation that studies with larger sample sizes modeling a causal effect will present results with greater statistical significance (Gorg and Strobl, 2001). This test uses a regression of the log of the absolute value of the t-statistic of the foreign presence variable of the studies against the associated log of the square root of the degrees of freedom (Card and Krueger, 1995). While the results from equation (6) may give some guidance regarding publication bias, Card and Krueger (1995) also argue that equation (6) needs to include the meta-characteristics used in equations (3) through (5) as studies may have variable degrees of misspecification. We therefore also estimate equation 6 controlling for the study-characteristics as described above. If the estimated coefficient for the degrees of freedom in the above analysis is significant and smaller than one in size, this may indicate publication bias.

IV. Empirical Results and Discussion

A. Logit Estimates of Factors Explaining Spillover Significance

Model (1) of Table 4 presents logit coefficient estimates of the association of various study and data characteristics with the likelihood of a study finding FDI spillovers that are statistically significant at the 5% level. Choice of study dependent variable, as measured with OUTPUT, does not significantly affect the likelihood of spillover significance relative to other productivity measures. On the other hand, the use of output share as a measure of foreign presence appears to significantly increase the likelihood of finding significant spillovers. Among the variables capturing data characteristics, the significant and negative estimated coefficient for AVGYR indicates that more recent data generates less statistically significant findings of spillovers from FDI.

It is reasonable to expect that if spillovers are significant across studies, estimation of Equation (3) will generate a positive and statistically significant coefficient for LN_SQRT_DF. In Table 4, results show that this expectation obtains and suggest that FDI spillovers (positive or negative) are weakly significant in the studies taken cumulatively. Intuitively, larger data sets may more precisely measure the effects of the determinants of productivity, and so additional degrees of freedom increase the likelihood of obtaining a statistically significant foreign presence coefficient.

Since economic theory indicates that labor quality, capital, and R&D are contributors to productivity, the exclusion of these variables in a study may affect the estimates spillover effects leading to a mis-specified model in which the effects on productivity of these variables are attributed instead to foreign presence to some degree. This is a matter of omitted variable bias. Results in Table 4 suggest that, on average, misspecification may be a problem in the surveyed literature. Specifically, spillover effects obtained from regressions that include a measure of labor quality, and therefore hold it constant in the estimation, are likely to generate more statistically significant spillover effects.

Exclusion of sector R&D intensity is associated with more significant spillover effects but perhaps the strongest indication of potential misspecification is the significantly higher likelihood of finding significant spillover effects in studies that do not include capital in the estimation. Once again this is suggestive of omitted variable bias as it is reasonable to expect that productivity and capital (per worker or stock) are positively related. We also note that significance of spillover effects documented in studies concerning countries in Asia appears to be significantly higher relative to results from other countries and regions. The estimated coefficient of ASIA is significant, positive, and quite large in magnitude.

Models (2) and (3) in Table 4 present the results from estimation of Equation (3) with alternative definitions of the dependent variable. In Model (2), SIG_i, takes on the value of 1 if the foreign presence coefficient observation is statistically significant at the 1% level or better (zero otherwise) while in Model (3) SIG_i is set to 1 if significance is at the 10% level or better (zero otherwise). The values and statistical significance of estimated coefficients are quite similar in Models (1 and 3), with the exception of LQ, which does not significantly affect the likelihood of a study result being significant at the 10% level. On the other hand, fewer variables are significant in explaining the likelihood of a spillover result being statistically significant at the 1% level. This is partially explained by the fact that only four more observations are significant at the 10% level or greater as opposed to at the 5% level or greater, while 11 observations that are significant at the 5% level are not significant at the 1% level. In Model (2), only LN_SQRT_DF and NO_K are statistically significant, ASIA is weakly significant, and the coefficient signs are consistent with those of Models (1 and 3).

B. Factors Explaining Positive vs. Negative Spillovers: Logit Estimates

Estimation of Equation (4) models the likelihood of a positive or negative foreign presence coefficient associated with the dependent variables. Regression results are presented in Table 5. Once again, the choice of output as a dependent variable is not significantly associated greater likelihood of positive spillovers. With respect to the foreign presence measures employed in the surveyed literature, the use of both capital and output share is significantly more likely to generate findings of negative spillovers than the use of employment share.

