

**A Firm-Level Analysis of Technological Externality of Foreign  
Direct Investment in South Africa**

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**Abstract**

This paper examines how Foreign Direct Investment (FDI) impacts on productivity performance in host economy by raising and addressing two key questions: (i) To what extent does technological externality of FDI (FDI Spillover) rely on host economy's skill deficiency characteristic before it can be generated and appropriated? (ii) Is there a regional dimension to the level of spillovers from multinationals to domestic firms? Using establishment level data for the South African economy, we estimate regression equations for a representative sample of her manufacturing plants. Our findings reveal that regardless of the environmentally imposed skill deficit factor, foreign firms are able to generate productivity spillovers for their host. Successful diffusion to domestic firms is however mediated and significantly circumscribed by the skill factor. It also appears that some support exists for the claim that level of FDI spillovers to domestic firms relies on regional presence, i.e. closeness to the region in which foreign firms locate.

**Keywords:** Foreign Direct Investment Spillover, Technology Transfer, Skill Constraints, Agglomeration Economies.

**JEL Classification:** F21, F23, O24, R39

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## **1. Introduction**

For much of the developing world, the decade of the 1980s was a turning point in experimental economics as market pessimism gave way to measured optimism in development policy engineering. The abandonment of import substitution strategies that were principally influenced by the dependency and Neo-Marxist theories of earlier decades saw governments across the South adopting many of the neoliberal policies of open and free market orthodoxy. As a major pillar of this new economic model, attracting foreign direct investment (henceforth, FDI) into the local economy became a policy priority for many governments. Consequently, varieties of generous investment incentive packages were developed by these governments in order to turn their economies into attractive destinations for investors.

For South Africa, this has been especially the case since the dismantling of Apartheid and subsequent formation of the democratic government in 1994. With her new found status as an integrated member of the global economy, the country joined the club of FDI contestants through its pronounced Growth Employment and Redistribution (GEAR) strategy in 1996. Several inducement packages were introduced at both national and provincial levels of governments to foster the growth of national stock of foreign capital. Besides being a signatory to the Trade Related Investment Measures (TRIMS) Agreement as well as over 30 bilateral investment treaties that have, as priorities, increasing the national stock of FDI, there were, as at 2004, more than 35 investment incentive schemes in place across the country (Gelb and Black, 2004).

A key motivation for these efforts by the South African authorities hinges around a widely held but controversially substantiated notion that there is a technological externality to FDI. Commonly referred to in the literature as FDI spillover, its proponents have argued that domestic economies in general and their firms in particular stand to reap technological reward from the activities of foreign multinationals (MNCs) operating in their countries. Despite the intuitive appeal of this claim, empirical analyses to date have yielded mixed results (Crespo and Fontoura, 2007). To improve our understanding on what currently appears to be an impasse some analysts have called for more detailed investigations that involve for instance, adopting an analytical framework which incorporates spillover promoting/inhibiting specific national factors (Lipse, 2002), as well as employing appropriate data, that is

generally considered to be panel data with disaggregation at the firm level (Gorg and Greenway, 2001).

Past efforts at explaining the incidence of FDI spillover in South Africa have generally relied on aggregated country or industry level data to confirm its positive impact (Fedderke and Romm, 2006; Gelb and Black, 2004). However, it is now known that relying on results obtained with aggregated data at a macro as opposed to micro firm-level template may not provide an accurate understanding of FDI gains, especially if the observed positive impact at national or industry level also comes with negative distributional implications. For instance, it is quite possible that by virtue of location specific attributes such as agglomeration, productivity gains attributable to FDI at a more aggregative macro level only accrue to a subset of firms within the entire national population. Or even if all firms were to benefit, chances are also there that these benefits will not be evenly spread across board. A scenario of this sort presents a distributional distortion that in the views of Crespo and Fontoura (2007) calls for research attention. In articulating their argument the authors made the following remark:

...although FDI may work as a convergence mechanism at the national level, if it produces significant gains in efficiency for domestic firms, it can also increase domestic inequalities at a regional level. This is a result that certainly justifies further research (Crespo and Fontoura, 2007: 417).

