# When and Where Does Foreign Direct Investment Generate Positive Spillovers? A Meta-Analysis[1]

**Klaus E. Meyer**
Professor
School of Management, University of Bath
Bath, BA2 7AY, United Kingdom
www.klausmeyer.co.uk
e-mail: k.meyer@rdg.ac.uk

and

**Evis Sinani**
Assistant Professor
Department of International Economics and Management
Copenhagen Business School
Porcelænshaven 24, 2000 Frederiksberg, Denmark
E-mail: es.cees@cbs.dk
Tel: +45 38153052

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**www.klausmeyer.co.uk**
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# When Does Foreign Direct Investment Generate Positive Spillovers?

# A Meta-Analysis

## Abstract

Local firms may attract productivity spillovers from foreign investors, yet these vary with local firms' awareness, capability and motivation to react to foreign entry. In consequence, spillovers vary across countries at different levels of economic development.

We apply competitive dynamics theory to analyze these contextual moderators of spillovers and test hypotheses thus derived in a Meta-analysis of the empirical literature on spillovers. Our analysis suggests a curvilinear relationship between spillovers and the host country's level of development in terms of income, institutional framework and human capital.

**Keywords**: spillovers, foreign direct investment, technology gap, awareness-motivation-capability framework, meta-analysis

## INTRODUCTION

Local firms experience inward foreign direct investment (FDI) as both a competitor and a source of advanced technologies and managerial knowledge. However, the scale and scope of such spillovers varies with firms' characteristics (Feinberg and Majumdar, 2001; Sinani and Meyer, 2004) and the context in which they are interacting (Keller, 1996; Blomström and Kokko, 2003).

Development economists emphasize that spillover benefits may increase with the technology gap between local recipient firms and the foreign investors (Findlay, 1978; Wang and Blomström, 1992, Perez, 1997). However, this effect may be important only for developing countries. Management scholars emphasize that firms' response to entry in their industry is crucially dependent on their own awareness, motivation and capability (Chen, 1996; Smith, Ferrier and Ndofor, 2001). Firms' own capability is crucial to make use of knowledge that they can access (Keller, 1996; Blomström and Kokko, 2003; Rogers 2004), while direct competition without institutional protection creates stronger motivation to react (Baum and Korn, 1996). We thus extend Chen's (1996) awareness-motivation-capability framework to explain cross-contextual variations of local firms' productivity upgrading in response to foreign entry.

These dynamics of competition lead to a non-linear relationship between economic development and received spillovers. In low income economies, a large technological gap may permit conventional demonstration effects. With economic development, these benefits decline, while foreign investors become more likely to compete directly with local firms and thus to cause crowding out effects (Aitken and Harrison, 1999). However, at advanced levels of economic development, local firms also develop their motivation and capability to react to foreign entry. Beyond a certain threshold, they are likely to generate net benefits from the interaction with inward

investors based on their own capability to absorb latest technologies, and to react to increased competition by upgrading their productivity.

Economic development encompasses many closely related dimensions. At an aggregate level, it is associated with higher levels of *per capita* income (Borensztein, Gregorio and Lee, 1998). Underlying economic development, however, are the institutional development and the endowment of the country with resources, especially human capital (Hirschman, 1958; World Bank, 1993; De Mello, 1997). We thus hypothesize a curvilinear relationship between spillovers from FDI and multiple dimensions of development, namely per capita income, human capital and institutional frameworks. This is confirmed in our empirical analysis.

Our methodology, a Meta-analysis, takes advantage of the extensive empirical literature on FDI spillovers. Meta-analysis can play a crucial role in advancing scientific knowledge from context-specific knowledge to general theory. Many studies create context-specific knowledge because their data do not allow clear identification of boundary conditions (Tsui, 2004; Meyer, 2006; 2007). However, business scholarship aims to create general knowledge in form of universally valid theorems (Huff, 1999; Tung and van Witteloostuijn, 2008), which requires cross-contextual analysis to validate the generalizability of results (Cheng, 1994; Rosenzweig, 1994). A Meta-analysis provides a powerful tool to identify the moderating effects of contextual variables, and thus to establish the boundary conditions of scientific knowledge.

We build on an earlier Meta-analysis by Görg and Strobl (2001). Many studies test for spillovers by estimating a production function with FDI in the industry as an explanatory variable: a significant positive impact of this proxy on firms' productivity provides support for positive spillovers. Yet, we lack understanding of whether and how these results are affected by the specific context because most of these studies are single

country studies.[1] We thus conduct a Meta-analysis to investigate an issue for theory development rather than to assert the average effect or methodological issues affecting the results. Contextual variation is analyzed through country-level variables rather than controlled for by dummies. Moreover, we improve over Görg and Strobl (2001) by including three times as many research papers, employing random effects Meta-analysis, and controlling for additional study characteristics.

Our results show that productivity spillovers are related in a U-shaped form to the host country's level of development in terms of per capita income, human capital and institutional development, while trade openness has a positive effect. These results have implications not only for theory development and the design of future empirical studies, but for economic policy. Countries that develop from low levels progressively face stronger direct competition between local and foreign investment firms, while demonstration effects decline. However, beyond a threshold, development strengthens local firms' motivation and capability to counter competitive challenges of FDI, and thus to attract knowledge spillovers.

## ECONOMIC DEVELOPMENT AND SPILLOVERS

The competitive interaction between local and foreign firms evolves with economic development. Where they are separated by large gaps in technology, locals have a lot to learn, and can thus potentially attract major knowledge spillovers (Findlay, 1978; Wang and Blomström, 1992). This 'technology gap' indicates potential for catching up, and thus explains part of the cross-national variations in received spillovers (Lorentzen, 2005).

However, learning depends crucially on actions by the recipient firms themselves. In particular, competitive dynamics theory suggests that firms need

appropriate *awareness*, *motivation*, and *capabilities* to react to entrants competing for their markets and resources (Smith, Grimm, Gannon and Chen, 1991; Chen, Su and Tsai, 2007). These factors also vary across countries, and contribute to the international variation of realized spillovers.

**Technology Gap**

Local firms learn from foreign investors, for instance by observing technologies employed by MNEs (Kokko, 1992; Wang and Blomström, 1992) or by attracting employees that have been trained by multinational enterprises (MNEs) (Meyer, 2004; Spencer, 2007). These demonstration effects depend on the local firms' catch-up potential: Relatively backward firms may increase their productivity even by imperfect copying of advanced practices, while firms operating close to the foreign investors' level of technology would gain little from copying easily observable aspects of their business.

Hence, the *potential* for productivity improvements is positively related to the technology gap between local and foreign firms in an industry. A stream of theoretical models demonstrates that, for a given level of foreign presence, spillovers increase with the technology gap between foreign and domestic firms (Findlay, 1978; Wang and Blomström, 1992; Perez, 1997).

However, despite considerable empirical research, evidence for this 'technology gap hypothesis' is weak (Haddad and Harrison, 1991; Kokko, 1994; Kokko, Tasini and Zejan, 1996; Sjöholm, 1999). This lack of support may be because the assumptions underlying the hypothesis are reasonable only under specific conditions. In particular, it is assumed that the technology can be easily observed, for instance by reverse engineering. Moreover, the knowledge needs to be *non-proprietary* in the sense that the

foreign investor is not preventing its diffusion. These conditions may apply to standardized technologies and practices that do not form part of the foreign investors' core competences. Local firms in developing countries may still find such basic knowledge beneficial to improve their productivity (Lall, 1978). In other contexts, it is much less likely to be relevant. Once foreign investors recognize local firms as potential competitors, rather than needy recipient of development aid, they can be expected to increase measures to prevent knowledge diffusion.

**Awareness**

Foreign investment represents a high profile form of entry, compared to international trade, and local firms are thus normally aware of these entrants. Yet, they may not always comprehend the potential impact on their own business – both in terms of competition, and in terms of the learning potential. Such awareness of entrants' potential impact on their own business depends on the similarity of their operations and markets (Chen, 1996; Yu and Cannella, 2007).

