Spillovers from Foreign Direct Investment

A Meta Analysis

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Summary

The extensive empirical literature analyzing productivity spillovers from foreign direct investment to local firms provides inconclusive results. Some studies find that foreign presence has a positive impact on the productivity of domestic firms, while others find no evidence or a negative effect. Differences in the results may be attributable to contexts, such as the structural differences between developed, developing and transition economies. However, results may also vary due to different empirical methodologies, notably the use of aggregate versus firm-level data and cross-section versus panel data analysis. We conduct a meta-analysis to investigate reasons for these conflicting results, and provide a revised interpretation of earlier research and its policy implications, and new priorities for future research. Our analysis suggests that the hypothesized spillovers are not confirmed for industrialized countries in the 1990s. Transition economies may experience spillovers, but these have been declining in recent years.

Keywords: developing countries, transition economies, spillovers, foreign direct investment, technology transfer, meta-analysis

1. INTRODUCTION

Foreign direct investment (FDI) is often regarded as a source of advanced technologies and managerial knowledge. Thus, governments designing policies vis-à-vis FDI would like to document the existence and magnitude the spillovers from FDI (Patibandla and Petersen, 2002; Lorentzen, 2005; Li and Liu, 2005). Scholars of multinational enterprises and of economic development have tried to empirically verify the contribution of FDI to host economies, but overall, the results of this research appear inconclusive.

A large stream of research has investigated such technology spillovers from FDI starting with Caves (1974) and Globerman (1979). This research had to overcome the limitation that the knowledge flow expected to generate spillovers cannot be measured directly. Therefore researchers employ a variety of indirect measures to capture the impact. The most common approach is to estimate a production function with firm-performance as the dependent variable and FDI in the industry as an explanatory variable (Blomström et al., 2000; Görg and Strobl, 2001). The proposition of positive spillovers is supported if FDI in the industry has a significant positive impact on the performance of other firms. Results have been mixed for all types of countries, including developing (e.g. Haddad and Harrison, 1993; Aitken and Harrison, 1999) and transition economies (e.g. Djankov and Hoekman, 1998; Konings, 2001). Thus, despite considerable research efforts, leading scholars have expressed concern about the empirical evidence supporting the claim that FDI generates positive spillovers for the host economy (Wells, 1998; Caves, 1996; Roderik, 1999). We reassess the empirical evidence by conducting a meta-analysis of prior studies investigating intra-industry spillovers from FDI.

Theoretical considerations suggest that the existence and size of spillovers would vary across different contexts, notably for different levels of industrial development and for different types of FDI. Thus the setting of different studies may explain the variation of the results in prior research. Yet, the variation may also be due to varying types of data and methods of empirical analysis. We thus develop propositions on how study characteristics may influence the size of the observed spillovers, and test them in out Meta regression analysis.

A specific feature of this study is the combination of meta-techniques. Firstly, we aggregate the results of different studies in a dimension-less test statistic for the existence of spillovers (Djankov and Murrell, 2002). Second, we control for the specific characteristics of different studies in a meta-regression analysis (Stanley and Jarrell, 1989; Görg and Strobl, 2001), and then use these data to generate predicted values for t-statistics. Our results show that the different empirical methodologies, such as the use of aggregate versus firm-level data and cross-section versus panel data analysis as well as the differences between developed, developing and transition economies produce significantly different results. We also reflect over the relative merits of the alternative methods of meta analysis.

The next section of the paper reviews the theoretical and empirical literature an FDI spillovers. We then discuss how the variation of results may be explained by contextual influences (section 3) and by the data and methodology of the study (section 4). In section 5, we conduct a meta-analysis using a variety of comparative statistics, followed by a meta-regression analysis in section 6. Section 7 concludes with implications for future research and policy.

2. SPILLOVER EFFECTS IN THEORY AND EMPIRICAL STUDIES

(a) Theoretical Perspectives

Many countries aim to attract inward FDI to accelerate the development of technological capabilities. They seek knowledge that may be codified in blueprints or embodied in machineries, ready for use in a host economy but also complex capabilities and tacit knowledge. The latter types of knowledge are more to transfer such that MNE are often considered a suitable transfer vehicle. As MNEs interact with local firms, they may thus generate spillovers that enhance the productivity of local firms. The theoretical literature points to four different channels of impact: demonstration effects, labor mobility, export channel access and improved quality of inputs.

The **demonstration effect** works through the direct contact between local agents and MNEs operating at different levels of technology (Kokko, 1992). This effect is also known as ‘contagion’ or ‘imitation’ effect. After observing a product innovation or a novel form of organization adapted to local conditions, local entrepreneurs may recognize their feasibility, and thus strive to imitate them. As local businesses observe existing users, information about the technology is diffused, uncertainty is reduced, and imitation increases (Blomström and Kokko, 1996).

A second channel of spillovers is the contribution to human capital formation, especially through training and **labor mobility** (Patibandla and Petersen, 2002). Trained local employees can contribute to higher productivity, when they move to locally owned firms or start their own entrepreneurial businesses. Even rank and file employees acquire skills, attitudes and ideas on the job through exposure to modern forms of organization and international quality standards. MNEs may not oppose such movements if the new firms become business partners, however, they may pay salaries above local standards to discourage highly trained employees from leaving.[i]

A third channel by which MNE may influence local firms is by facilitating access to **export markets.** MNEs are more likely to share general trade knowledge, as it is less industry-specific and not part of their core capabilities and its diffusion to local businesses does not endanger their own competitive advantage. Moreover, foreign investors may help building a country of origin reputation that local followers may build on, and they may use the same trade channels (Altenburg, 2000). Thus local firms may develop their export activities along the lines of foreign investors in the same industry.

Finally, foreign investors may support the development of local supplier industries and **markets for specialized inputs** to the industry, such as labor and materials. Beyond the quality of physical products this may enhance in particular the quality of services provided by suppliers, such as just-in-time delivery and low default rates. With access to these improved inputs, local firms in turn may be able to enhance their productivity. These four effects complement each other in potentially strengthening local firms.

In addition, local firms may benefit from **vertical linkages** in a supply chain, benefiting from knowledge transfers to suppliers and customers. These effects may primarily benefit firms in other industries, for instance providers of business services; yet some recipients are in the same industry, especially if industry classifications with high levels of aggregation are used. Thus studies of intra-industry spillovers may capture also some technology transfers along the supply chain.

However, negative spillovers on local firms are also possible, notably through **crowding out effects**. Aitken and Harrison (1999) note that foreign investors may gain market share at the expense of local firms. This would leave the local firms, at least in the short run, with excess production capacity and thus low productivity and low profitability. Moreover, foreign investment may source internationally and thus weaken the industry’s domestic supplier base. Hence, strong theoretical arguments suggest that there may be positive spillover effects from foreign investors to local firms, yet counter effects may negate or even over-compensate the positive effects.

***** Table 1 approximately here *****

(b) Empirical studies

Empirical studies of knowledge spillover face the fundamental problem that knowledge flows cannot be observed or measured directly, and in consequence, knowledge spillovers are difficult to quantify. The predominant approach in the literature of FDI spillovers thus is to relate performance changes of potential recipient firms empirically to the presence of FDI in the industry. Knowledge spillovers are measured by changes in local firms productivity and the influence of FDI by the share of foreign-owned firms in the industry (Blomström et al., 2000; Görg and Strobl, 2001).