One possible explanation for this result may be that the measure of foreign presence using the baseline specification of employment share may overstate FDI presence in high technology-gap sectors, therefore attributing relatively greater spillovers for a given level of FDI, which would explain a positive sign for this baseline specification. That is, as a result of their technological advantages, foreign-invested firms may utilize relatively less labor and more capital to produce a given level of output, as compared with domestic firms. Of course, it may alternatively be argued that output share understates spillovers in such a case. What is clear is that the measurement of spillovers from FDI is sensitive to the definition of foreign presence.

Sinani and Meyer (2004) author the only study that employs all three measures of foreign presence, and find that using employment share leads to a finding of greater spillovers, which is consistent with the meta-regression results in Table 5. The study includes data on these variables for a number of economic sectors. The greatest divergence from the relative ratios between these variables at the national level occurs in the electrical and optical sector—while the foreign-invested firms in this sector employ only a small portion of the sector labor force, they produce a large portion of its output and hold a large share of the sector capital. The level of data aggregation appears to affect the likelihood of positive spillover findings; the estimated coefficient of FIRM is negative, large in magnitude, and significant. The use of cross section data, which may give results biased by time-invariant omitted variables, appears not to affect the likelihood of positive spillover findings.

The use of more recent data appears to increase the likelihood of a positive foreign presence coefficient. AVGYR has a positive and highly significant coefficient. Along with the result of estimation of Equation (3), this indicates that studies based on newer data tend to have a greater likelihood of having a positive coefficient for foreign presence, but have a lower likelihood of that coefficient being statistically significant. The former result may indicate that time-variant effects that are not incorporated into the productivity models of the studies are facilitating greater FDI spillover absorption, but the latter result may indicate that more recent studies are more correctly specified, and spillovers do not actually exist.

Estimation of Equation (4) generates a weakly significant and positive estimated coefficient for LN_SQRT_DF. Combined with the results estimation of Equation (3), the results indicate that a greater number of degrees of freedom is associated with an increased likelihood of FDI spillovers being both positive and significant. The coefficient of RD is significant and negative, which, together with the results of estimation of Equation (3), indicates that the inclusion of a measure of R&D intensity is associated with a greater likelihood of a negative and insignificant foreign presence coefficient.

Equation (4) could not be estimated using LQ since every study included in the meta-regression in which labor quality was used as an explanatory variable, also had a positive foreign presence estimated coefficient. While most studies support this observation (i.e. labor quality positively contributes to productivity), Chuang and Lin (1999) find mixed results for the contribution of labor quality, and postulate that excessive numbers of white-collar workers may be associated with firm bureaucratization. Likewise, Liu and Wang (2003) find that effects of labor quality on productivity are statistically insignificant. Sinani and Meyer (2004) find that foreign presence that is facilitated by level of labor quality in a given sector negatively affects productivity.[4]

The estimated coefficient of SECDUM is insignificant in the estimation of Equation (4), but for YRDUM is negative and weakly significant. The estimation of time fixed effects increases the likelihood of a negative coefficient for foreign presence, but does not affect the likelihood of spillover significance. The results from the logit estimations indicate that studies of Asian countries have a greater likelihood of finding positive FDI spillovers.

C. Determinants of the Magnitude of Spillovers: WLS with Fixed Effects

Table 6 reports four sets of results for the WLS fixed effects estimation of Equation (5). Model (5) includes only the study observations with a positive foreign presence coefficient, Model (6) includes those with a negative foreign presence coefficient, and Model (7) includes all observations. Employing another way of ensuring that each study is equally represented in the meta-regression, Model (8) uses mean observations for each study. In all WLS models, coefficients are estimated with heteroscedasticity-consistent standard errors.