Yet, foreign investors' operations are often distinctly different from those of local firms because they compete on the basis of firm-specific resources (or 'ownership advantages' (Dunning, 1988)) transferred from other units of the MNE (Rugman, 1981). These firm-specific resources that allow overcoming the liability of foreignness are typically based on intangible assets, such as brands and technology. Moreover, foreign investors have frequently been noted to employ more capital intensive methods of production than local firms in developing countries. In consequence, they typically operate in more up-market segments, where they experience little direct interaction with local firms operating in volume driven mass-markets with small margins (Dawar and Chattopadhay, 2002). Moreover, foreign investors that manufacture for export have

limited competitive interaction with firms operating locally, even when classified in the same sector of industry.

This limited interaction and low similarity reduces managers' cognizance of the relationship with the entrant, and thus reduces their awareness of the potential impact on their own business (Chen et al., 2007). Thus, in countries where operations of foreign and local firms are quite dissimilar, awareness of the likely impact of the foreign investment is likely to be low.

## Motivation

Foreign investment intensifies competition in the industry it enters, both by increasing the number of competitors, and by introducing new ways to compete (Dunning, 1988; Blomström and Kokko, 2003; Driffield and Love, 2007). Local firms may adapt their strategies to counter the challenge, and thus to raise their competitive edge (Bowen and Wiersema, 2005). However, their reaction depends on their motivation and thus the incentives they face (Smith et al., 1991; Chen et al. 2007).

These incentives are shaped by the institutional framework, especially the effectiveness of both domestic and international markets (North, 1990; Peng, Wang and Jiang, 2008) and the national innovation system (Nelson, 1993; Lundvall et al., 2002). Institutional frameworks establish incentives and business practices that influence the nature of competition and knowledge acquisition processes. A pivotal aspect is the liberalization of international trade, which enhances both opportunities and incentives to innovate (Keller, 1996; Hoekman et al., 2005).

Where local firms are subject to rules that constrain their options for restructuring or protect them from the impact of competition, they have less motivation to engage in the often risky strategies of technological change and upgrading. Local

firms may be most motivated to react to foreign investors if the institutional framework provides them with the freedom to act, and generates incentives systems that reward innovation and strategic change.

## Capability

Recipients have to connect new knowledge with existing knowledge, and to transform it for application in their own context. Firms' ability to do so varies as a result of their endowment with resources, especially human capital (Smith et al., 1991; Chen, 1996; Chen et al., 2007). This ability, also known as 'absorptive capacity' (Cohen and Levinthal, 1990; Zahra and George, 2002), has been analyzed for specific business units (Lyles and Salk, 1996; Minbaeva et al., 2003), firms (Keller, 1996; Rogers 2004; Lai, Peng and Bao, 2006) as well as national economies (Borensztein, et al., 1998; Xu, 2000; Criscuolo and Narula, 2008).

Absorptive capacity captures firms' ability to utilize acquired knowledge, and thus to increase their realized spillovers. Local firms that lack this capability may be unable to catch up, and thus be crowded out by foreign investors. Similarly, local firms that only recently started facing foreign competitors, as in transition economies, may lack managerial resources to adequately respond and to raise their productivity (Konings, 2001). This can, at least in the short run, cause excess production capacity and thus low productivity (Aitken and Harrison, 1999).

The capability of potential recipient firms is a function of their human capital their organizational structures that may facilitate innovation and thus enhance the benefits from received knowledge (Keller, 1996; Blomström and Kokko, 2003; Spencer, 2008). Moreover, this capability is closely associated with the level of income in the economy, which provides financial resources to acquire complementary resources, and

to pay wages that match foreign investors' wages, and thus to benefit from attracting and retaining skilled employees (Gershenberg, 1987; Aitken, Harrison and Lipsey, 1995).

## HYPOTHESIS DEVELOPMENT

Many of the effects underlying spillovers have been shown to be non-linear, including the relationship between learning and benefits from learning (Kotabe et al., 2007; Björkman, Stahl and Vaara, 2007) the relationship between the intensity of competition and firms strategic action (Chan, Makino and Isobe, 2006) and the technology gap and productivity spillovers (Liu, Siler, Wang and Wei; 2002; Buckley, Clegg and Wang, 2007). This suggests that the relationship we are investigating may be curvilinear as well.

Spillovers are conditioned by the local environment. We thus explore how characteristics of the host economy, in particular its level of development, moderate the effects discussed above, with the aim of developing hypotheses regarding the strength of spillover effects across countries. To develop the argument, we first consider three scenarios of low, middle and high income economies (Figure 1) before discussing the dynamics of changes in income levels (Figure 2).

****** Figures 1 and 2 approximately here ******

### Scenarios

**Low Income Economies.** At low levels of development, the assumptions underlying the technology gap hypothesis may be appropriate. In such contexts, local firms may benefit from standardized knowledge that foreign investors do not prevent from diffusing, and that can be obtained by observation or indirect interactions. This would suggest that the technology gap argument is more relevant in developing economies

(Findlay, 1978; Kokko, 1992), where some studies find empirical support (Jordaan, 2005; Wang and Yu, 2007).

Moreover, foreign investors in less developed economies are likely to operate in different market segments than local firms, and thus not likely to compete directly (Dawar and Chattopadhay, 2002; Spencer, 2008). While local firms often serve mass-markets, foreign investors largely focus on premium segments and neglect the potential markets 'at the bottom of the pyramid' (Prahalad, 2004; London and Hart, 2004). In addition, many foreign investors seek low cost labor and natural resources with the aim to serve export markets where they compete only indirectly with local firms (Spencer, 2008). This lack of direct competition reduces the local managers' awareness of the relevance of the foreign investors experience for their own business (Chen 1996). Moreover, segmentation and protection of markets may reduce motivation to react, while weak absorptive capacity reduces the capability to do so (Keller and Yeaple, 2003; Karpaty and Lundberg, 2004). Hence, in low income economies, local firms are likely to benefit from demonstration effects due to a large technology gap, even though their *awareness*, *motivation* and *capability* for strategic reaction to foreign entry is low.

**Medium Income Economies.** Local firms are more likely to compete with foreign investors when their products and technologies are more similar (Wang and Blomström, 1992). In middle income economies, foreign investors typically enter the same product and factor markets as local firms. Yet, their competitive edge may make it difficult for local firms to retain their market share (Spencer, 2008). This market stealing effect causes excess capacity in local firms, as observed in Venezuela by Aitken and Harrison (1999) and in Spain by Barrios et al. (2004). These types of economies are thus likely to experience local firms struggling in the face of FDI competition.

General knowledge that can be acquired by demonstration effects is unlikely to

create substantive benefits in middle income economies, where local firms normally would need advanced industry-specific capabilities to advance further. To the extent that foreign investors have more advanced technologies, these are usually proprietary, and cannot be easily observed and copied by indigenous firms (Javorcik, 2004). Hence, demonstration effects are unlikely to be substantial. Thus, awareness of foreign investors' impact is likely to be high in middle income economies, yet with weak capability, local firms are unlikely to be able to act strategically to attract benefits for themselves.

**High Income Economies.** In advanced economies, inward investors normally compete directly with incumbent local firms in the same or similar market segments, such that awareness of the entrant is high. Moreover – in contrast to a typical middle income economy - local firms usually have developed strong *capability* to successfully compete with the foreign entrants (Liu et al., 2000; Haskel et al., 2007): Their human and financial capital improves their utilization of new knowledge encountered in interactions with foreign investors. Moreover, their motivation is high as the institutional framework is market-oriented and their performance is dependent in their own efforts with little protection from governments.

**Dynamics.** As countries advance from low to middle income levels, the technological gap declines thus reducing the potential knowledge gains from demonstration effects. At the same time, local firms are more likely to face head-on competition as market segmentation and protection decline. Yet, their capability to react strategically remains weak because they lack experience with this sort of competition, and with advanced technological knowledge that would allow them to upgrade further.

As countries advance further from middle to high income levels, beyond a certain threshold, they develop the capability to stand-up to foreign investors and raise

their competitive edge by upgrading their own competitiveness (Perez, 1997; Liu et al., 2000). At the same time, their motivation to do so is enhanced by institutional frameworks rewarding performance. Taking the negative effects at lower levels, and the positive effects at higher levels together suggest a U-shaped relationship between the level of economic development and spillover effects:

*Main Proposition: The host country's level of development influences FDI spillovers in a curvilinear way, taking a U-shaped form.*

Economic development encompasses many dimensions. While it is closely associated with a country's level of income, it incorporates also human and institutional aspects. We thus explore three key dimensions of economic development to test our main proposition: income, human capital and institutional development.