We have identified in total 41 empirical studies (see Table 1). Many of the early studies, starting with Caves (1974) and Globerman (1979) in Canada and Australia find significant positive effects. Also recent studies in the UK suggest positive effects (Liu et al., 2000; Haskel et al., 2002), while results from Southern European countries are more mixed (Barrios et al., 2001; Flôres et al., 2000).

Research on developing economies has been led by Swedish researchers whose studies in countries like Mexico (Blomström 1986), Uruguay (Kokko et al. 1996) and Indonesia (Sjöholm 1999) point to positive and significant productivity spillovers. In contrast, the results for recent panel data research in developing countries show negative effects in two major studies by Aitken and Harrison (1999) on Venezuela 1976-89 and Kathuria (2000) on India 1975-89. Other studies such as Haddad and Harrison (1993) on Morocco 1985-89 or Feinberg and Majumdar (2001) on India 1980-1994 find insignificant effects.

For transition economies, the evidence is equally unclear. Liu (2002) in China, Yudaeva et al. (2000) in Russia and Sinani and Meyer (2002) in Estonia find positive effects, while other studies find negative effects in Bulgaria, Romania (Konings, 2001) and the Czech Republic (Djankov and Hoekman, 2001), or insignificant intra-industry effects in Lithuania (Javorcik, 2004).

Hence, the overall evidence is rather contradictory. It may be related to the setting of the study, notably the time of the data and host country's level of development, but it may also be an artifact of varying methodologies employed.

3. CONTEXTUAL INFLUENCES ON THE MAGNITUDE OF SPILLOVERS

Contextual variables may influence the magnitude and direction of FDI spillovers, such that studies conducted in different contexts would generate different results. Thus, the variation of settings may explain why some studies report significant spillovers, while others do not. We explore four aspects of the setting of the study: the level of economic development of the host economy, the time period, the aspect of FDI investigated, and the recipient firms.

(a) Country-specific issues

The relationship between FDI and economic growth varies across countries (Borensztein *et al*. 1998; Li and Liu 2005). Local firms' ability to attract spillovers may vary with the technology gap, namely the difference in technological levels between domestic and foreign firms. The more foreign investors have to offer that local firms do not yet have, the larger is the potential for productivity improvements. Relatively backward local firms may increase their productivity even by imperfect copying of processes used by cutting edge firms. Thus spillovers would increase with the size of the technology gap, such that countries at lower levels of development may have more to gain from FDI.

The technology gap hypothesis has been investigated in single country empirical studies, but they do not find empirical support. Some studies even find the reverse effect that spillovers appear to be larger for smaller technological gaps, at least in certain sub-samples (Haddad and Harrison 1991, Kokko 1994, Kokko, Tasini and Zejan, 1996). In recent years, scholars have paid more attention to local firms' ability to make use of the received technology, often with reference to the concept of absorptive capacity. Potential technology spillovers increase with the technology available in the FDI firm, which increases with the gap. However, the realized spillovers may decline as firms fall too far behind to be able to absorb the technology (Blomström and Sjöholm, 1999), such that the relationship between the technological gap and spillovers received by local firms may be non-linear (Liu *et al*., 2000).

The possible relationship between the local firms' own technology and their potential and realized spillovers implies that spillovers would also vary between countries at different levels of economic and technological development. In particular, the original technological gap hypothesis implies that **local firms in developing and transition economies may receive larger spillovers than those in industrial countries.**

(b) Time

The nature and size of spillovers may also vary over time. Technological progress implies that the types of technologies that provide firms with competitive advantage have evolved over the past three decades. To an increasing degree firms are deriving their competitive advantages from organizationally embedded knowledge that is more difficult to imitate by competitors, which greatly reduces the potential for demonstration effects. Similarly, modern technologies are usually too complex to be dismantled and reassembled in a process of reverse engineering, which was an important mechanism of learning for catch-up economies such as Japan until the 1970s. Moreover, the potential for reverse engineering has been considerably reduced by more precise definition and tighter enforcement of intellectual property rights.

Thus, **positive productivity spillovers may be smaller in the 1990s compared to the 1970s**, because of the changing nature of FDI, of interaction with local agents, and of host country policy regimes. For policy advice, the emphasis should be on studies employing recent data. Meta-analysis may moreover permit extrapolating trends to predict the size of spillovers in the near future when possible current policy would become effective.

(c) Characteristics of FDI

Spillovers also vary with the characteristics of the FDI project (Meyer, 2004). Knowledge spillovers are in particular associated with knowledge intensive operations such as R&D (Feinberg and Majumdar, 2001) and to some extent with production. FDI operations that focus on the local sale and marketing of imported products are considerably less knowledge intensive, reducing the potential for spillovers. Moreover, knowledge transfer through labor mobility would depend on the scale of the labor force, and its human capital.

Data on these specific characteristics of FDI have not been included in spillover studies. However, empirical studies have measured FDI presence in different ways, namely by sales, employment or equity. These measures of FDI give different weights to different types of foreign investors. Based on the aforementioned considerations, we would expect that employment intensive foreign investors would generate larger spillovers, notably in form of labor mobility. On the other hand, sales-intensive foreign investors may primarily sell imported good and have little local value added, and thus generate fewer spillovers. **Hence, we expect that studies proxying FDI by employment share find larger spillovers than those using sales share.** For instance, Sinani and Meyer (2004) include three alternative measures of foreign presence in an industry to proxy spillover, and find different results. These results support the prediction tested here across multiple countries.

(d) Recipients

Some studies investigate spillovers received by domestic firms only, while other studies include both foreign and domestically owned firms as potential recipients. Some policy makers may be concerned with the overall value added in the economy, and thus the ability of an industry to generate tax revenues. This would suggest considering spillovers received by all firms. Other policy makers may be concerned with the economic activity under control of domestic agents, and thus spillovers received by domestically-owned firms only.

While both approaches may be relevant for policy, they may generate different results. Theoretical considerations suggest that foreign firms typically face a lower technological gap and higher absorptive capacity than local firms, which should facilitate them realizing productivity spillovers. This is reinforced by possibly tighter network relationship between foreign entrants, compared to the linkages between foreign and domestic firms. Several studies run alternative regressions including all firms or only domestic firms and find significant positive effects in the former, while the latter generate insignificant or negative effects (Djankov & Hoekman, 1998; Haddad & Harrison, 1993; Kinoshita, 2001; Barrios, 2001). Moreover, Feinberg and Majumdar (2001) find that in India spillovers benefit other foreign firms, but not necessarily local firms in the same industry. Thus we would expect that **identified productivity spillovers are smaller if only domestic firms are considered as recipients**.

4. METHODOLOGICAL ISSUES

Studies of productivity spillovers vary in terms of methodology, in particular with respect to the types of dataset employed. Some studies use industries as level of analysis, while other studies provide more fine-grained measurement by using firm-level data. Moreover, early studies employ cross-sectional data that allow to measure variations across industries, while most recent studies employ panel data.