[4] Higher levels of labor quality in a sector may be associated with lower levels of spillover absorption if foreign-invested firms attract and retain the most skilled workers. In addition, FDI may locate disproportionately in sectors that are export-oriented and are not skills-intensive. While R&D intensity would facilitate FDI absorption in such sectors through demonstration effects, the level of labor quality within the sector would tend to be relatively low. On the other hand, if FDI locates in skills-intensive sectors, it is possible that they would seek those sectors in which their technological advantage is greatest, and the sectoral skills gap between the FDI source and host country is greatest. If it is the case that, at the sectoral level, labor quality is negatively associated with spillover absorption, then the inclusion of a measure of labor quality would tend to control for this effect, and to produce a larger coefficient for the contribution of foreign presence to productivity. Indeed, in the single instance of explicit modeling of such association using an interaction term between foreign presence and human capital (Sinani and Meyer, 2004), such a result is found. It may be the case that inexpensive labor attracts FDI, even in cases involving technology-intensive sectors.

It must be noted that because Model (6) uses log of the absolute value of the foreign presence coefficient as its dependent variable, and the sub-sample for this model only includes negative observations of the foreign presence coefficient, the estimated coefficients of the model must be interpreted with reversed signs. Because Models (7-8) include both positive and negative observations, estimated coefficients reflect the relationship with the degree of foreign presence effect on the productivity measure; as such, these models will likely generate insignificant results for those variables instead affecting direction of spillover effect. As regards foreign presence measurement, in Models (5, 6 and 8), the estimated coefficient of OUTPUT is significant and positive, though only weakly significant in Model (8). A coefficient for OUTPUT may not be estimated using Model (6) because of collinearity, and 57 of 64 observations in this sub-sample use output as the dependent variable. CAP_SHARE does not significantly affect magnitude of spillovers in Models (5-8), and OUT_SHARE is significant and negative in Model (8), but insignificant in Models (5-7).

The estimated coefficient of FORDEF is significant and negative in Models (5 and 7). The estimated coefficient of PANEL is significant and positive for Model (5), but significant and negative for Model (7). A coefficient for PANEL may not be estimated for Model (6), because 60 of 64 negative observations use panel data. Therefore, despite the positive coefficient for PANEL in Model (5) using only positive observations, it appears that the use of cross sectional data produces lower foreign presence coefficient magnitudes. On the other hand, the results for FIRM are only significant in Model (7) and the coefficient is negative. The estimated coefficient of AVGYR is significant and positive in Models (5 and 7). LN_SQRT_DF is significant and negative in Models (5-7)—larger data sets are associated with finding a smaller magnitude of either negative or positive spillovers in Models (5-6). It is expected that use of large data sets will produce estimated foreign presence effects closer in value to the true effect.

As regards study inclusion of various independent variables, all of the estimated coefficients are highly significant in the sub-sample of positive spillovers, but insignificant in the sub-sample of negative spillovers. For the positive sub-sample, the signs of the estimated coefficients are consistent with those of Model (1); that is, inclusion of a measure of R&D intensity or a measure of capital in the productivity model is associated with both a lower level of spillovers and the likelihood of a less statistically significant result. On the other hand, the inclusion of labor quality is associated with more likelihood of statistically significant FDI spillovers, of a greater magnitude. Similarly, the results of SECDUM and YRDUM for the positive sub-sample indicate that studies estimating sectoral or time fixed effects find a lower foreign presence coefficient magnitude. Regarding study region, the estimated coefficient for ASIA is significant and negative for the positive sub-sample; however, most Asian studies have positive foreign presence coefficients, and as shown in Model (1), studies of Asian countries have a greater likelihood of producing such a result.

D. Publication Bias Results

Table 7 displays the results of the test for publication bias. Panel A reports the results from estimation of Equation (6) while Panel B replicates this test controlling for the study characteristics. The results in both panels show that the estimated coefficient on the log of the square root of the degrees of freedom is statistically significantly less than one leading to rejection of the null hypothesis of no publication bias at the 1% level.[5] As Stanley (2005) notes, such a result for this test for publication bias may indicate actual publication bias; however, this result may also indicate non-existence of the empirical effect under consideration. In this sense, publication bias is a form of misspecification in which an effect that does not actually exist is statistically inferred. When the results of the test for publication bias are viewed in light of the estimated coefficients for LN_SQRT_DF in Models (5-7), it seems likely that intra-industry spillovers simply do not exist or are quite negligible.