Another limitation with current evidence from South Africa is that to date there has been no visible attempt at accounting for factors that promote or inhibit spillover occurrence especially with respect to the role of environmental specificities that Lipsey recommended. Yet it is well known also that the South African economy, like those of other developing ones, is encumbered with many deficient characteristics, among which skilled manpower shortage occupies a pride of place. Indeed, as recently as 2009, a report carried on the website of Grant Thornton cited International Business Report as finding for the third consecutive time that skill shortage remains the greatest constraint to business growth in South Africa (Grant Thornton, 2009). There are also several Survey Reports produced by both local and international organizations that have documented the acuteness of manpower shortage in the economy<sup>1</sup>. As we shall see later in this paper, if theoretical predictions of the implications of skill shortage for FDI spillover are anything to go by, an investigation of the impact of foreign capital on productivity performances of South African firms would surely be a revealing exercise.

In the light of all these considerations, we are inclined to define research questions to be investigated in ways which depart from previous attempts as follows: (i) To what extent does FDI spillover rely on host economy's skill deficiency characteristic before it can be generated and appropriated? (ii) Is there a regional dimension to the level of spillovers from multinationals to domestic firms? To address these issues, we estimate regression equations for a representative sample of South African manufacturing firms using information obtained from World Bank Enterprise Survey database. Our findings reveal that regardless of the presence of this environmentally imposed constraint, foreign firms are able to generate technological spillover for their host. Successful diffusion to domestic firms is however, mediated and severely circumscribed by the skill deficiency factor. Furthermore, support for the claim that level of FDI spillovers that diffuses to domestic plants relies on regional presence is weakly revealed in our evidence.

This paper is organized in six sections. We start with a review of relevant literature in Section 2, followed by motivation and specification of all hypothesised relationships in Section 3. In Section 4 relevant issues around model specification are treated alongside data and variable construction before presenting results in Section 5. The final section summarises and presents the paper's concluding remarks.

## **2. Skill Constraints, Agglomeration Economies and Technological Externality of FDI Debate**

**The Basic Argument:** Despite its recognition in early attempts to explore the impact of FDI on host country's economic performance, the productivity spillover dimension did not receive a formalised comprehensive theoretical treatment until the late 1970s when contributions from experts like Findlay (1978), Koizumi and Kopecky (1977) and Das (1987) among others began to appear in the literature<sup>2</sup>. In their various quests to explain the complex mechanism that generates the so-called "positive contagion" effect of foreign capital on host productivity, a very plausible but refutable proposition was made.

Assume as it is argued to be the case that foreign capitals of MNC subsidiaries embody some firm specific assets otherwise called technological advantages. Being backward offers the domestic firms in the FDI importing country an advantage to bring own technology level to those of their resident foreigners as long as they can capitalise on the now available opportunity to copy or learn from the advanced technology of MNCs. The importance of relative backwardness is very much emphas-

ised as a key determinant of potentials to close the technology gap. Thus the lower the host's technology level relative to the foreigner's, the better the chances and magnitude of successful technology diffusion. In the final analysis, the model has prediction to the effect that the larger the host's stock of foreign capital relative to domestic ones the higher the rate of her technical progress.

After nearly four decades of empirical research, it is hard to find concrete evidence in support of this prediction. In fact available evidence seems to weigh heavily against it. In a fairly recent survey of the literature, Gorg and Greenway (2001) reported that most works failed to find positive spillover impact of FDI while evidences of negative spillover were even discovered in a good number of studies. With regards to studies in the survey that used firm-level panel data which is generally considered to be the appropriate technique of inquiry of this kind, only 2 out of a total of 16 found significant positive spillover effect. Five of these studies found negative impact while the rest could not establish any statistically significant relationship between FDI and domestic firms' productivities.