(a) Cross-section and panel data

Caves (1974) analyzed cross-sectional data in his pioneering work, and similar datasets have been used in many subsequent studies. However, cross-section specifications do not allow identifying the direction of a causal relationship between two variables, such as FDI and productivity improvements. MNEs tend to have a stronger presence in technology intensive industries, and gravitate towards the more productive industries. Hence, productivity differences across sectors may influence the inflow of FDI to a sector (Aitken and Harrison, 1999). A positive association between local firms' productivity and FDI may thus be caused by foreign investors seeking more productive industries, rather than local firms increasing productivity as a result of the foreign investor presence. Empirical evidence suggests that this endogeneity has increased in recent years (Li & Liu, 2005). This self-selection of foreign firms into more productive industries creates a causality problem between the dependent variable (firm productivity) and the independent spillover variable (foreign presence in the industry). Thus, a positive coefficient in a cross-section dataset is weak evidence of spillovers because the reverse causality is highly plausible. Failing to account for this effect may result in a spurious positive coefficients between spillovers and foreign presence.

Therefore, panel data analysis is more appropriate to investigate productivity spillovers (Aitken and Harrison, 1999; Görg and Strobl, 2001). By following a firm over time, panel data allow to control for firm-specific effects that are time invariant and possibly correlated with foreign presence in the sector. Failure to control for such effects may lead to biased results. Based on an earlier meta-analysis, Görg and Strobl (2001) suggest that studies using cross-section-data generate systematically more positive estimates of spillover coefficients than panel data studies. In this study, we test this result on a larger and more diverse dataset, with more control for other possible influences. Following Görg and Strobl (2001), we **expect that cross-sectional studies systematically overestimate productivity spillovers**.

(b) Level of analysis

Empirical studies vary moreover in their level of analysis as some studies use firm level data, whereas many older studies use industry level data. Firm level data allow for more refined measurement of received spillovers, and for more careful controls for other influences on productivity, including firm-specific effects, and thus avoid aggregation biases. Görg and Strobl's (2001) do not find systematic biases related to the level of analysis, yet we wish to test this on a larger set of studies. **We expect that industry level analysis lead to an upward bias of estimated spillovers**.

(c) Measures of Performance

Most studies aim to identify spillovers from FDI, by estimating an augmented production function, where the dependent variable is a measure of firm's performance. The performance is measured in a variety of ways, namely the level or growth of value added, sales, or productivity measures such as output per employee or total factor productivity. We argued earlier that the primary benefit that local firms may attract would arise from technology transfer, which would primarily improve productivity, with secondary effects for sales or value added. Thus, we expect **productivity measures to show larger spillover effects**.

5. META-ANALYSIS: COMPARATIVE STATISTICS

(a) The use of Meta-Analysis in Economics

Meta-analysis statistically integrates the results of a large set of studies in one single empirical analysis. It is particularly useful when multiple studies yield inconclusive or conflicting results. Aggregating statistically across studies and correcting for statistical artifacts such as measurement and sampling errors, meta-analysis allows for more precise evaluation of the quantitative parameters (Bergh, 1997). We combine multiple meta-techniques to investigate the prior results on spillovers from FDI. We first aggregate the results of different studies to a dimension-less statistic that allows testing for the existence of spillovers. Then, we use a meta-regression analysis (Stanley and Jarrell, 1989), regressing t-statistics on meta-independent study characteristics. This provides us with a more rounded depiction of the evidence, and allows us to assess the validity of inferences drawn from any one technique.

Meta-analysis has been introduced to economics research recently, for instance by Ashenfelter et al. (1999) for the returns to schooling, by Djankov and Murrell (2002) on enterprise restructuring in transition economies, by Gallet and List (2003) on the elasticities of cigarette demand, and by De Mooij and Ederveen (2003) on tax-rate elasticities. In international business, recent meta-analyses include Zhao et al. (2004) on entry mode choice, and Tihanyi et al. (2005) on the cultural distance.

These studies point to methodological concerns in meta-analysis, namely heterogeneity, dependence of observations and publication bias. Heterogeneity is inherent in a meta-analysis as studies differ in numerous ways, such as the different spillover variable definitions used and/or the different countries and data type. Meta-studies account for heterogeneity by controlling for the different study characteristics. A problem related to heterogeneity is dependency, as observations in a sample may be mutually dependent if the meta-regression contains multiple observations from the same research project. We control for dependency within the sample by treating it as a panel and estimating it by random effects meta-analysis.

Moreover, published results may be affected by a publication bias because studies with significant results may have higher chances of being published in leading journals. Because of the potential publication bias, researchers tend to report only the most significant effect estimates, therefore exaggerating their magnitude. As consequence of the publication bias, we would expect that published studies over represent regressions with significant results. We thus include a test for publication bias.

(b) Our database

The database for the analysis has been constructed based on all known published and unpublished empirical papers on productivity spillovers. They have been collected by searching the EconLit database under the topic of spillovers from technology transfer and productivity spillovers, through the literature review of the different papers in productivity spillovers, as well as from searching the internet. Table 1 presents a summary of the studies found in the spillover literature. Out of the 41 papers, 16 study developing countries, 12 on transition economies, and 13 on developed countries. Early studies use cross-sectional data, yet as panel data techniques have become more available, most studies published use panel data analysis, in total 24 of 41 studies. Twenty seven papers use firm level data as unit of analysis, while the remainder use industry level data. Furthermore, 31 out of the 41 studies have been published in academic journals.

Regarding the spillover variable definition, 15 papers use as measure of foreign presence in the industry the share of foreign firm's sales/output/value added in total industry sales/output/value added, 15 papers use the share of foreign firm's employment in total industry employment, while 18 studies use as foreign presence in industry the share in equity and other definitions.[ii] Moreover, out of the 41 papers, 32 investigate spillovers for the sub-sample of domestic firms. Most studies, measure performance by a proxy of productivity, including output per employee (12 studies), value added per employee (14) or other measures such as total factor productivity (16). Other studies use sales (13) or value added (14) as dependent variables, where each of these measures may use level, log of level or growth data.

Many studies report multiple regression analyses using alternative definitions of the spillover variable, the dependent variable, or they estimate spillovers for different time periods. For instance, Konings (2001) and Barrios et al. (2001) investigate productivity spillovers for different countries such that we include multiple results.[iii] Multiple spillover results with different measures of firm performance or of foreign presence are included, for instance, from Blomström (1986) and Sinani and Meyer (2004). From Sjohölm (1999) we include three results. He estimated two regressions for two different time periods with the dependent variable in levels, and a third regression using the growth of the dependent variable. Other studies, such as Haddad and Harrison (1993), estimate separately spillovers for the overall sample of firms and for the sub sample of domestic firms. In such cases, we include both estimates. Inclusive these multiple results from some studies, the final database consists of 69 observations.

(c) Combined Significance

In view of the inconclusive results of the research to date, this meta-analysis shall generate a general statement, on spillovers, that integrates the empirical research. We thus need to aggregate the results into one test statistic that allows a conclusion concerning the existence of the effect. We do so by focusing on a dimension-less variable, namely the t-statistic, which depends neither on the units of measurement of the dependent variable nor on those of the spillover variable. The combined t-statistics is constructed as follows (Greene, 2003):

$$T = \frac{t_1 + \ldots\ldots t_k}{\sqrt{k}} \qquad (1)$$

Where t is the t-statistic for the estimate of the spillover variable and k is the number of observations.