V. Concluding Remarks

Governments of developing countries offer multinational companies significant incentives in an effort to attract foreign direct investment. While theoretical arguments point to the existence of productivity spillover effects from FDI, the empirical literature on technology (productivity) spillovers provides mixed results. This study presents a quantitative review of the empirical literature on intra-sectoral productivity

[5] Performing the test for publication bias using only results of published studies generates a similar result.

spillovers from FDI in developing countries. We use meta-regression analysis with a sample of 141 spillover effects contributed by 32 studies to investigate what study characteristics significantly increase the likelihood that these effects are either significant, or positive, or large in magnitude.

Our empirical results show that results from the studies, taken as a whole, provide weak evidence in support of the existence of gains to domestic firms in developing countries from the presence of FDI in the same sector. We find that individual study results are highly sensitive to model specification and studies that use panel and firm-level data tend to find insignificant or even significant negative horizontal FDI spillovers. Our results also show that, on average, greater degrees of freedom in a sample is associated with smaller FDI spillovers which suggests that misspecification may be a problem in the empirical studies reviewed. Stripping away such misspecification would generate intra-sectoral spillovers findings lacking in statistical or economic significance. This finding is further reinforced by the results from our test for publication bias which confirms this finding for our sample and reinforces previous findings.

While the idea that intra-sectoral spillovers from FDI may be largely non-existent is not new to this paper (see Rodrik, 2004), our results provide new evidence in support of this. Our results also have important policy implications. Understanding the effects of inward FDI on the economies of developing countries is of significant practical importance as both policies to attract FDI and those aimed at the provision of public goods for domestic industry compete for finite resources. While investment incentives targeting firms are popular in the competition among countries for FDI, the evidence in this study enforces the importance of broad-based policies to attract FDI in developing countries such as raising the quality of education and infrastructure.

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Table 1. Study Characteristics

Paper	Country	Dependent Variable	Foreign Presence Measure	Sign of Foreign Presence Coefficient[1]	# of Obs[2].
Aitken and Harrison (1999)	Venezuela	Output	L-share	1/6	7
Aslanoglu (2000)	Turkey	Eff. Index, LP	Output share	+	3
Blomström (1986)	Mexico	Eff. Index	L-share	+	4
Blomström and Persson (1983)	Mexico	LP	L-share	+	4
Blomström and Sjojolm (1999)	Indonesia	LP	Output share	+	2
Bosco (2001)	Hungary	Output	Output share	3/13	16
Buckley *et al*. (2002)	China	LP	K-share, L-share	+	2
Chuang and Lin (1999)	Taiwan	TFP	K-share	+	8
Damijan *et al*. (2003)	Transition Economies[a]	Output	Output share	2/6	8
Djankov and Hoekman (2000)	Czech Rep.	Output	K-share	-	4
Feinberg and Majumdar (2001)	India	Output	K-share	-	1
Haddad and Harrison (1993)	Morocco	Output, Eff. Index	K-share	3/5	8
Kathuria (2002)	India	TFP	Output share	-	2
Khawar (2003)	Mexico	LP	K-share	4/4	8
Kinoshita (2000)	Czech Rep.	Output	L-share	4/3	7
Kokko (1994)	Mexico	LP	L-share	+	1
Kokko *et al*. (1996)	Uruguay	LP	Output share	+	1
Konings (1999)	Bulgaria, Poland, Romania	Output	Output share	1/14	15
Liu and Wang (2003)	China	TFP	K-share	+	2
Liu *et al*. (2001)	China	LP	K-share	+	1
Lutz and Talavera (2004)	Ukraine	LP	Output share	+	2
Rattsø *et al*. (2003)	Thailand	TFP	K-share	+	1
Sadik and Bolbol (2001)	Arab Countries[b]	Output	Output share	1/5	6
Sgard (2001)	Hungary	Output	K-share	+	5
Sinani and Meyer (2004)	Estonia	Output	Output share, L-share, K-share	-	3
Sjöholm (1999a)	Indonesia	LP	Output share	+	3
Sjöholm (1999b)	Indonesia	LP, Output	Output share	+	2
Thuy (2005)	Vietnam	LP	L-share	+	6
Tian (2004)	China	Output	Output share	+	1
Vahter (2004)	Estonia, Slovenia	LP	K-share	3/1	4
Yudaeva *et al*. (2003)	Russia	Output	Output share	+	1
Zhu and Tan (2000)	China	LP	K-share	+	3

[1]Numeric values correspond to positive/negative coefficients (example: the Aitken and Harrison (1999) study contributes a total of 7 observations to our sample of which one is positive and the other 6 are negative).
[2]Indicates the total number of observations each study contributes to our sample.
[a] Includes Bulgaria, Czech Republic, Estonia, Hungary, Poland, Romania, Slovakia and Slovenia.
[b] Includes Oman, Morocco, Saudi Arabia, Jordan, Tunisia and Egypt.