Level of income is a direct measure of economic development. Host countries at very low levels of income may benefit from demonstration effects and other indirect benefits, yet the effect declines when foreign and local firms directly compete for markets and resources. Beyond a threshold, however, local firms acquire the capability to react strategically, and thus to translate competitive pressures and technology exposure into increased productivity and competitiveness. Moreover, at high levels, income provides financial resources that enable firms to acquire capabilities to utilize knowledge transfer. Hence, our first hypothesis offers a direct test of our main proposition:

*H1a: The host country's level of per capita income influences FDI spillovers in a curvilinear way taking a U-shaped form.*

Human capital is a major foundation of firms' capability to react to foreign entry, and to make use of knowledge spillovers. It comprises both general education as well as specialist competences such as skills and learning processes of R&D (Lorentzen, 2005), and is commonly proxied by measures as such as educational achievements and R&D expenditures (Kinoshita, 2001; Kathuria, 2001; Barrios et al., 2004).

At low levels of human capital, a large technology gap facilitates demonstration effects. With increasing human capital formation, these benefits diminish while direct competition increases, for instance in markets for managerial talent. Beyond a threshold level of human capital, local firms develop their own absorptive capacity, which strengthens their capability to take initiatives that enhance productivity. The more human capital advances, the more firms are able to retain qualified staff, absorb latest technologies, and thus to enhance their productivity. Hence, the relationship between human capital and knowledge spillovers is likely to be curvilinear:

*H1b: The host country's level of human capital influences FDI spillovers in a curvilinear way taking a U-shaped form.*

The institutional development of the host economy influences both the national innovation system and the patterns of competition between foreign and local firms (Nelson, 1993; Lundvall et al., 2002). Weak institutions tend to be associated with inefficient markets, network-driven business practices and protected niches for local firms (Khanna and Palepu, 2000; Peng, 2003). Foreign investors thus may be constrained in their organizational forms (Meyer, Estrin, Bhaumik and Peng, 2008), while local firms may take advantage of such business practices and weak intellectual property protection to attain knowledge that foreign investors may otherwise be able to

prevent from diffusion. Such possibilities, however, diminish with the advance of legal institutions.

Improvements of institutions from a low level would remove regulation protecting incumbents and allow foreign investors to fully exploit their competitive advantages at the expense of local firms. Especially in early stages of liberalization, inertia at both national and firm level may inhibit organizational change and strategic flexibility, such that local firms may be ill prepared for direct competition (Konings, 2001). However, beyond a threshold of institutional development, local firms have developed competitive positions in their home markets, and are thus both motivated and capable to face foreign investment competition. They thus are more likely to counter the challenge by raising their own productivity. Hence, we propose:

*H1c: The host country's level of institutional development influences FDI spillovers in a curvilinear way taking a U-shaped form.*

Hypotheses 1a to 1c suggest a curvilinear relationship for several aspects of development. Support for all three sub-hypotheses would represent very strong support for the main proposition. However, the nature of development is such that human and institutional development are mutually interdependent, and jointly influence of per capita income. Thus, the logic of economic development leads us not expect that the effects of H1a to H1c can be separated.

**International Trade**

A key aspect of the institutional environment is the foreign trade regime (World Bank, 1993; Bhagwati, 1994; De Mello, 1997). Firms facing competition from imports are likely to develop the strategic flexibility and learning practices that also strengthen their

ability to learn from foreign investors (Keller, 1996). They thus are likely to have developed *motivation* and *capability* to react to foreign entry in ways that enhances their productivity and market position. Moreover, with an open trade regime, local firms can acquire complementary investment goods and technologies that help them absorb knowledge from foreign investors (Hoekman et al., 2005).

An open trade regime entails few restrictions on international trade and thus encourages investors to design location and sourcing strategies based on efficiency considerations. Inward foreign investors are thus likely to be highly integrated in international trade and adopt internationally competitive technologies. In consequence, local firms can observe latest technologies and face a tougher competition, which enables them to develop capabilities to act flexibly in a volatile environment.

Moreover, an open trade regime facilitates export-oriented foreign investors, which may enhance local firms' business opportunities directly when integrating into MNE supply networks, and indirectly by providing information on foreign tastes, market structure, competitors, distribution networks and transport infrastructures (Kokko, Tasini and Zejan, 2001). It may even help local firms to become exporters themselves (Aitken, Hanson and Harrison, 1997).

Thus, openness to international trade may generate a more competitive market environment and a higher level of technology exchange. In support of this argument, empirical studies find a stronger association between FDI and GDP growth in countries with export-oriented rather than import-substituting policies (Balasubramanyam, Salisu and Sapsford, 1996; Athukarola and Chand, 2000). Thus, we expect that FDI combined with trade openness is associated with higher productivity increases of local firms:

*H2:* *FDI spillovers are more likely, the more open the host country is to international trade.*

## DATA AND METHODOLOGY

### *Our Database*

Our database encompasses all known published and unpublished empirical papers that estimate FDI spillovers by the sensitivity of local firm's productivity to the presence of FDI in industry. They have been collected by searching the EconLit database and the Internet using keywords such as spillovers from technology transfer and productivity FDI spillovers, and through review papers on productivity spillovers. We have identified 66 empirical studies using such research designs in developing countries (23 studies), transition economies (22) or developed countries (21).

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

Many of the early studies, starting with Caves (1974), find significant positive effects. Also recent studies in the UK suggest positive effects (Liu et al., 2000; Haskel et al., 2007), while results from Southern European countries are more mixed (Barrios et al., 2004; Flôres et al., 2007). Early research in developing economies, such as Mexico (Blomström, 1986), Uruguay (Kokko et al., 1996) and Indonesia (Sjöholm, 1999), points to significant positive productivity spillovers. In contrast, recent panel data studies show negative effects in two major studies by Aitken and Harrison (1999) on Venezuela and Kathuria (2000) on India. For transition economies, the evidence is equally unclear. Liu (2002) in China, Yudaeva et al. (2003) in Russia and Sinani and Meyer (2004) in Estonia find positive effects, while other studies find negative effects in Bulgaria, Romania (Konings, 2001) and the Czech Republic (Djankov and Hoekman, 2000). Hence, the overall evidence is rather inconclusive.

Early studies use cross-sectional data, yet as panel data techniques have become more available, most recent studies use panel data, in total 43 of 66 studies. Twenty

papers use industry-level data, while the remainder uses firm-level data. Spillovers are proxied by the presence of foreign investors in the industry, which however is measured by their share in industry employment (25), industry equity capital (28), or industry sales, output or value added (25).[2] The performance of recipient firms is measured by a proxy of productivity, such as output per employee or value added per employee (29), value added (11) or total factor productivity or output (30), where any 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 or the dependent variable, or they estimate spillovers for different countries and time periods. From these studies we include all spillover estimates in our Meta-analysis.[3] With these multiple results from some studies, the database consists of 124 observations. However, two studies with three spillover estimates (Sjöholm, 1999; Chuang & Lin, 1999) report t-values that are 10 times larger than the mean. Without these outliers from the analysis, the final database includes 121 observations.[4]

### *Methodology*

Our Meta-regression analysis regresses t-statistics on country variables as well as independent study characteristics to investigate the patterns of prior results (Stanley and Jarrell, 1989). This approach allows to investigate moderating effects on a relationship explored in earlier empirical research (Figure 3).

****** Figure 3 approximately here ******

Our sample includes multiple spillover estimates for many studies, which allows us to analyze the data as panel. However, fixed and random effects in a meta-analysis refer to assumptions about heterogeneity of the effect estimates and not to assumptions of the variation across time and firms (Hedges and Vevea, 1998). Under the fixed

effects models, the effect size in the population is assumed to be the same across studies (the homogeneity assumption). In the random effects models, each study has a different effect size (the heterogeneity assumption).