****** Table 2 approximately here ******

The combined t-statistic (T) has a standard normal distribution because the individual t-statistics have a standard normal distribution. Table 2, columns 4 and 6 show that the aggregate effect of spillovers is significant and positive for all studies, as well as for the separate groups of studies, namely, developing, transition and developed countries. Five studies have exceptionally large t-statistics, which may affect the overall result. We thus define as outliers those studies with t-statistics more than 10 times greater than the mean, and exclude them from the sample.[iv] Moreover, significant effects may result from reverse causality between FDI presence and productivity in the local industry. Therefore, a cautious interpretation of the T-statistic results requires that we account for the potential selection bias caused by foreign firms entering more productive industries. Thus, we introduce weights that reflect the extent to which studies correct for this potential selection bias. Following Djankov and Murrell (2002), we create a weighted T-statistic (T_w) as follows:

$$T_w = \frac{w_1 t_1 + ...w_k t_k}{\sqrt{\sum_{k=1}^{k} w_k^2}} \qquad (2)$$

where w_k is the weight assigned to the k^{th} study.

The weight takes the value 1 if authors do not control for the possibility of such a bias, for instance cross-section studies that estimate an OLS regression. The weight takes value 2 if a technique is employed that would reduce or correct the selection bias, for instance, cross-section studies that estimate a treatment effect and/or use instrumental variables. A weight of 3 is assigned if the issue is addressed with sophisticated methodologies, as in the case of panel data with fixed and/or random effects, GMM instrumental variables, first and second level differences, or lags of foreign presence as instrumental variables (e.g. Aitken and Harrison, 1999; Konings, 2001; Yudaeva et al., 2003; Sinani and Meyer, 2004; Javorcik, 2004).

The T_w-statistics confirm a significant and positive aggregate effect of spillovers across the different study groups (Table 2, columns 5 and 7). However, they are usually smaller than the T-statistic with no weights, especially, when outliers are excluded (column 7). The smaller T_w -statistics suggest that reported spillover effects in simple studies may be inflated by selection biases.

(d) Partial Correlation Coefficients

While t-statistics do not depend on the units of measurement, they reflect sample size. Partial correlation coefficients do not depend on the unit of measurement or the sample size (Rosenthal, 1991). This feature makes partial correlation coefficients very attractive for a meta-analysis. Although partial correlations are not usually reported in papers they can be very easily calculated based on the simple relation between partial correlations and the t-statistics (Greene 2003):

$$r_k^2 = \frac{t_k^2}{t_k^2 + n_k} \qquad (3)$$

Where n_k is the degrees of freedom of the k[th] study.

****** Table 3 approximately here ******

Table 3 presents the mean estimates of partial correlations for different groups of countries, data and spillover types employed in the studies. A pattern emerging from this table is that positive spillover effects on firm productivity (i.e., estimates of partial correlations) are largest for developing countries, when spillover is measured as the share of foreign firms' employment to industry employment, and for cross-section studies. In addition, spillovers are negatively associated with firm productivity when measured as share in output, and a marginal effect for panel data studies. Furthermore, the estimates of partial correlations are reduced when the weight is applied (column 3 to column 4). This comparison suggests that, selection bias increases the estimated magnitudes of spillover effects. However, for transition and panel data studies, the mean weighted partial correlations are larger.

Mean difference tests on the significance of the partial correlation coefficients, require transforming each partial correlation into a statistic, the Fisher's Z, and use the mean of the transformations, which is approximately normally distributed (Hedges and Olkin, 1985):

$$Z_k = 0.5 \ln\left(\frac{1 + r_k}{1 - r_k}\right) \qquad (4)$$

Furthermore, a weighted-mean of Fisher's Z_k transformations is constructed as follows: $Mean = \frac{\sum (x_i w_i)}{\sum w_i}$, where w_i is the weight for observation i, using the same weighting scale as in (2). Mean difference tests are then conducted on the weighted mean of transformations.

****** Table 4 approximately here ******

In Table 4, we report the mean difference tests for the partial correlation coefficients in Table 3 for different groups of studies. The results show that spillover effects in cross-section studies are stronger than in panel data studies at 1% and 10% significance level, respectively. Similarly, spillover effects are significantly larger when measured as share in employment or equity than when measured as share in output.

The tests in Table 2 and 4 suggest that the size of spillover effects varies when studies are classified according to countries, spillover and data type. This gives rise to the question, what causes the variation of the effect sizes? We investigate this question using Meta-regression analysis.

(e) Tests for Publication Bias and Heterogeneity

Before proceeding with the regression analysis, we need to perform some tests that help designing the estimation strategy. First, a publication bias may lead to papers with strong statistical significance being more likely to be published. This implies that published results may exaggerate the magnitude of the effect. A test for publication bias is based on the fact that studies using larger sample size would normally find more significant results than studies based on a small sample size[v]. However, if publication bias were present, we would expect that the significance (t-statistic) of the spillover estimate to be independent of sample size. To test for the possibility of publication bias, Egger et al. (1997) propose a test based on a meta-regression analysis of the t-values. The logic of the test is that researchers would select larger effects for the published version of their study, even when the sample size is small and standard errors (SE) are large. The meta-regression may be subject to heteroscedasticity due to different variances of the effect in different studies, such that we employ a weighted least squares version:

$$t_i = \beta_0 + \beta_1(1/SE_i)+ e_i \qquad (5)$$

According to Egger et al. (1997), β_0 would be insignificant in the absence of publication biases. However, Table 5 shows that the estimate of β_0 is 2.7, which is significantly different from zero at 1% significance level[vi]. Hence, a publication bias exists in the spillover literature, and the aforementioned results are likely to contain an upward bias. As such, we have to exert caution in the interpretation of results.

****** Table 5 approximately here ******

Second, we perform a heterogeneity test, which in the context of meta-analysis is also known as a fixed versus random effects model test. Fixed and random effects models for meta-analysis refer to assumptions about heterogeneity of the effect estimates and not to assumptions of the variation across time and region, as these terms are used in panel data studies in the econometric literature. Under the fixed effects models, the effect size in the population is assumed to be the same across studies. Under the null hypothesis, this is known as the homogeneity assumption. In the random effects models, each study has a different effect size and this is known as the heterogeneity assumption. In reality, it is more likely that we find the effect sizes vary randomly from study to study. Therefore, the random effects model is probably more realistic than the fixed effects model (Hedges, 1992).

Our heterogeneity test generates pooled estimates for both fixed and random effects, both of which are positive and significant at 0.1% level. However, the magnitude of the pooled estimate is larger for the random effects and their confidence bounds do not overlap. The chi-squared test statistic for the null hypothesis of homogeneity (fixed effects model) is 3016.6, which is significant at 1% significance level. Hence, we cannot accept the null hypothesis of homogeneity, and should employ the random effects model. This suggests that there is substantial unexplained heterogeneity, which has to be controlled for in the multivariate meta-regression analysis.