Table 2. Meta-Regression Variable Characteristics

Variable	Definition	Summary Statistic[a]
	Productivity Measures and Variable Characteristics	
OUTPUT	=1, productivity measure is output (levels or growth); =0, otherwise	81
LP	=1, productivity measure is labor productivity; =0, otherwise	39
TFP	=1, productivity measure is total factor productivity; =0, otherwise	13
EFF_Index	=1, productivity measure is efficiency index; =0, otherwise	8
	Foreign Presence Measures and Variable Characteristics	
LN_FP	Log of the absolute value of the coefficient of the foreign presence variable	-2.65 (2.19)
CAP_SHARE	=1, measure of foreign presence is ratio of capital of foreign-invested firms to total capital within a sector; =0, otherwise	47
OUT_SHARE	=1, measure of foreign presence is ratio of output of foreign-invested firms to output within a sector; =0, otherwise	60
EMP_SHARE	=1, measure of foreign presence is ratio of employment in foreign-invested firms to employment within a sector; =0, otherwise	24
FORDEF	Fraction of firm equity that must be foreign-held for classification as foreign-invested firm (in percent)	12.55 (16.19)
POS	=1, foreign presence coefficient is positive; =0, otherwise	77
SIG_5	=1, foreign presence coefficient is significant at 5% level; =0, otherwise	67
	Study Explanatory Variables	
RD	=1, includes R&D expenditure as explanatory variable; =0, otherwise	21
LQ	=1. includes labor quality as explanatory variable; =0, otherwise	25
NO_K	=1, does not include capital or capital per worker as explanatory variable, =0, otherwise	61
SECDUM	=1, includes sectoral dummies; otherwise	38
YRDUM	=1, includes annual time dummies; =0, otherwise	54
	Data Characteristics	
PANEL	=1, observation uses panel data; =0, cross section data	98
FIRM	=1, observation uses firm-level data; =0, utilizes sectoral data	110
AVGYR	Average year of data in study	1991.40 (6.64)
LN_SQRT_DF	Log of the square root of the degrees of freedom	3.57 (1.02)
ASIA	=1, country is in Asia; =0, otherwise	34

[a] For AVGYR, FORDEF, LN_FP and LN_SQRT_DF, the summary statistic is the mean, with the standard deviation in parentheses. For all others, the reported statistic is the number of observations for which the dummy variable is equal to 1.

Table 3. Composite Sample Statistics

Sub-sample estimates of normally distributed test statistics for productivity and foreign presence measures used in the reviewed literature. Composite statistics generated using $\sum_{k=1}^{m} w_k t_k \bigg/ \sqrt{\sum_{k=1}^{m} w_k^2} \sim N(0,1)$, where m demotes the number of observations in the sub-sample, *t* denotes t-statistics of the estimated foreign presence coefficient from study *k*, and *w* denotes weights assigned to each observation such that each study is equally represented.

Dependent Variable	Number of Estimates Contributing to Cumulative Statistic	Normally Distributed Test Statistics
Output	81	6.37
Labor Productivity	39	12.96
Total Factor Productivity	13	10.60
Efficiency Index	8	5.11
Foreign Presence Measure	**Number of Estimates Contributing to Cumulative Statistic**	**Normally Distributed Test Statistics**
Capital Share	47	13.71
Output Share	60	8.27
Employment Share	24	9.35
Foreign Presence Measure Sign	**Number of Estimates Contributing to Cumulative Statistic**	**Normally Distributed Test Statistics**
Positive	77	24.46
Negative	64	-5.46

Table 4. Study Characteristics that Contribute to Significance

For Model (1), the dependent variable equals 1 if observation foreign presence coefficient is different from zero at the 5% level of significance and zero otherwise; for Model (2), the dependent variable equals 1 if observation foreign presence coefficient is different from zero at the 1% level of significance and zero otherwise; for Model (3), the dependent variable equals 1 if observation foreign presence coefficient is different from zero at the 10% level of significance and zero otherwise. For each model, sample comprises 141 observations from 32 studies. Standard errors are in parentheses below the coefficient estimates. ***, **, and * indicate coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels.