**Local Environmental Conditions, Skill Shortages and Agglomeration:** Attempts to make sense of these divergent results have seen critics launch a two-pronged attack on both theoretical and empirical fronts. Those who grudge the theory argue that technological diffusion does not only depend on relative backwardness of FDI importer but also on a number of other host's economic characteristics. In what can be described as a non mainstream explanation Marin and Bell (2004) argue that certain aspects of the local environment that create constraints and opportunities for MNC subsidiaries do matter for FDI spillover occurrence. In their unconventional exposition, the authors present a framework which conceptualises a typical MNC subsidiary as a knowledge creating entity and not, according to conventional model, a passive knowledge transferring intermediary that simply receives knowledge initially created outside by its parent company and delivers it to beneficiaries in the host economy. In this view, if local environmental conditions like socio-political system, labour markets, skill structures and infrastructures are not supportive of the knowledge creation process, no spillover will be created let alone appropriated. A particularly striking aspect of their contribution lies in the message that it is what the MNC subsidiaries actually do in the host country as may be revealed in knowledge-creating and knowledge-accumulating activities as well as embeddedness in linkages with domestic firms that matter for spillover. Since these

activities are essentially independently driven at local levels and not dictated or directed from headquarters we are reminded by the authors that the mere existence of MNC subsidiaries is not what is really important for technology to be generated and its value appropriated.

But while this brand of argument relates to the supply-side of spillover another paradigm as revealed in works on absorptive capacity focuses on demand side with similar conclusion that local environmental conditions like those mentioned above must be right before there can be incidence of spillover (Wang and Blomstrom 1992; Perez, 1997; Kinoshita, 2001; Hermes and Lensink, 2003). Also, Baskaran and Muchie (2009) suggest that weak national system of innovation is linked to low absorptive capability of technology spillover from FDI. They established possible relationships between the characteristics of a National System of Innovation (NSI) and their impact on FDI outcomes, particularly in developing countries. They employed a heuristic NSI-FDI conceptual framework linking the robustness of NSI to the benefits or lack of it from FDI and applied this to analyse descriptive data from selected developing economies – China, India, South Africa, Ghana, Ethiopia, Tanzania and Zambia (Baskaran and Muchie, 2009; Muchie and Baskaran, 2009).

The concept of absorptive capacity as argued in many of these contributions actually presupposes that spillover does not accrue in a vacuum. Rather, it is influenced by certain capacity related characteristics of the host. This capacity can be thought of in terms of a required threshold in the level of development (Xu, 2000), especially as it relates to the skill quality of labour force (Blomstrom *et al.*, 1994; Kokko and Blomstrom, 1995). Whereas the requirement of relative backwardness presupposes the existence of some technology gaps between the MNCs and their hosts before spillover can materialise, the argument that a threshold in level of labour force's skill is needed suggests that this gap should not be too wide. When it is too wide, as may be captured in say, relatively highly unskilled (or acute shortage of skilled) labour force, the prospect of the host's firms engaging moderately skilled workforce with capacity to copy and adapt the technology of MNCs for their own purpose will be impaired. Conversely, a relatively moderate gap with sufficient assurance that the host's workforce is in possession of the right quantum of skill needed to internalise the foreigners' best practices will ensure successful diffusion. This argument would lead us logically to view differences in skill level of workforce or national absorptive capacities in general as one possible explanation for the divergent results that are revealed in the literature.

In the context of South Africa therefore, one may be tempted to suspect that her problem of inadequate supply of skill manpower would definitely constitute an inhibiting force to the realisation of FDI spillover in the economy. But while this may be a significant problem in its own right there are also other environmental factors that either place significant demand on skill requirement as a key factor in FDI technology diffusion or raise the stake for investing in its supply. On the demand side, the capital intensive nature of FDI that the country has attracted over the past years places relatively enormous demand on highly skilled workforce before knowledge can be generated and transferred. As Figure 3 reveals for instance, the distribution of foreign firms is positively skewed in favour of the more capital intensive and skill demanding sectors like Motor Vehicle, Chemical & Allied Products, Electrical & Electronics and Machinery. On the supply side, it can be argued that the prevalence of such national calamities as crime and AIDS creates uncertainties and prevents medium and long term commitment of firms by discouraging investment in training and development of staff. Despite her problem of skill shortage a recent World Bank Report reveals that relatively few firms in the country, in comparison with other countries like China and Brazil, have training programmes for their staff. About 45 per cent of firms interviewed had expressed concern over the impact of the AIDS epidemic and that this concern had a strong impact on their investment (Clarke *et al.*, 2005).