6. THE REGRESSION ANALYSIS

(a) Methodology

Our sample includes multiple spillover estimates for some of the studies, which allows us to analyze the data as panel. We thus estimate the following unbalanced panel data model:

$$Y_{ij} = \alpha_i + \beta X_{ij} + \varepsilon_{ij} \qquad (6)$$

where Y_{ij} is the t-statistics derived from the ith study, α_i represents random effects that control for the commonality and dependency of estimates within and across studies and X_{ij} is a vector of study characteristics. We include the log of the number of observations to control for sample size of a study, as t-statistics are a function of sample size. This is a major concern in our sample, as the number of observations per study ranges from 20 in Blomström and Wolff (1994) to 32,521 in Aitken and Harrison (1999). Further, we include a dummy for cross-section studies, a dummy for industry level studies, and a dummy for studies including only domestic firms as potential recipients. Two dummies capture whether foreign presence is measured as the share in employment or the share in equity (base case: any other definition such as output, sales or value added). We distinguish three types of dependent variable: sales as base case, as well as value added and productivity proxied by dummies. A median year variable permits us to test for a possible time trend. Possible cross-country variation is analyzed using dummy variables for developing or transition economies (base case: developed countries). In a variation of the model, we replace these dummies with the GDP per capita in the host country in the year 1994.

We estimate a random effects model to utilize the panel nature of the data and to accommodate heterogeneity. A random effects meta-analysis estimates the extent to which one or more covariates, with values defined for each study in the analysis, explain heterogeneity. In addition, we also report the results of an ordinary least squares (OLS) regression with heteroscedastic-autocorrelation consistent errors. This accounts for the fact that the error terms in (6) may not satisfy the requirement of homoscedasticity as the dataset includes multiple estimates for some studies and a dependent variable extracted from different studies.

**** Table 6 and Figure 1 approximately here ****

(b) Results

The results of the meta-regression analysis are reported in Table 6. The results of the OLS and random effects are, with some exceptions, similar and the coefficients are of similar size. Therefore, we focus on the random effects model when interpreting the results. As expected, studies with a larger sample size have a higher t-statistics. Studies based on cross-section data show more significant spillover effects in comparison to panel data studies. Studies using industry level data show, *ceteris paribus*, more significant spillover effects compared to firm level data studies. In addition, transition economies benefit more from spillovers of FDI than developing and developed countries. These results are consistent across the different specifications[vii].

The country variation becomes even more apparent when we capture them using GDP instead of country type dummies (column 9). The results for other dummies are not affected by this substitution, such that we do not report all regressions here. The result shows that countries with high levels of GDP experience less significant spillover effects. This supports the technological gap hypothesis, which suggests that local firms in developing and transition economies may receive larger spillovers than those in industrial countries**.**

Figure 1 illustrates the results of the regression analysis by depicting the predicted t-values for selected combinations of independent variables. To support the hypothesis of spillovers from FDI benefiting local firms, the t-statistic would have to be at least 2.57 (1% significance) or 1.96 (5% significance) for large sample sizes. As base case we chose a study in a developed country, with 1995 as average time period and firm level panel data with a sample size of n = 3425, namely the median value of firm level studies. For this base case, the t-value takes a negative and insignificant value, such that we cannot accept the hypothesis of positive spillovers for developed countries in the 1990s.

For all single item variations from the base case, the results remain insignificant. For instance, as illustrated in Figure 1, a study with the same characteristics as the base case, but conducted in a transition economy would generate a t-statistic of 0.90, which is substantially larger than for the base case, though still not high enough to accept the hypothesis of a positive effect. Why would the spillover effect be larger in transition economies that in developing economies? Transition economies required in particular managerial knowledge rather than technology training because they were highly industrialized by the market economy put new demands on managers (World Bank, 1996). Yet such general managerial knowledge is not a core competence of multinational firms, and they would be less concerned about potential negative side effects of sharing such knowledge with local firms (Meyer, 2004).

The average time period is statistically not significant. However, there seem to be a lot of noise in the data that inhibit generating a precise estimate. The coefficient of the average time period is negative across all specifications, which implies that earlier studies generate higher t-statistics. This has potentially major implications, especially when it comes to extrapolating the results to the future. In view of the importance of such an effect for policy, further research ought to investigate the evolution of spillover effects over time.

Moreover, it does not appear to matter whether spillovers are estimated for all firms or only the sub-sample of domestic firms as the coefficient on 'domestic firms only' is small and not significant. This suggests that there are no significant differences in the significance of spillovers when the equation is estimated for all versus just the domestic firms. This result is surprising in view of several studies (Djankov and Hoekman, 1998; Haddad and Harrison, 1993; Kinoshita, 2001; Barrios, 2001; Feinberg and Majumdar, 2001[viii]) that find differences within specific countries.

We also predicted that the characteristics of FDI projects would matter, and in consequence, different measures of FDI presence in the industry would affect the estimated effect. However, contrary to what studies like Sinani and Meyer (2004) led us to expect, the dummies for alternative measure of FDI presence are not statistically significant, though the impact is substantive. If we combine different contextual effects, our results predict that a study in a transition economy, measuring foreign presence by equity, and performance by growth would increase the chances of obtaining a statistically significant result.

Turning to methodological issues, studies using cross-section data generate larger positive t-statistics, as predicted. We reached the same conclusion in Tables 2 and 3, when comparing the size of spillovers across the different groupings of papers. Cross-sectional analysis may generate more positive spillovers because they do not control for possible reverse causality between FDI and productivity. For instance, a positive spillover coefficient may be due to the contribution of FDI spillovers to local firms' productivity, or it may be caused by MNCs investing in the more productive sectors in the host economy. In contrast, panel data usually produce negative and/or insignificant spillover effects, presumably because the reverse causality has been controlled for.

Studies that use industry level data have – for dataset with same sample size – t-statistics that are (according to column 5) on average 2.02 points higher. Industry data are subject to aggregation bias because they do not allow controlling for firm fixed effects, which may be correlated with foreign presence in industry. However, in evaluating industry level studies we also have to consider that they typically have much smaller datasets. The median sample-size of industry-level datasets is 145, compared to

3425 for firm-level datasets.[ix] The predicted t-value for such median industry level in a developed country in recent years is negative (Figure 1), leading to the same conclusion as firm-level studies, namely that there is no statistically significant spillover effect.

Finally, researchers have spent considerable efforts to refine their performance measures, yet alternative measures of performance appear to have no statistically significant effect on estimated spillovers. However, Figure 1 shows that the variation in results may be substantive at least if value added is compared to sales in the base case scenario. Theoretically, it would be preferred to measure productivity, which takes an intermediate position in the equation. The substantive but insignificant results for methodological issues suggest being cautious when designing such studies.

7. DISCUSSION AND CONCLUSION

We employed different methods of meta-analysis, and the results point to different directions. In particular, composite t-statistics (Table 2) may be interpreted as evidence for the existence of spillovers under any of the study constellations analyzed. However, the meta-regression indicates that this significance is largely driven by sample size. Composite t-statistics aggregate all regression results as if all datasets were merged into a Meta-dataset with a very large number of observations. Thus, even small effects may be found to be statistically significant. The appropriate interpretation of Table 2 is hence that on average spillover effects are positive (and statistically significant), but they may be very small. Ideally, we would like to analyze marginal effects, yet, as discussed above, we cannot aggregate marginal effects across studies because they employ different units of measurement.

We have generated predicted values of t-statistics from our Meta-regression. These not only control for simultaneous influences, but show t-statistics that would be generated by a study with a median number of observations. They are thus more suitable for policy discussions, suggesting that in most constellations, no statistically significant spillovers emerge.