	Model (1)	**Model (2)**	**Model (3)**
Intercept	251.05**	143.67	246.14**
	(126.651)	(100.429)	(124.98)
Output Model	-0.43	-0.9	-0.7
	(1.078)	(0.888)	(1.099)
Capital Share FDI Measure	-0.22	-0.44	-1.04
	(0.947)	(0.73)	(0.989)
Output Share FDI Measure	3.63**	1.29	3.2**
	(1.527)	(0.991)	(1.461)
FDI Firm Foreign Equity Threshold	0.04	0.026	0.024
	(0.028)	(0.024)	(0.027)
Panel Data	-2.03	0.018	-1.99
	(1.417)	(1.018)	(1.537)
Firm-level Data	0.41	-1.14	0.39
	(1.729)	(1.352)	(1.687)
Average Year of Data	-0.13**	-0.075	-0.13**
	(0.064)	(0.051)	(0.063)
Log of Square Root of Degrees of Freedom	1.45*	1.29**	1.35*
	(0.828)	(0.63)	(0.727)
Includes R&D Measure	-2.67**	-0.77	-1.8*
	(1.349)	(0.84)	(1.051)
Includes Labor Quality Measure	2.71**	1.35	1.99
	(1.288)	(0.891)	(1.276)
Excludes Capital Measure	4.17***	1.82***	4.64***
	(1.166)	(0.616)	(1.246)
Sector Fixed Effects	-0.52	-0.08	-1.27
	(0.828)	(0.691)	(0.861)
Time Fixed Effects	0.60	-0.15	1.28
	(1.110)	(0.847)	(1.108)
Asian Country	6.26***	1.76*	6.31***
	(2.048)	(0.981)	(1.93)
Positive Foreign Presence Coefficient	1.25	0.87	1.51*
	(0.781)	(0.643)	(0.814)
Number of observations	141	141	141
Pseudo R^2	0.55	0.39	0.54
Model P-Value	0.000	0.000	0.000

Table 5. Study Characteristics that Contribute to Sign—Positive or Negative

The dependent variable equals 1 if observation foreign presence coefficient is positive and zero otherwise. Sample comprises 141 observations from 32 studies. Standard errors are in parentheses below the coefficient estimates. ***, **, and * indicate coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels.

	Model (4)
Intercept	-901.12***
	(294.487)
Output Model	-0.59
	(1.099)
Capital Share FDI Measure	-2.78*
	(1.608)
Output Share FDI Measure	-4.01**
	(1.890)
FDI Firm Foreign Equity Threshold	0.0032
	(0.035)
Panel Data	-1.79
	(1.151)
Firm-level Data	-6.53***
	(2.535)
Average Year of Data	0.45***
	(0.149)
Log of Square Root of Degrees of Freedom	1.81**
	(0.866)
Includes R&D Measure	-3.44*
	(1.855)
Includes Labor Quality Measure	-
	-
Excludes Capital Measure	0.42
	(1.022)
Sector Fixed Effects	-0.23
	(0.727)
Time Fixed Effects	-1.71*
	(0.961)
Asian Country	3.06*
	(1.702)
Foreign Presence Coefficient Significant at 5% Level	1.16
	(0.731)
Number of observations	141
Pseudo R^2	0.43
Model P-Value	0.000

Table 6. Analysis of the Size of the Spillover Effect – Direction of Spillovers

In Models (5-8), the dependent variable is the log of the absolute value of the foreign presence coefficient. In Models (5-7), the weight equals the inverse of the standard error of the foreign presence coefficient, multiplied by a weight such that each study is equally-weighted, holding ($1/SE_{FP}$) constant, and a paper-specific fixed effects estimation is employed. Model (7) sample comprises 141 observations from 32 studies. Models (5-6) use only the positive and negative observations of the spillover measure, respectively. The sample for Model (8) comprises the mean observation values for 32 studies, and the weight equals ($1/SE_{FP}$). Robust standard errors are in parentheses below the coefficient estimates. ***, **, and * indicate coefficient estimates are significantly different from zero at the 1%, 5%, and 10% levels.