We test for fixed versus random effects meta-analysis with a heterogeneity test (Lau et al., 1992). Based on this test, we can reject the null hypothesis of no heterogeneity at 1% significance level. Hence, we employ the random effects model. The advantage of estimating a random effects meta-analysis is that it integrates in the model the between studies heterogeneity not explained by covariates. Maximum likelihood estimates of model coefficients are then obtained with weights being the between study variance (Thompson and Sharp, 1999). We thus estimate the following random Meta-analysis model:

$$Y_{ij} = \alpha_i + \gamma_c \Gamma_c + \beta_{ij} X_{ij} + \varepsilon_{ij} \qquad (1)$$

where $Y_{ij}$ is the t-statistics[5] of the spillover coefficient derived from the $j^{th}$ regression in $i^{th}$ study, $\alpha_i$ represents random effects that control for the commonality and dependency of estimates within and across studies, $\Gamma_c$ is a vector of explanatory variables that account for cross-country variations (including their quadratic terms where appropriate), and $X_{ij}$ is a vector of control variables for study characteristics.

***Explanatory Variables***

We test our hypotheses by introducing country-level variables in the Meta-regression. Hypothesis 1a is tested using *GDP per capita* of the host economy, measured at constant prices of the year 2000, as reported in the World Bank's World Development Indicators. Hypothesis 1b is tested using several indicators of human capital. *Tertiary education* is measured as the gross enrolment ratio in tertiary education;[6] *R&D*

*expenditures* refer to R&D expenditure of the private sector as percentage to GDP; *patenting* is measured by patents granted to host country residents, scaled in patents per billion dollars, weighting them with GDP (at 2000 constant prices). The sources for these data are respectively the World Bank's Education Statistics, the World Bank's World Development Indicators, and World Intellectual Property Office's statistics.

Hypothesis 1c is tested using two institutional development variables: *Economic freedom* is measures by a subset of five items of the Economic Freedom Index from the Heritage Foundation. We selected the five items that most closely relate to the notion of institutions guaranteeing the efficiency of markets, which are: business freedom, trade freedom, property rights, investment freedom and financial freedom. *Transparency* is measured with the corruption perception index provided by Transparency International; high values of this index indicate low levels of corruption. Hypothesis 2 is tested using *trade openness* of the host economy, which is measured by the sum of exports and imports divided by GDP, which we also obtained from the World Bank's World Development Indicators.

A methodological issue in constructing these data concerns the relevant time because the underlying studies used data from different time periods. We thus constructed all these variables as the average over the data period of the underlying studies. For instance, if a study investigates FDI spillovers for the period 1995-2000, we construct averages of respective variables for this period. Where data are missing for the required time period, we use data for nearest year available. This, however, has been an issue only with the Economic Freedom Index.

***Control Variables***

The underlying studies vary in their methodologies and measurements (Görg and Strobl, 2001); we thus need to control for these issues. First, we include the log of the number of observations to control for sample size of a study. This is a major concern, as the number of observations per study ranges from 20 in Blomström and Wolff (1994) to 32,521 in Aitken and Harrison (1999).

Second, we include a dummy for panel versus cross-section studies. Cross-section studies do not permit to control for possible reverse causality as foreign investors may seek more productive industries, which may bias estimates upward (Aitken and Harrison, 1999). Third, studies vary in their level of analysis as some use firm-level data, whereas some cross-sectional studies use industry-level data. Fourth, spillovers vary with the nature of the foreign investment in the industry. In particular, foreign presence has been measured by the share in, respectively, industry sales, employment or capital. We introduce two dummies for studies using respectively the share in employment or equity capital.

Fifth, the studies by Schoors and v.d. Tol (2002), Yudaeva et al. (2003), Javorcik (2004), Liu (2008) and Halpern and Muraközy (2007) analyze both horizontal and vertical spillovers in the same regression. However, the horizontal effect may be affected by the simultaneous inclusion of vertical effects. Therefore, we introduce a dummy to control for studies that include vertical spillovers. Finally, some studies control for the effect of technology gap, which may cause variations of effects across firms within the industry (Thuy, 2005; Tian, 2007). Therefore, we include a dummy to control for these studies. This and the previous control variable are in addition to the set of independent variables used by Görg and Strobl (2001). Finally, our time trend variable refers to the median year of the data period covered, with 1970 taking the value of zero and 1995 taking the value of 25.

Table 2 presents means, standard deviations and the correlation matrix for all variables. *GDP per capita*, *transparency*, *economic freedom*, *tertiary education* and *R&D expenditures* are strongly correlated with each other. Hence, including them together in regressions may lead to biased coefficient estimates. We have thus assessed possible multicollinearity on the basis of variance inflation factor tests. These show that dropping *GDP per capita*, *transparency* and *economic freedom* removes the multi-collinearity.

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

We have used this information to design our estimation strategy. In Table 3, we estimate jointly and separately the three explanatory variables that are not highly correlated. In Table 4, we estimate the hypothesized non-linear effects controlling for *trade openness* and *patenting*.

****** Table 3 and 4 approximately here ******

## RESULTS

Table 5 presents the regression results for the linear and non-linear effect of *GDP per capita, trade openness* and *patenting*. The curvilinear effect of per capita income is tested in Model 1, where both *GDP per capita* and its square are significant at 1% significance level. This result is robust to the addition of additional variables in Models 3 to 5. This non-linear relationship between a country's level of economic development and its received FDI spillovers supports Hypothesis 1a. Hence, rising incomes in low income economies reduce FDI spillovers; only above a certain threshold does this relationship turn positive.

Figure 4 illustrates this effect of an increase of GDP per capita on spillovers by depicting the t-statistics that our regression results predict for the underlying studies. The U-shaped curve shows that low income countries such as India and China benefit

on average from FDI spillovers, but this effect declines as they advance to the levels of for instance Russia, Hungary and Mexico. On the other hand, among high income countries such as UK and USA, the curve has an upward slope. Thus, both very poor and very rich countries appear to benefit more from FDI spillovers than countries in the intermediate range.

**** Figure 4 approximately here****

Model 5, 8 and 9 (Tables 3 and 4) test for the curvilinear effect of the human capital variables, namely, *patenting, tertiary education* and *R&D expenditures*. In support of hypothesis 1b, these results show that the quadratic form of *patenting, tertiary education* and R&D expenditures are significant at 1% significance level. These results point to the curvilinear relationship between human capital and spillovers – *independent of how it is measured*. In all cases, the linear term is negative, while the quadratic term is positive. Hence, spillovers are least likely at intermediate levels of human capital.

The threshold level beyond which the significance of spillovers increases is in all cases in the relevant range of the variable.[7] The lowest effect of *patenting* occurs at 2.93 granted patents per billion USD. In our dataset, 58.63% of observations are below this critical value. The threshold for tertiary education is 32.75%, with 59.5% of observations being below this level. For *R&D expenditures*, the threshold is 1.33%, and 78.5% of our observations are below this critical value. In each case, countries below the critical value include developing economies, transition economies, and Southern European countries such as Greece, Spain and Italy.

Models 6 and 7 (Table 4) test the curvilinear effect of institutional variables, namely, transparency and economic freedom. In both cases, the linear terms are negative and the quadratic terms are positive, both significant at 1% or 5% level. Hence,

we find support for Hypothesis 1c. The curvilinear effect of economic freedom suggests that countries with a moderate degree of institutional development may least benefit from spillovers. The threshold level for the economic freedom is 52.16, with 28.1% of the observations below this level. Hence, most of the countries in our sample enjoy economic freedom above the critical level and can thus expect increases of FDI spillovers when they further enhance their institutional development.

The threshold level for transparency is 5.69, and 67.77% of the observations in the dataset are below this level. This result suggests that for high levels of corruption, spillovers are higher than at intermediate levels. At high levels of corruption, local firms may be able to shield themselves from foreign competition, and thus avert direct confrontation and being crowded out. Moreover, firms in corrupt countries may be able to use illegitimate means to attain technologies from foreign investors.

Models 3 and 4 (Table 4) test for the linear and nonlinear effects of trade openness. The linear effect in Model 3 is significant, which supports Hypothesis 2, while the non-linear specification (Model 4) is not significant. This finding is consistent with the argument that, on average, an open trade regime enables and motivates local firms to increase their productivity (De Mello, 1997; Kokko, Tasini and Zejan, 2001). This positive relationship appears to apply to all countries, contrary to the other country-level effects analyzed in this study.