From a methodology perspective, the significant difference between cross-sectional and panel data studies lends additional support to the assertion by Görg and Strobl (2001) that cross-sectional studies tend to generate upward biased estimates of spillovers. The cause is the inverse effect of FDI not only promoting industrial development, but itself being attracted to more productive industries. Recent evidence suggests that this FDI endogeneity is increasing over time (Li and Liu, 2005). In consequence, we would strongly advise against the use of pure cross-sectional data to study spillovers.

The second methodologically interesting result is the significant effect of the industry-level dummy. Industry-level studies *ceteris paribus* generate higher levels of significance; yet this *ceteris paribus* condition includes sample size. These studies typically use much smaller datasets: the median sample size for industry level studies is 145, compared to 3425 for firm level studies. Adding these two effects together, industry level studies do not report significantly higher t-statistics than firm level studies (Figure 1).

Policy makers would be interested not only in the average spillover, but in the circumstances under which positive spillovers are more likely. All three of our meta-analyses show differences in the effect size, which allows inferences in which contexts positive spillovers may emerge. The comparison of the mean partial correlations shows some of these differences to be statistically significant. Yet, the Meta-analysis suggests that most contextual differences are too small to be statistically significant once other influences (notably different sample sizes) have been controlled for.

However, two result stands out, namely the significance of the transition economy dummy and the negative result of GDP per capita (Table 6). The specific context of economic transition created a need for the transfer of general management knowledge rather than specialist technology, and foreign investors may have been relatively open to sharing such knowledge, as they would not consider it key to their own core competences. Such special conditions, however, are diminishing. As transition economies become more like other countries, they may attract fewer spillovers. The declining time trends points in a similar direction, but it is small and insignificant.

Our results are probably politically most interesting where we find no effect. Our analysis suggests that governments in developed economies such as the United Kingdom or Ireland should not expect FDI intra-industry spillovers! Hence policies in West European countries aiming to attract FDI should be reconsidered very carefully.

The contextual variables influencing spillover effects are of high policy relevance as policy makers would want to know under which circumstances FDI would benefit their local economy. Their insignificance thus sets earlier studies in perspective. More research on this issue is thus warranted, possibly by investigating country-level effects in multi-country firm level studies, as in Konings (2001). Moreover, with continuing research in the field, future Meta-analysis may be able to focus on the size of the marginal effect, i.e. the elasticities, which is most relevant for policy makers.

Since we find so little support for the existence of intra-industry spillovers, future research may move from analyzing intra-industry spillovers to inter-industry spillovers. The studies reviewed here are designed to capture horizontal spillovers. They would capture vertical spillovers only for suppliers classified in the same SIC industry, as may be the case in certain engineering supply chains, such as cars. However, most supplier relations transcend industry boundaries, such that detailed input-output data are required, as in Javorcik (2004). Further research along this line may be very promising.

Other research may investigate the particular contexts in which positive spillovers occur by focusing on specific phenomena such as national absorptive capacity (Lorentzen, 2005), or industrial clusters (Patibandla and Petersen, 2002; Thompson 2002). Such research at this time is largely based on firms or industry-case studies, yet larger cross-industry or cross-cluster analysis may be worthwhile.

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Table 1: Summary of Papers on Productivity Spillovers

Panel 1: Developing Countries (n=16)

Authors	Countries	Data year [1]	Data type[2]	Level of analysis[3]	Proxy for foreign presence	Dependent variable[4]	Result [5]
Blomström & Persson (1983)	Mexico	1970	CS	Industry (dom.)	Share in employment	VA/L	+
Blomström (1986)	Mexico	1970, 75	CS	Industry (dom.)	Share in employment	Deviations of VA/L from industry best practice	+
Haddad & Harrison (1993)	Morocco	1985-89	Panel	Firms (all+ dom)	Share in assets	Growth of VA	- n.s. (all) - n.s. (dom)
Blomström & Wolff (1994)*	Mexico	1970, 75	CS	Industry (dom.)	Share in employment	VA/L growth	+
Kokko (1994)	Mexico	1970	CS	Industry (dom.)	Share in employment	VA/L	+
Kokko (1996)	Mexico	1970	CS	Industry (dom.)	Share in employment	VA/L	+
Kokko, Tasini &Zejan (1996)	Uruguay	1990	CS	Firms (dom.)	Share in output	VA/L	+ n.s.
Aitken & Harrison (1999)	Venezuela	1976-89	Panel	Firms (all)	Share in equity, weighted with employment	Log (Y)	-
Blomström & Sjöholm (1999)	Indonesia	1991	CS	Firms (dom.)	Share in total gross output	VA/L	+
Sjöholm (1999)	Indonesia	1980, 91	CS	Firms (dom.)	Share in output	1) VA/L 2) VA growth	+
Chuang & Lin (1999)	Taiwan	1991	CS	Firms (dom.)	Share in assets	TFP	+
Kathuria (2000)	India	1975-89	Panel	Firms (dom.)	Share in sales / Foreign technical capital stock to total industry sales	Productivity growth	- +
Kathuria (2001)	India	1975-89	Panel	Firms (all+ dom.)	Share in sales / Foreign technical capital stock to total industry sales	Productivity growth	- n.s. (all) + (dom)
Kokko , Tasini & Zejan (2001)	Uruguay	1988	CS	Firms (dom.)	Share in output	VA/L	+
Feinberg & Majumdar (2001)	India	1980-94	Panel	Firms(all + dom.)	R&D stock of foreign firms	Log(Y)	+ n.s. (all) - n.s. (dom)
Bouoiyour (2003)*	Morocco	1987-96	Panel	Firms (dom)	Share Equity	Y/L	+ n.s.

Panel 2: Transition Economies (n=12)

Authors	Countries	Data year [1]	Data type[2]	Level of analysis[3]	Proxy for foreign presence	Dependent variable[4]	Result [5]
Djankov & Hoekman (2000)	Czech Republic	1992-97	Panel	Firms (all + dom.)	Share in sales	TFP growth	+ (all) - (dom)
Konings (2001)	Bulgaria, Poland, Romania	1993-97	Panel	Firms (all)	Share in sales	Log(Y)	- Bulgaria - Romania, n.s. Poland
Zwkovska (2000)	Poland	1993-97	Panel	Industry (dom.)	Share in output	Y/L growth	-
Kinoshita (2001)*	Czech Republic	1993-98	Panel	Firm (all+ dom.)	Share in Employment	VA growth	+ n.s. (all) - n.s. (dom)
Schoors & v.d. Tol (2002)*	Hungary	1997-98	CS	Firms	Share in sales	Y/L	+n.s.intra-industry - backward link + forward link
Liu (2002)	China	1993-98	Panel	Industry	Share in equity	Log(real VA) Growth (real VA)	+

Buckley et. al (2002)	China	1995	CS	Industry (dom)	Shares in Sales / equity	Y/L	+
Damijan et al (2003)	Eight East European countries	1994-98	Panel	Firms(all + dom.)	Share in Sales / export.	Y growth	+ Romania, - Slovenia, n.s. six others
Yudaeva et al (2003)	Russia	1993-97	Panel	Firms (dom.)	Share in output	Log VA	+ intra-industry - backstream - upstream
Wei and Liu (2003)*	China	2000	CS	Firms (dom)	Share in Equity	Log VA	+
Javorcik (2004)	Lithuania	96-2000	Panel	Firms(all + dom.)	Share in equity, weighted with output	Change Log(Y) Change in Log TFP	-n.s.intra-industry + backward link
Sinani & Meyer (2004)	Estonia	1994-99	Panel	Firms (dom.)	Share in equity / sales / employment	Y growth	+