	Model (5)	**Model (6)**	**Model (7)**	**Model (8)**
Intercept	-218.37***	3156.14	-276.02***	-167.57
	(14.135)	(3219.27)	(43.568)	(102.369)
Output Model	2.95***	-	2.21***	2.18*
	(0.076)	-	(0.499)	(1.082)
Capital Share FDI Measure	-0.036	3.91	-0.066	-0.073
	(0.461)	(2.676)	(0.427)	(0.971)
Output Share FDI Measure	-0.24	12.78	-0.215	-2.57*
	(0.471)	(20.052)	(0.436)	(1.344)
FDI Firm Foreign Equity Threshold	-0.13***	0.343	-0.098**	-0.027
	(0.002)	(0.478)	(0.048)	(0.022)
Panel Data	1.83***	-	-12.64***	-0.40
	(0.515)	-	(2.280)	(0.807)
Firm-level Data	0.47	9.55	-4.94***	1.33
	(0.377)	(10.653)	(1.363)	(1.140)
Average Year of Data	0.11***	-1.59	0.14***	0.082
	(0.007)	(1.627)	(0.024)	(0.052)
Log of Square Root of Degrees of Freedom	-0.48***	-1.96**	-1.59**	0.18
	(0.081)	(0.928)	(0.737)	(0.633)
Includes R&D Measure	-4.88***	-0.66	0.19	-1.16
	(0.295)	(0.964)	(0.773)	(0.701)
Includes Labor Quality Measure	6.94***	-	2.74**	2.09**
	(0.491)	-	(1.273)	(0.873)
Excludes Capital Measure	6.57***	0.69	2.04	1.28**
	(0.117)	(2.429)	(1.344)	(0.453)
Sector Fixed Effects	-0.20***	-0.07	-0.18***	-4.37***
	(0.042)	(0.413)	(0.062)	(0.940)
Time Fixed Effects	-1.28***	.036	-0.89***	-0.95
	(0.450)	(0.389)	(0.274)	(1.470)
Asian Country	-1.311***	-18.57	6.20***	-0.99
	(0.441)	(20.170)	(1.864)	(0.750)
Positive Foreign Presence Coefficient	-	-	1.73***	2.55**
	-	-	(0.447)	(1.000)
Number of observations	77	64	141	32
Adjusted R^2	0.98	0.71	0.90	0.93
Model P-Value	0.000	0.000	0.000	0.000

Table 7. Test for Publication Bias

The dependent variable is the log of the absolute value of the t-statistic of the foreign presence coefficient. Robust standard errors are in parentheses next to coefficient estimates. *** indicates that the coefficient estimate is significantly less than 1 at the 1% level. Panel A: Results from test for publication bias. Panel B: Results from test for publication bias controlling for study characteristics. Number of observations equals 141 in both panels.

PANEL A	
Intercept	-0.076
	(0.338)
Log of Square Root of the Degrees of Freedom	**0.16*** **
	(0.103)
R-squared	.006
Model P-Value	0.132
PANEL B	
Intercept	-16.83
	(31.131)
Log of Square Root of Degrees of Freedom	**0.02*** **
	(0.196)
Output Model	-0.65
	(0.397)
Capital Share FDI Measure	-0.57
	(0.336)
Output Share FDI Measure	-0.42
	(0.422)
FDI Firm Foreign Equity Threshold	-0.02
	(0.012)
Panel Data	0.16
	(0.357)
Firm-level Data	0.48
	(0.467)
Average Year of Data	0.01
	(0.016)
Includes R&D Measure	-0.43
	(0.253)
Includes Labor Quality Measure	1.10
	(0.268)
Excludes Capital Measure	1.20
	(0.187)
Sector Fixed Effects	-0.19
	(0.253)
Time Fixed Effects	-0.04
	(0.232)
Asian Country	1.14
	(0.333)
R-squared	0.56
Model P-Value	0.000