With respect to control variables, our results show that studies using cross sectional data, on average, find stronger spillover effects. This finding is in line with Görg and Strobl (2001). However, in addition, we also find that studies that use industry-level data find stronger spillover effects and that studies controlling for vertical spillovers when estimating horizontal spillovers, tend to find less significant positive

spillover effects. This is a very interesting finding in that studies that do not account for vertical spillovers seem to overstate the likelihood of horizontal spillovers.

In addition to the regressions reported in Tables 3 and 4, we have tested a number of other specifications that substantively yielded the same results. For instance, a measure of secondary education yielded results very similar to those for tertiary education. We moreover run the same regressions on a subset of panel data studies only. The results are substantially identical, except that the coefficient for trade openness is not significant (possibly because of the smaller sample size). Thus, despite the 5% significance in our main analysis, we cautiously interpret this result as only weak support for Hypothesis 2.

## DISCUSSION AND CONCLUSION

*Theoretical contribution*

We have applied and advanced the awareness–motivation–capability framework of recent management research (Chen, 1996) to analyze a research question at the interface between economics and management studies, namely the reaction of local firms to inward foreign investors. This application suggests further potential for applying it to firm or industry-level studies of spillovers where more concise measures may be available. The modification required is to incorporate the potential benefits that may be gained, which relate to the size of the technology gap.

Our results support the view that FDI spillovers are influenced by the specific context of the study. In particular, we proposed that FDI spillovers have a curvilinear relation with the level of economic development, and we have assessed this proposition with respect to three dimensions of development: income, human capital and institutions (Hypotheses 1a to 1c). Hence, very poor and very rich countries appear to benefit most

from inward FDI. The consistency of the non-linear relationship across a range of development indicators provides very strong evidence in favor of our main proposition.

While these results confirm our main theoretical argument, they also raise important issues for future theory development. In particular, how do human capital and institutional development interact in building motivation and capability of local firms: are they separate effects, or is one of them mediating the effect of the others? For instance, per capita income may be mediated by human capital and institutional frameworks rather than affecting firms' productivity increases directly. Moreover, which institutions affect the motivations of local firms, and how? Applications of dynamic competition theory along these lines may further enhance the emerging institutional view of international business strategy (Peng et al., 2008; Meyer, et al., 2008).

*Policy issues*

Our study suggests that both low and high income economies are likely to benefit from FDI spillovers, yet our theoretical discussion suggests that the underlying forces creating the spillovers may be quite different. In poor countries, demonstration effects may create spillovers with little direct interfaces, while in advanced economies spillovers result from complex competitive interactions and from local firms' strategic reaction to the entry of foreign investors in their industry. This analysis highlights that policy instruments to facilitate such spillovers may need to be quite different.

Moreover, policy vis-à-vis foreign investors has to consider two effects of institutional change. Institutional development attracts more FDI, as has been shown in a number of studies using indices similar to ours, namely economic freedom (Bengoa and Robles 2003; Kahai, 2004) and corruption (Smarzynska and Wei, 2000; Voyer and

Beamish, 2004; Cuervo-Cazurra, 2006). This effect has to be combined with our result of a curvilinear relationship between FDI and spillovers to extract policy advice.

In advanced economies, these effects are cumulative: an improvement of institutions will attract more FDI, and raise the spillovers gained from any one foreign investment project. In less advanced economies, the relation is more complex, and our results suggest that policy advice may not be directly transferable. A small improvement in economic freedom, or a reduction in corruption, may reduce the spillover benefits or even turn them negative, while at the same time increasing the volume of FDI. Such countries thus have to be more cautious in designing liberalization programmes, in particular they need to avoid situations where foreign investors directly or indirectly reap the benefits of residual protectionism.

Moreover, policy makers and development scholars may be concerned whether globalization enhances or depresses spillovers. The positive effect of *trade openness* provides some support for the advocates of trade liberalization, yet it also raises the question why trade openness has a different effect than other measures of institutional development.

*Limitations and future research*

Many of the limitations of our study arise from limitations of the underlying body of empirical literature. In the Meta-analysis, we can address limitations of context-specificity and small sample biases. However, other limitations in the literature, such as issues relating to the measurement of spillovers and the need to capture firm-specific effects, remain.

Further research may 'bring the firm back' into spillover research, and investigate the characteristics of both foreign investors and local recipient firms (Meyer, 2004, 2008; Driffield and Love, 2007; Spencer, 2008). For instance, some domestic

companies may benefit from direct links to foreign subsidiaries via different non-equity agreements, while others do not have such links. Our results for control variables suggest that capital intensive foreign investors may be more likely to generate spillovers, though the effect is not significant.

Moreover, researchers may move from analyzing horizontal spillovers to vertical spillovers. Most studies in our database are designed to capture horizontal spillovers; they capture vertical spillovers only for suppliers classified in the same industry. However, most supplier relations transcend industry boundaries. Recent research using industry-level input-output data thus offers promising new perspectives (Schoors and van der Tol, 2002; Javorcik, 2004; Merlevede and Schoors, 2008). As yet there are however too few studies to conduct a Meta-analysis of these types of spillovers.

Beyond the literature on the impact of FDI, we hope that our Meta analysis methodology will be used to analyze other pertinent research questions in international business. The variation of business behavior across contexts is a central theme of international business studies, and it is an essential to establish the boundary conditions of theories in use in the field of management (Whetten, 2002). Yet, progress is inhibited by the lack of multi-country firm-level datasets, an obstacle that can be overcome by using Meta-regression analysis, as applied here.

In conclusion, we demonstrate that FDI does generate positive spillovers *under certain circumstances*. These circumstances vary with the context of the FDI. We have argued that the prime driving forces of such contextual variation are local firms' motivation and capability to react to foreign entry, which are grounded in their human capital and the institutional framework.

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**Table 1** Summary of Papers on Productivity Spillovers

| | Countries | Data year [1] | Data type[2] | Result |
|---|---|---|---|---|
| ***Developing Countries (n=23)*** | | | | |
| Blomström & Persson 1983 | Mexico | 1970 | CS | + |
| Blomström 1986 | Mexico | 1970, 75 | CS | + |
| Haddad and Harrison 1993 | Morocco | 1985-89 | Panel | - n.s. (all), - n.s. (dom) |
| Blomström and Wolff 1994* | Mexico | 1970, 75 | CS | + |
| Kokko 1994 | Mexico | 1970 | CS | + |
| Kokko 1996 | Mexico | 1970 | CS | + |
| Kokko, Tasini and Zejan 1996 | Uruguay | 1990 | CS | + n.s. |
| Aitken and Harrison 1999 | Venezuela | 1976-89 | Panel | - |
| Blomström and Sjöholm 1999 | Indonesia | 1991 | CS | + |
| Sjöholm 1999 | Indonesia | 1980, 91 | CS | + |
| Chuang and Lin 1999 | Taiwan | 1991 | CS | + |
| Aslanoglu 2000 | Turkey | 1993 | CS | + |
| Kathuria 2000 | India | 1975-89 | Panel | -/+ |
| Kathuria 2001 | India | 1975-89 | Panel | - n.s. (all), + (dom) |
| Kokko, Tasini and Zejan 2001 | Uruguay | 1988 | CS | + |
| Feinberg and Majumdar 2001 | India | 1980-94 | Panel | + n.s. (all), - n.s. (dom) |
| Rattsø and Stokke 2003 | Thailand | 1975-96 | Panel | + |
| Bouoiyour 2004* | Morocco | 1987-96 | Panel | + n.s. |
| Khawar 2003 | Mexico | 1990 | CS | - n.s., - n.s. |
| Takii 2005 | Indonesia | 1990-95 | Panel | + |
| Thuy 2005* | Vietnam | 95-2002 | Panel | + |
| Jordaan 2005 | Mexico | 1993 | CS | $\pm$ |
| Bwalya 2006 | Zambia | 1993-95 | Panel | - (dom), - n.s. |
| ***Transition Economies (n=22)*** | | | | |
| Djankov and Hoekman 2000 | Czech Republic | 1992-97 | Panel | + (all) , - (dom) |
| Zukowska-Gagelmann 2000 | Poland | 1993-97 | Panel | - |
| Konings 2001 | Bulgaria, Poland, Romania | 1993-97 | Panel | - Bulgaria, - Romania,, n.s. Poland |
| Bosco 2001 | Hungary | 1993-97 | Panel | - n.s. |
| Kinoshita 2001* | Czech Republic | 1993-98 | Panel | + n.s. (all), - n.s. (dom) |
| Sgard 2001* | Hungary | 1992-99 | Panel | + |
| Schoors and v.d. Tol 2002* | Hungary | 1997-98 | CS | + n.s. |
| Liu 2002 | China | 1993-98 | Panel | + |
| Buckley et. al. 2002 | China | 1995 | CS | + |
| Wei and Liu 2003* | China | 2000 | CS | + |
| Damijan et al. 2003 | Eight countries (Central & Eastern Europe) | 1994-98 | Panel | + Romania, - Slovenia, , n.s. six others |
| Yudaeva et al. 2003 | Russia | 1993-97 | Panel | + |
| Javorcik 2004 | Lithuania | 96-2000 | Panel | -n.s. intra-industry<br>+ backward link |
| Sinani and Meyer 2004 | Estonia | 1994-99 | Panel | + |
| Lutz and Talavera 2004 | Ukraine | 1998-99 | Panel | + |
| Vahter and Masso 2007 | Estonia | 95-2000 | Panel | + (time t), - n.s. (time t-1) |
| Wei and Liu 2006 | China | 98-2000 | Panel | + within regions |
| Wang and Yu 2007 | China | 2001 | CS | + (employment)<br>+ (capital) |
| Tian 2007 | China | 1996-99 | Panel | + (capital), + n.s. (sales), + n.s. (employment) |
| Buckley et. al. 2007 | China | 1995 | CS | curvilinear (inverse-U) |
| Halpern and Muraközy 2007 | Hungary | 1996-2003 | Panel | - n.s. |
| Liu 2008 | China | 1995-99 | Panel | - |
| **Developed Countries (n=21)** | | | | |