But recent development in the of analysis of skill factor as an element of absorptive capacity has shifted the focus beyond national level accounting to that of a sub-regional one and in the process draws attention to the possibility of a regional bias in FDI spillover effect. It is being claimed that its occurrence may vary among the constituent regions of a nation depending on the skill characteristics of regional workforces. The implied hypothesis that we may expect to associate regions with high level of educational attainment or sufficient presence of skilled workforce with successful FDI technology adoption and those with low level or insufficient presence with limited success at best has been confirmed in some studies (Ponomareva, 2000; Yudaeva *et al.*, 2003).

Reinforcing the above allusion to regional distortion in spillover effect is the argument of those who model economic geography as a determinant of technology diffusion. According to this view, there are several reasons to expect that all regional constituents of a nation will not benefit in equal measures from the activities of MNCs. Some of these include: (i) both demonstration effects and mobility of labour from

foreign to domestic firms which constitute two key channels of technology transfer may be confined to local areas where MNCs are located; (ii) due to transport costs, vertical linkage that is also another source of technology diffusion may be bounded in space. Since all these factors operate in favour of those native firms with significant presence in or around the regions where MNCs are present the expectation follows that much of the technology that will diffuse to domestic firms will be confined to these regions. Several authors have pushed this argument beyond mere rhetoric by empirically showing that FDI spillover has a circumscribed regional dimension (Renato, *et al.*, 2007; Torlak, 2004; Girma, 2003; Girma and Wakelin, 2001).

With respect to the empirical evidence, the major issues that have arisen are centred on appropriateness of research design employed in many of the studies. For instance, the use of aggregate country or industry level data which appears to be popular with spillover empirical studies rather than firm level ones does not allow for detailed investigation by controlling for other factors (Gorg and Strobl, 2001). As further pointed out by Gorg and Greenway (2001), the notion of building empirical conclusions around cross-sectional as opposed to panel data evidence that is the case with many of the existing investigations does not allow the time variant nature of the studies to be captured. A final aspect of empirical inadequacy is implied in Lipsey's recent suggestion that a detailed analysis of the different circumstances and policies of countries, industries and firms that promote or obstruct spillovers is needed for better understanding of how FDI impacts on productivity (Lipsey, 2002).

**South Africa-based Studies:** A literature survey of FDI spillover studies that have so far been conducted for the South African economy reveals that the emerging body of evidence still has much to learn from many aspects of the critics' arguments mentioned above. For instance, in Fedderke and Romm (2006), spillover was modelled in a growth accounting framework using aggregated data at national level to confirm its positive impact. Gelb and Black (2004) represents another attempt at accounting for the incidence of spillover by using statistical averages at sector level to shed some lights on MNC subsidiaries' expenditure on training and human capital development in South Africa. As these studies neither accounted for the role of environmental specificities such as skill constraint factor nor employed firm level data as we did in this paper, the departure and relevance of our study has hopefully been well established.

### **3. Main Hypotheses**

All the hypotheses investigated are inspired by the basic theoretical proposition that foreign capital generates technological returns for the host economy and empirical convention which captures this argument in terms of some qualified pattern of relationship between proxies for foreign presence and productivity performances in the economy.