Panel 3: Developed Countries (n=13)

Authors	Countries	Data year [1]	Data type[2]	Level of analysis[3]	Proxy for foreign presence	Dependent variable[4]	Result [5]
Caves (1974)	Australia, Canada	1965, 67	CS	Industry (dom.)	1) Share in Sales 2) Share in Equity	Profit/Equity VA/L	+ Australia, - n.s. Canada
Globerman (1979)	Canada	1972	CS	Industry (dom.)	Share in value added	VA/L	+
Liu et al. (2000)	UK	1991-95	Panel	Industry (dom.)	Share in equity	Log(VA/L)	+
Flôres et al (2000)*	Portugal	1992-95	Panel	Industry (dom.)	Share in value added	VA/L	- n.s.
Barrios (2000)*	Spain	1990-94	Panel	Firms (all + dom.)	Share in value added.	Log(VA)	+ n.s. (all) - n.s. (dom)
Driffield (2001)	UK	1986, 92	CS	Industry (all)	Growth of foreign sales/capital	VA growth	+ n.s.
Barrios et al (2002)*	Greece, Ireland, Spain	1992, 97	CS	Firms (dom.)	Share in employment.	Log(Y/L)	- n.s. Greece, -n.s. Ireland + n.s. Spain
Haskel, et al (2002)*	UK	1973-92	Panel	Firms (dom.)	Share in employment	Y growth	+
Girma and Görg (2002)*	UK	1980-92	Panel	Firms (all)	Share Employment	LogTFP	+ n.s.
Imbriani & Reganati (2003)*	Italy	1994-96	Panel	Firms (all)	Share in Employment	Log VA	- n.s.
Ruane & Ugur (2005)	Ireland	1991-98	Panel	Firms (dom)	Share Employment	Y/L, Growth(Y/L)	+ n.s.
Barry et al. (2005)	Ireland	1990-98	Panel	Firms (dom)	Share Employment	Y/L, TFP	-
Dimelis (2005)	Greece	1992-97	CS	Firms (all + dom)	Share Equity	Growth Y	+

Notes (for all panels):
1. Data period analyzed
2. CS = cross-sectional data;
3. Some studies cover impact on all firms ('all'), while other studies consider only impact on domestic firms (dom.) and yet other studies have separate regressions for both (all + dom.).
4. VA = value added, L = labor, Y = output (using different proxies, such as sales).
5. = Intra-industry productivity spillovers unless otherwise specified, forward/backward refer to the perspective of the MNE, + and - means significant positive or negative spillovers; n.s. indicates insignificant spillovers.
6. * = unpublished studies.

Table 2: The Effect of Spillovers on Firm Productivity:
Composite t-statistic without (T) and with (T_w) weights

Groups of Studies	Nr of observations		All Studies		Excluding outliers	
	All Studies	Excluding outliers	T	T_w	T	T_w
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Developing Economies	26	23	19.5***	12.6***	7.2***	4.2***
Transition Economies	21	19	15***	16.4***	5.2***	4.8***
Developed Economies	22	22	2.2**	1.4	2.2**	1.39
Cross-Section data	26	23	22.6***	18.6***	10.5***	8.3***
Panel data	43	41	9.7***	11.6***	2.7***	3.1***
Spillover as share in Employment	21	20	10.9***	12.2***	5.2***	2.3**
Spillover as share in Equity	23	21	14.9***	8.3***	5.7***	4.4***
Spillover as share in Output	25	23	11.5***	10.9***	3.8***	3.1***
All Studies	69	64	22.6***	17.5***	8.4***	5.8***

Note: ***, ** and * means significant at 1%, 5% and 10% significance level, respectively.

Table 3: Comparing Spillover Effects on Firm Productivity in Different Types of Studies.
(Excluding outliers)
(Descriptive statistic used: Mean partial correlations)

Groups of Studies (1)	Nr of observations (2)	NoWeights (3)	Weighted (4)
Studies on Developing (G_1)	23	0.094	0.075
Studies on Transition (G_2)	19	0.042	0.045
Studies on Developed (G_3)	22	0.048	0.029
Cross-Section Studies (D_1)	23	0.15	0.13
Panel-Data Studies (D_2)	41	0.011	0.022
Share in Employment (S_1)	20	0.13	0.08
Share in Equity (S_2)	21	0.069	0.066
Share in Output (S_3)	23	-0.00044	-0.0022
All Studies	64	0.062	0.047

Table 4: Group Mean-Difference Tests for Different Types of Studies.

Null Hypothesis (1)	No Weights (2)	Weighted (3)
Mean(G_1)-Mean (G_2)=0	0.99	0.017
Mean(G_1)-Mean (G_3)=0	0.82	0.72
Mean (G_2)-Mean(G_3)=0	-0.18	0.53
Mean (D_1) – Mean (D_2)=0	3.0***	1.89*
Mean(S_1)-Mean (S_2)=0	1.17	-0.27
Mean(S_1)-Mean (S_3)=0	2.2**	2.1**
Mean (S_2)-Mean(S_3)=0	1.8*	2.3**

Note: Spillover types defined as in table 3; Test–statistic constructed from the transformation of partial correlations.***, ** and * mean significant at 1%, 5% and 10% significance level.

Table 5: Meta Regression for Publication Bias.

Variables	Equation (6) estimates
$1/Se_i$	-0.0002
	(-0.65)
β_0	2.7***
	(3.56)
Nr. Observations	69
R-squared	0.06

Notes: t-statistics in parentheses. *** denotes significance at 1% significance level.