| | | | | |
|---|---|---|---|---|
| Caves 1974 | Australia, Canada | 1965, 67 | CS | + Australia, - n.s. Canada |
| Globerman 1979 | Canada | 1972 | CS | + |
| Liu et al. 2000 | UK | 1991-95 | Panel | + |
| Driffield 2001 | UK | 1986, 92 | CS | + n.s. |
| Girma, et al. 2001 | UK | 1991-96 | Panel | n.s. (signs vary) |
| Barrios and Strobl 2002 | Spain | 1990-98 | Panel | - |
| Girma and Görg 2003* | UK | 1980-92 | Panel | + n.s. |
| Imbriani & Reganati 2003* | Italy | 1994-96 | Panel | - n.s. |
| Keller and Yeaple 2003* | U.S. | 1987-96 | Panel | + |
| Barrios et al. 2004 | Greece, Ireland, Spain | 1992, 97 | CS | - n.s. Greece, - n.s. Ireland, + n.s. Spain |
| Karpaty and Lunderberg 2004* | Sweden | 90-2000 | Panel | + |
| Driffield 2004 | UK | 1983-97 | Panel | - |
| Girma 2005 | UK | 1989-99 | Panel | + n.s. |
| Ruane and Ugur 2005 | Ireland | 1991-98 | Panel | + n.s. |
| Barry et al. 2005 | Ireland | 1990-98 | Panel | - |
| Dimelis 2005 | Greece | 1992, 97 | CS | + |
| De Propris and Driffield 2005 | UK | 1993-98 | Panel | - |
| Driffield and Love 2007 | UK | 1987-97 | Panel | + |
| Flôres et al 2007 | Portugal | 1992-95 | Panel | - n.s. |
| Murakami 2007 | Japan | 1994-98 | Panel | - |
| Haskel et al. 2007 | UK | 1973-92 | Panel | + |

*Notes (for all panels)*:
1. Data period analyzed
2. CS = cross-sectional data;

* = unpublished studies.

**Table 2**: Correlation Matrix of Main Variables (N=121)

| Variables | Mean | st. Dev | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. t-statistic | 1.79 | 4.03 | 1 | | | | | | | | | | | | |
| 2. Spillover employment dummy | 0.30 | 0.46 | -0.023 | 1 | | | | | | | | | | | |
| 3. Spillover equity dummy | 0.35 | 0.48 | 0.101 | -0.44*** | 1 | | | | | | | | | | |
| 4. Firm level data dummy | 0.77 | 0.43 | -0.024 | -0.056 | 0.002 | 1 | | | | | | | | | |
| 5. Panel data dummy | 0.70 | 0.46 | -0.30** | -0.076 | 0.031 | 0.42*** | 1 | | | | | | | | |
| 6. Vertical spillover dummy | 0.07 | 0.26 | -0.113 | -0.047 | 0.123 | 0.155 | 0.115 | 1 | | | | | | | |
| 7. Technology gap dummy | 0.11 | 0.32 | -0.041 | -0.010 | -0.099 | -0.044 | 0.121 | -0.100 | 1 | | | | | | |
| 8. GDP per capita | 7.27 | 8.07 | -0.077 | 0.32*** | -0.120 | 0.105 | 0.130 | -0.18** | -0.109 | 1 | | | | | |
| 9. Trade openness | 0.58 | 0.36 | 0.051 | -0.064 | -0.108 | 0.34*** | 0.27*** | 0.137 | -0.089 | -0.108 | 1 | | | | |
| 10. Patenting | 5.91 | 11.21 | 0.029 | -0.101 | -0.015 | 0.159 | 0.21** | 0.166 | -0.086 | -0.022 | 0.106 | 1 | | | |
| 11. Transparency | 4.79 | 2.31 | -0.140 | 0.137 | -0.079 | 0.143 | 0.27*** | -0.123 | -0.091 | 0.82*** | 0.164 | -0.038 | 1 | | |
| 12. Economic freedom | 61.29 | 15.75 | -0.049 | 0.113 | -0.148 | 0.090 | 0.146 | -0.098 | -0.21** | 0.66*** | 0.32*** | -0.055 | 0.77*** | 1 | |
| 13. Tertiary education (%) | 26.57 | 17.84 | -0.053 | 0.049 | -0.159 | 0.26*** | 0.22** | -0.061 | -0.19** | 0.72*** | 0.29*** | 0.19** | 0.72*** | 0.66*** | 1 |
| 14. R&D expenditures | 0.94 | 0.72 | 0.058 | 0.18** | 0.005 | 0.088 | 0.2** | -0.156 | -0.094 | 0.86*** | -0.103 | 0.139 | 0.82*** | 0.56*** | 0.61*** |

Notes: ***, **, significant in 1% and 5% respectively.

1) GDP per capita is scaled per 1000 USD
2) Patents granted to residents is scaled per billion dollars
3) Corruption Perception Index varies from 0 (highly corrupt) to 10 (highly clean)
4) Economic Freedom Index varies from 0 (repressed) to 100 (free)
5) Gross enrolment ratio in tertiary education is the total enrollment in tertiary education, regardless of age, expressed as a percentage of the population in the official age group corresponding to this level of education.
6) R&D expenditures is the expenditure of the private sector as percentage to GDP.