Following Aitken and Harris (1999), the productivity spillover of FDI can be measured at both plant and industry levels. In the former case, if foreign capital embodies advanced technology we should, other things being equal, associate establishments with foreign presence with significant productivity gains. But all things are not equal in a skill constrained economy. It is arguable that as a result of skill shortage, enterprises' chances of engaging employees with the right kind of skills needed to internalise the foreign technology will be constrained. However, we argue here that inability to attract skilled workforce will hardly constitute a significant problem for the MNCs. Because of their better incentives, they can price out their domestic counterparts from the marginal skilled labour market that exists thereby equipping own plants with capable hands<sup>3</sup>. We have come to know as well that when skill shortage is the problem, MNCs do provide training for employees in order to raise their level of competence to that required by them. Hence, our first hypothesis will not depart from conventional wisdom which says:

Hypothesis 1: Plant level foreign presence is positively related to productivity performance and those with more foreign equity participation should exhibit higher productivity performances than their comparable domestic counterparts.

In the latter case, economists have proffered several reasons why the presence of foreign technology in an industry should have a positive contagion effect on domestic technology of the industry. First, the demonstration effect makes it possible for domestic plants to imitate or copy the technological practices of their foreign competitors (Wang and Blomstrom, 1992; Barrios and Strobl, 2002). Second, workers from MNC subsidiaries can move to local companies and in effect deploy the skill and knowledge they acquired in the former for the latter's benefit (Glass and Saggi, 2002). Third, vertical linkages by foreign firms with local suppliers or customers also afford the natives the opportunity to learn the best practices.

All these various channels of technological leakages have implicit assumptions that learning, on the part of domestic firms' employees, is concurrently and effortlessly taking place. But this may not be so if by virtue of skill shortage in the economy these plants are unable to engage the right calibre of workers. This is likely to be so especially if the MNCs completely absorb all of the marginal skill manpower that exists in the economy and jealously guard them from leaving to work for domestic competitors. Employees with inadequate skills will almost certainly have difficulty copying or imitating the advanced technological practices of MNCs. In similar manner domestic suppliers/customers with poorly trained staff who interact with foreign companies may practically learn little or nothing from their interaction<sup>4</sup>. All these blur the chances that technology will get transmitted through the previously discussed channels. Hence the question of how well externalised foreign knowledge gets diffused to the locals is now a question of how well the locals are prepared to make the right kind of investment in human capital in order to increase their absorptive capacity. Those who invest well enough are more likely to do a better job attracting capable hands and absorbing foreign technology than their counterparts, other things being equal. Hence the second hypothesis for investigation can be stated thus:

Hypothesis 2: Domestic firms with relatively highly skilled workforce are more successful in absorbing technology spillover from resident MNC subsidiaries.

Finally, it is understandable to have some people argue that levels of technology that do spillover to domestic establishments have a regional tone. This is simply because by virtue of possession of certain competitive attributes some regions are relatively better at attracting manufacturing activities to their areas. These attributes as may be revealed in the presence of better economic infrastructures or as the New Economic Geography literature would have us believe, access to certain external economies confer some significant economic advantages on the locals. For instance, being close to regional clusters may facilitate access to common pool of skilled labour or enhance knowledge linkages among management staff. Linkages with suppliers/distributors are also other sources of external economies that come with agglomeration. If foreign firms are driven to locate in this type of region, as it is likely, then for the simple reason that proximity enhances the effectiveness of technology diffusion channels we may expect to observe domestic firms in the region absorbing more of the spillover returns than their counterparts

elsewhere<sup>5</sup>. For instance, effective capture of the diffusion benefits of demonstrating a new product or production process favours those that are closer to the place where such demonstration takes place. Also, if a highly skilled MNC employee decides to leave and transfer the knowledge he has gained to domestic firms it is the ones located nearby that stand the better chance of engaging his service. Furthermore, linkages with local suppliers and distributors may be limited to the region because of transportation cost. The hypothesis therefore is that:

Hypothesis 3: The level of spillover absorbed by domestic establishments is greater for those located in regions with more foreign presence.