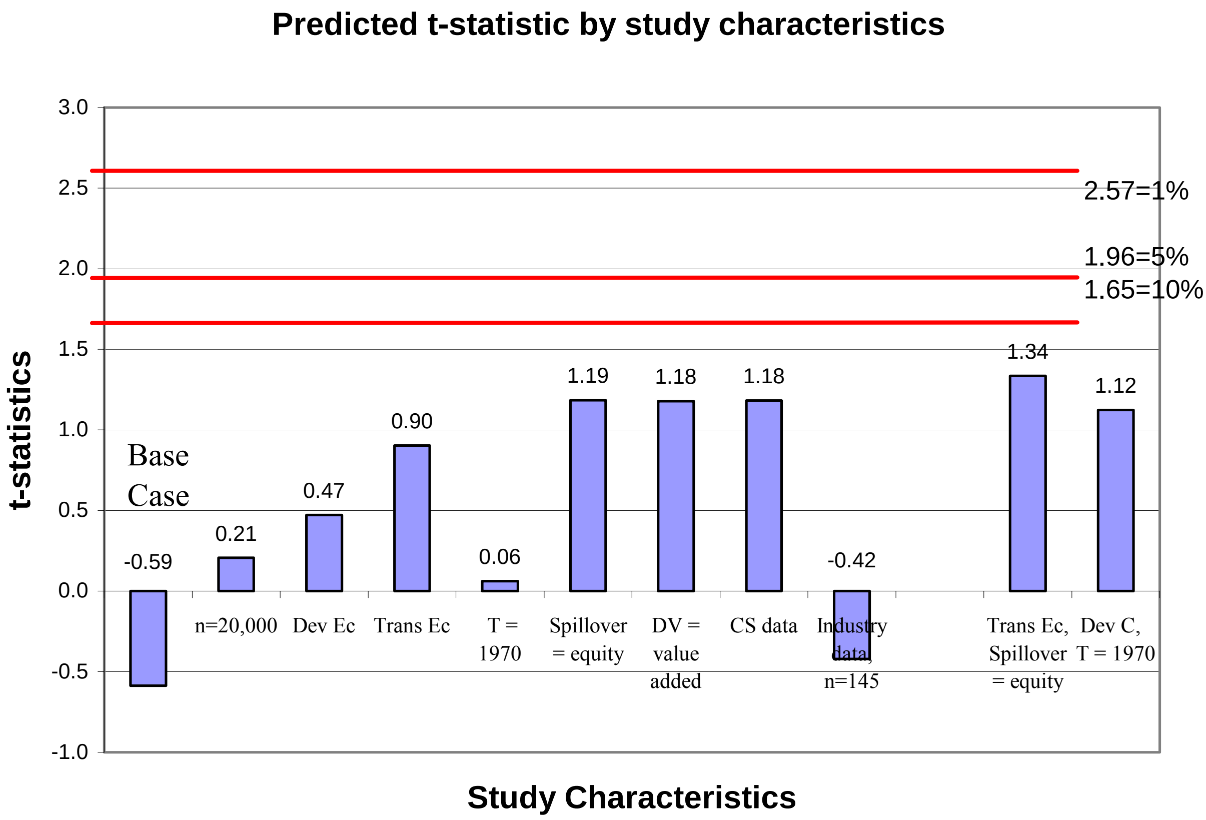
Table 6: A meta-regression analysis on the impact of different study characteristics. [i]

	OLS				Random Effects Meta Analysis [ii]				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(N)	0.45*	0.44	0.47	0.42*	0.53***	0.52***	0.55***	0.49**	0.51***
	(1.74)	(1.57)	(1.60)	(1.69)	(2.77)	(2.69)	(2.88)	(2.55)	(2.7)
Median year of study	-0.026	-0.024	-0.046	-0.044	-0.01	-0.008	-0.03	-0.03	-0.007
	(-0.59)	(-0.52)	(-0.90)	(-0.85)	(-0.20)	(-0.16)	(-0.63)	(-0.5)	(-0.20)
Dummy Developing Countries	1.06*	1.05	0.75	-0.9	1.05	1.03	0.72	0.91	-
	(1.68)	(1.64)	(1.13)	(-1.29)	(1.48)	(1.44)	(0.96)	(1.21)	
Dummy Transition Countries	1.49	1.45	1.41	1.57	1.37*	1.30*	1.31*	1.44*	-
	(1.38)	(1.20)	(1.37)	(1.34)	(1.84)	(1.69)	(1.78)	(1.88)	
GDP per capita	-	-	-	-	-	-	-	-	-0.0001**
									(-2.08)
Dummy Cross-Section v. Panel Data	1.77***	1.78***	2.06***	1.64**	1.84***	1.86***	2.16***	1.74***	1.86***
	(2.87)	(2.89)	(3.53)	(2.66)	(2.92)	(2.93)	(3.29)	(2.6)	(2.96)
Dummy Industry level data	1.59*	1.59*	1.35	1.24	2.02**	2.03***	1.75*	1.69*	2.19**
	(1.76)	(1.77)	(1.43)	(1.47)	(2.17)	(2.18)	(1.85)	(1.72)	(2.43)
Dummy Domestic firms only	-	-0.09	-	-	-	-0.15	-	-	-
		(-0.14)				(-0.27)			
Dummy Spillover is share in employment	-	-	-0.056	-	-	-	-0.043	-	-
			(-0.08)				(-0.07)		
Dummy Spillover is share in equity	-	-	0.85	-	-	-	0.87	-	-
			(0.96)				(1.32)		
Dummy if Dep. Variable is Value Added [iii]	-	-	-	1.01	-	-	-	0.83	-
				(0.91)				(1.07)	
Dummy if Dep. Variable is Labor Productivity [iii]	-	-	-	0.42	-	-	-	0.32	-
				(0.41)				(0.41)	
Constant	-3.60**	-3.50*	-3.49*	-3.25*	-4.50**	-4.40**	-4.40**	-4.17**	-3.25**
	(-2.04)	(-1.68)	(-1.97)	(-1.92)	(-2.37)	(-2.22)	(-2.32)	(-2.15)	(-1.97)
No. Observations	64	64	64	64	64	64	64	64	63
R-squared	0.23	0.24	0.26	0.25	-	-	-	-	-
F-Test	5.31***	5.0***	7.9***	5.36***	-	-	-	-	-

Note: ***, ** and * mean significant at 1%, 5% and 10% significance level.

i) Outliers excluded, t-statistics in parenthesis.
ii) Random effects-meta analysis is estimated with maximum likelihood.
iii) Includes level, log of level and growth of the variable.

Figure 1: Predicted t-values of the regression analysis



Note: Based on columns 1 to 4 in Table 6.

Base Case = Developed Country, 1995 data, firm level panel data, N=3425 (=median value for studies that are firm-level panel data), dependent variable = sales, spillover variable = sales.

Interpretation: Predicted values are for a bases case, and variations of explanatory variables over the base case. Note that for industry level studies, the median number of observations in these studies (n=145) was used.

Endnotes

[i] The empirical evidence on spillovers from labor mobility is inconclusive. MNE typically pay higher wages paid by MNE and their outward labor mobility is low, yet many successful local firms trace their origins to entrepreneurs or top managers that had prior links to MNEs (Altenburg, 2000). Thus, not many employees move, but those who do move may make a substantive impact on local firms.

[ii] Some studies such as Kathuria (2000, 2001), Buckley et al. (2002), Sinani and Meyer (2004) use multiple definitions of the spillover variable. Therefore, the sum of the papers by definitions of the spillover variable is larger than 41.

[iii] In papers with multiple similar regressions we take the estimate of the regression with the highest R-squared.

[iv] This does not substantially effect the conclusions. We did the same analysis inclusive the outliers and obtained substantially the same results.

[v] T-statistic=effect size/standard error. The standard error is larger when sample size is small, and this translates into less significant t-statistics.

[vi] β_0 remains significant at 1% significance level if we re-estimate equation (5) with heteroscedastic-autocorrelation consistent standard errors.

[vii] We also perform the same analysis when the outliers are not excluded. These results are similar in sign and significance to the once presented in Table 7, however, larger in magnitude. Furthermore, in contrast to when the outliers are excluded, both coefficients of the dummies for developing and transition countries are positive and significant, suggesting that developing countries benefit more from spillovers of FDI than developed countries. In addition, spillovers are larger when the dependent variable is measured as the level of output, value added, sales or TFP. These results are available upon request.

[viii] In these studies, the differences seem to be driven by the fact that foreign firms usually possess more advanced technologies, hence, are more able to benefit from FDI spillovers of other foreign firms.

[ix] This issue does not arise for cross-section versus panel data studies as the median sample size is very similar.