**Table 3**: Random Meta-Analysis
Non-linear effect of GPD per capita, Trade Openness and Patenting.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| ***Country Variations*** | | | | | |
| GDP per capita | -0.032 | -0.367*** | -0.432*** | -0.459*** | -0.320*** |
| | (1.03) | (3.64) | (4.16) | (4.26) | (3.28) |
| GDP per capita squared | | 0.015*** | 0.018*** | 0.019*** | 0.013*** |
| | | (3.48) | (4.06) | (4.13) | (3.24) |
| Trade openness | | | 1.619** | 3.878 | |
| | | | (2.12) | (1.39) | |
| Trade openness squared | | | | -1.488 | |
| | | | | (0.87) | |
| Patenting | | | 0.036* | | -0.117** |
| | | | (1.91) | | (2.06) |
| Patenting squared | | | | | 0.02*** |
| | | | | | (2.81) |
| ***Controls*** | | | | | |
| Log N | 0.192 | 0.227* | 0.244* | 0.254** | 0.229* |
| | (1.41) | (1.74) | (1.93) | (1.98) | (1.84) |
| Time Trend | 0.032 | 0.036 | -0.008 | -0.007 | 0.038 |
| | (1.09) | (1.29) | (0.23) | (0.22) | (1.42) |
| Spillover employment | 0.927 | 0.671 | 0.788 | 0.693 | 0.628 |
| dummy | (1.63) | (1.22) | (1.47) | (1.29) | (1.18) |
| Spillover equity dummy | 0.529 | 0.357 | 0.715 | 0.586 | 0.225 |
| | (1.00) | (0.70) | (1.40) | (1.14) | (0.45) |
| Firm level dummy | -0.986 | -1.020 | -1.189 | -1.208* | -1.087 |
| | (1.26) | (1.37) | (1.63) | (1.64) | (1.52) |
| Panel data dummy | -0.954 | -1.415** | -1.843*** | -1.729*** | -1.243** |
| | (1.62) | (2.45) | (3.16) | (2.96) | (2.19) |
| Vertical spillovers dummy | -1.535* | -1.701** | -1.821** | -1.731** | -1.862** |
| | (1.77) | (2.06) | (2.26) | (2.13) | (2.35) |
| Technology gap dummy | 0.071 | -0.120 | 0.291 | 0.126 | -0.132 |
| | (0.10) | (0.18) | (0.43) | (0.19) | (0.20) |
| Constant | 0.666 | 1.622* | 1.497* | 1.132 | 1.738** |
| | (0.75) | (1.82) | (1.73) | (1.10) | (2.03) |
| Observations | 121 | 121 | 121 | 121 | 121 |
| $\tau^2$ | 5.344 | 4.841 | 4.543 | 4.645 | 4.408 |

Dependent variable: t-value of the spillover coefficient in studies included in the database.
Notes:
1) Absolute value of z statistics in parentheses
2) * significant at 10%; ** significant at 5%; *** significant at 1%
3) τ-squared is the unexplained between study variation. Its lower bound is zero, in which case the included covariates explain all of the heterogeneity between studies. Hence, the smaller and closer to zero this value, the better the model.

**Table 4**: Random Meta-Analysis:
Non-linear effect of institutions and human capital

| | (6) | (7) | (8) | (9) |
|---|---|---|---|---|
| ***Country Variations*** | | | | |
| Trade openness | 0.521 | 0.878 | 1.594** | 0.830 |
| | (0.72) | (1.13) | (1.98) | (1.18) |
| Patenting | 0.030 | 0.044** | 0.047** | 0.053*** |
| | (1.55) | (2.22) | (2.40) | (2.82) |
| Transparency | -1.820*** | | | |
| | (3.33) | | | |
| Transparency squared | 0.160*** | | | |
| | (3.14) | | | |
| Economic freedom | | -0.313*** | | |
| | | (2.63) | | |
| Economic freedom squared | | 0.003** | | |
| | | (2.50) | | |
| Tertiary education | | | -0.131*** | |
| | | | (3.06) | |
| Tertiary education squared | | | 0.002*** | |
| | | | (2.93) | |
| R&D expenditures | | | | -4.694*** |
| | | | | (4.44) |
| R&D expenditures squared | | | | 1.756*** |
| | | | | (4.64) |
| ***Controls*** | | | | |
| Log N | 0.088 | 0.264** | 0.201 | 0.245** |
| | (0.67) | (1.98) | (1.55) | (1.98) |
| Time Trend | 0.056 | -0.005 | 0.013 | 0.042 |
| | (1.60) | (0.16) | (0.40) | (1.32) |
| Spillover employment dummy | 0.589 | 0.726 | 0.531 | 0.609 |
| | (1.09) | (1.36) | (0.98) | (1.18) |
| Spillover equity dummy | 0.542 | 0.413 | 0.590 | 0.865* |
| | (1.04) | (0.76) | (1.11) | (1.72) |
| Firm level dummy | -0.787 | -1.317* | -1.048 | -1.492** |
| | (1.06) | (1.74) | (1.39) | (2.08) |
| Panel data dummy | -0.637 | -1.437** | -1.357** | -1.167** |
| | (1.08) | (2.42) | (2.36) | (2.10) |
| Vertical spillovers dummy | -1.621** | -1.083 | -1.928** | -2.065*** |
| | (1.99) | (1.27) | (2.32) | (2.59) |
| Technology gap dummy | 0.063 | -0.049 | 0.177 | 0.406 |
| | (0.09) | (0.07) | (0.25) | (0.61) |
| Constant | 4.201*** | 9.696*** | 1.584* | 1.571* |
| | (3.02) | (2.75) | (1.69) | (1.83) |
| Observations | 121 | 121 | 121 | 121 |
| $\tau^2$ | 4.737 | 4.915 | 4.839 | 4.354 |

Notes se Table 3.

***Figure 1:*** *Likely spillovers from foreign investment in an industry*

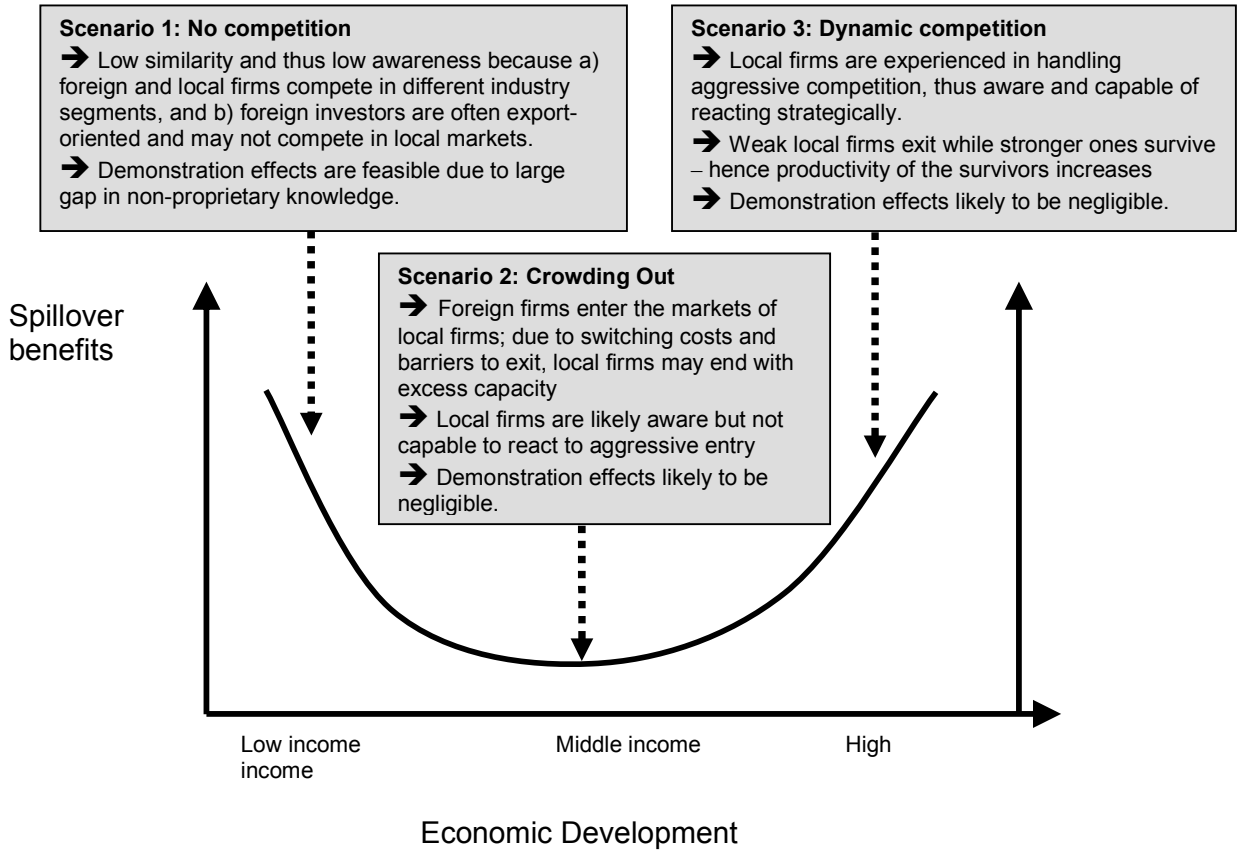


***Figure 2**: Evolution of spillover effects over economic development*

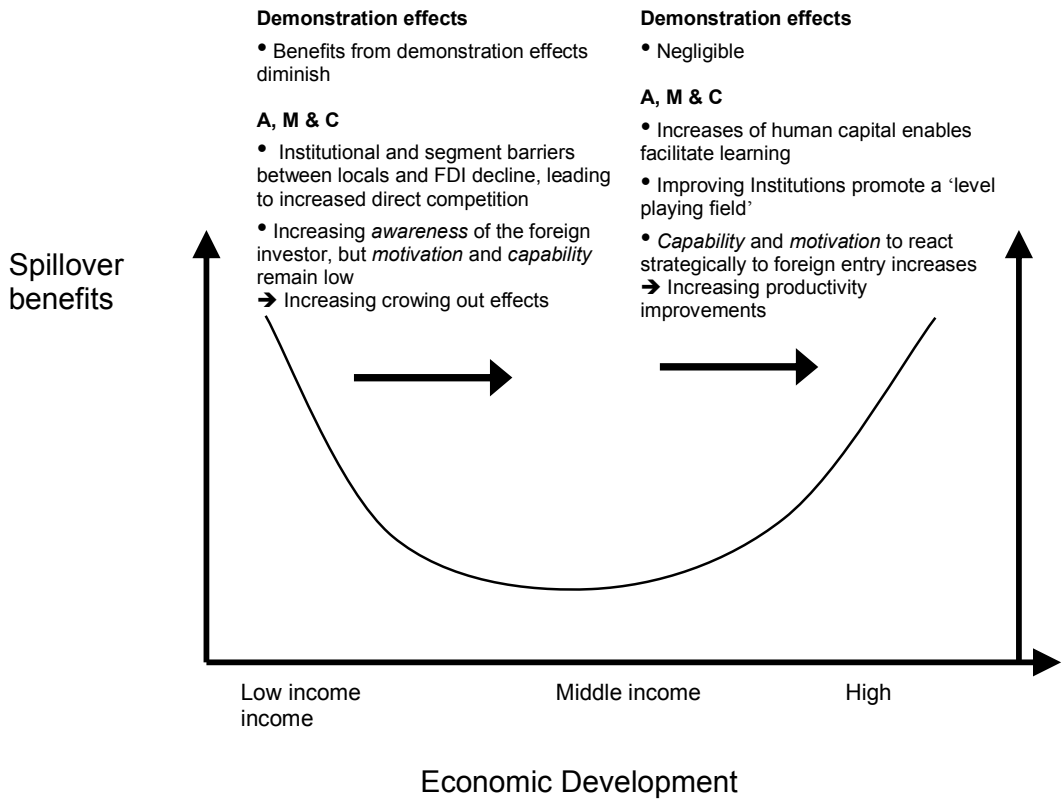


***Figure 3*** *Moderating Effects of Contextual Variables on FDI Spillovers*

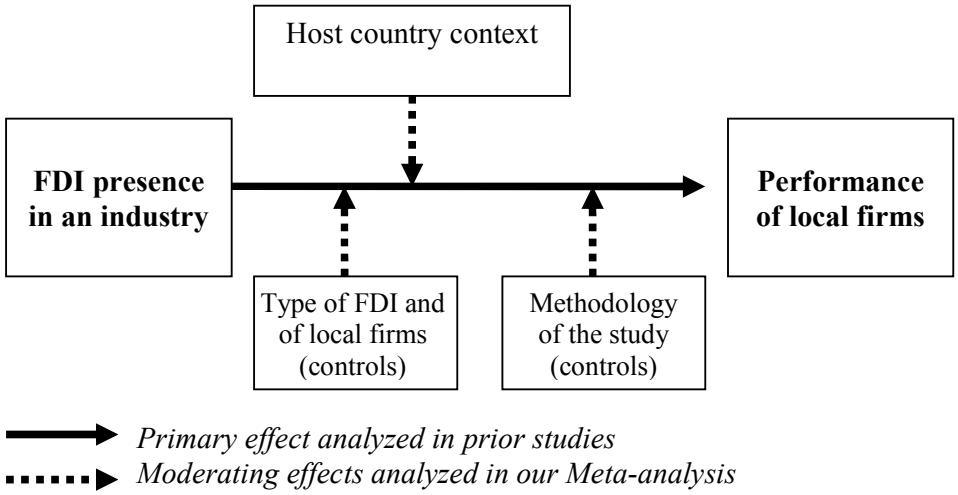
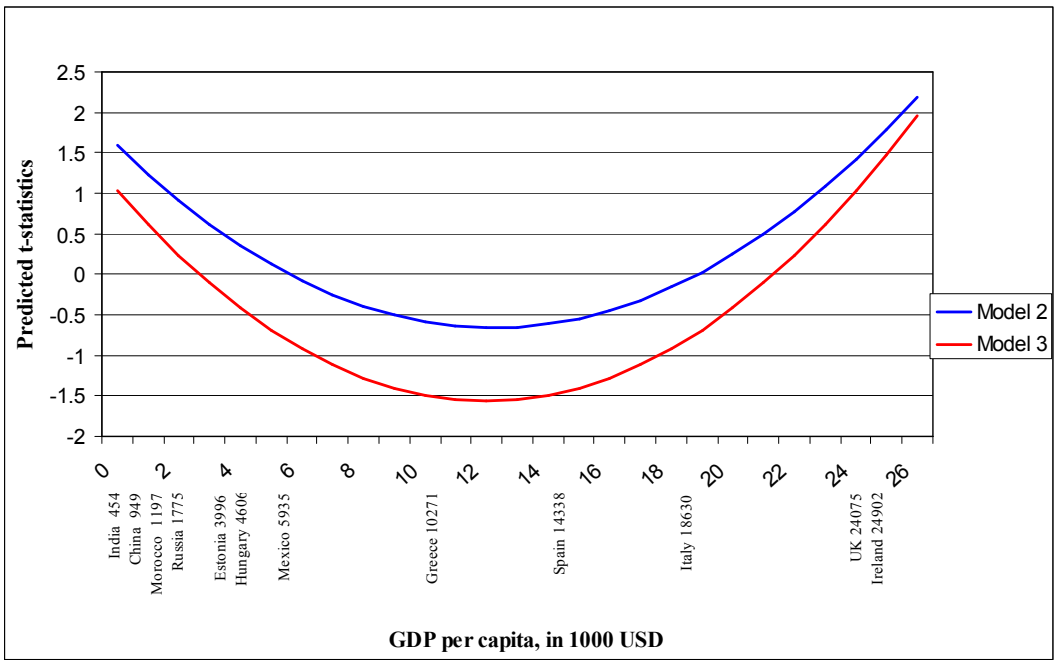



***Figure 4:*** *The effect of per capita income on the significance of FDI spillovers*




Note: This figure has been constructed by inserting GDP per capita values on models 2 and 3 in Table 6, while keeping the other variables at their median value. All GDP per capita values have been deflated to the year 2000.

## Endnotes

[1] Studies based on firm-level data from multiple East European countries find varying results across countries. Konings (2001) suggest that the negative effects for Bulgaria and Romania are attributable to the fact that in the early stage of transition the competition effect dominates. Other authors do not provide theoretical reasoning as to why spillovers would vary across countries (Damijan et al., 2003; Barrios et al., 2004).

[2] 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 66.

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

[4] Including the outliers in the analysis results in more significant spillover and firm level dummy estimates. Therefore, we opt for dropping them from the empirical analysis.

[5] For studies that report absolute values of t-statistics, we obtain its correct sign from the reported coefficient of the spillover variable.

[6] *Tertiary education* is the total enrollment in tertiary education, regardless of age, expressed as a percentage of the population in the official age group corresponding to this level of education.

[7] The critical value is $\frac{\partial Y}{\partial \Gamma_c} = \hat{\alpha}_3 + 2\,(\hat{\alpha}_4 * \Gamma_c) = 0$, where $\hat{\alpha}_3$ and $\hat{\alpha}_4$ are the respective regression coefficients in model 5, Table 6, and models 6-9 in Table 7.