#### **4. Model Specification, Data and Variable Construction**

**The Model:** The validity or otherwise of these hypotheses were tested by specifying and implementing an augmented Cobb–Douglas production function incorporating spillover and other productivity enhancing variables for a sample of South African manufacturing firms. We also included as controls other environmental constraints that appear to be of equal importance as skill shortage. Generally, the model estimated is of the form:

$$Q_{ij} = C + \beta_1 X_{ij} + \beta_2 Pe_{ij} + \beta_3 Ec_{ij} + \beta_4 fpp_{ij} + \beta_5 fpind_j + \beta_6 aggl_{ij} + e_{ij} \dots\dots\dots 1$$

where:

- $Q_{ij}$  = output for plant  $i$  in industry  $j$
- $X_{ij}$  = vector of production input for firm  $i$  in industry  $j$
- $Pe_{ij}$  = vector of other productivity enhancers that include human capital/skilled labour
- $Ec_{ij}$  = measure of other environmental constraints
- $fpp_{ij}$  = measure of foreign presence at plant level
- $fpind_j$  = measure of foreign presence at industry level
- $\beta_6 aggl_{ij}$  = measure of foreign presence at industry level in regional location.
- $e_{ij}$  = usual error term

For impact on domestic firms' estimations both dependent and control variables only reflect data for domestic firms as required by hypotheses 2 and 3.

In the above specification, output is assumed to be a function of not only measures of input variables but also different measures of spillover, environmental constraints, agglomeration and other productivity influencing factors. The coefficients of variables of interest (spillover) shall be interpreted as evidence of the impact of foreign presence, which may confirm or refute our hypotheses. Data for the equation (Eq. 1) which represents the basic model for estimating several regressions in accordance with the dictates of our hypotheses have been expressed in the log-liner form and Ordinary Least Square technique is employed all through. The data and preliminary evidence arising from casual analyses that were performed are discussed next.

**Data and Preliminary Evidence:** Data for the investigation come primarily from The World Bank Survey of Enterprise in South Africa. The said Survey was conducted and completed for about 800 establishments between January and December 2004. A stratified random sampling methodology that generated 603 manufacturing establishments from the 800 that were sampled was followed. The framework of the said sampling technique was carefully designed to generate large enough sample size for a given industry. Level of precision with respect to both estimates of population proportion and mean of log of sales at industry level was fixed at 7.5 per cent for 90 per cent confidence interval. This simply suggests that except in 10 per cent of the cases there is a guarantee that the population parameter will be within the 7.5% range of the observed sample estimate<sup>6</sup>.

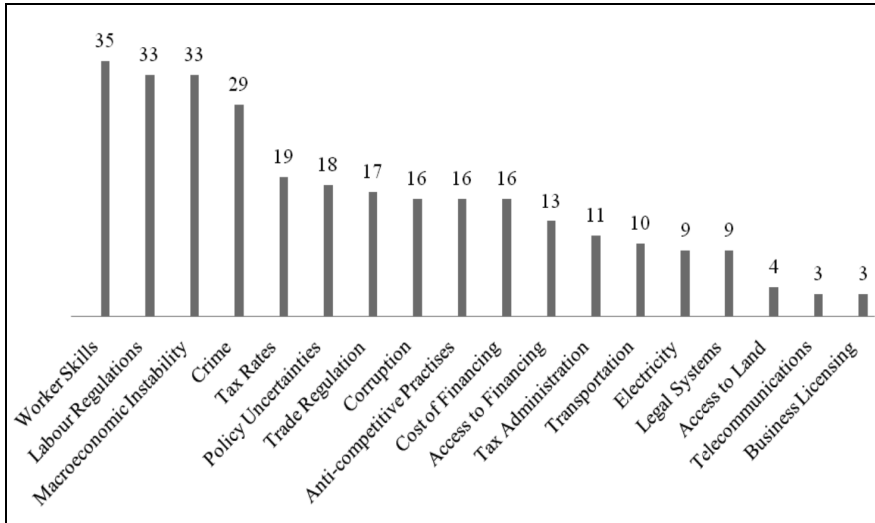
The unit of analysis was the establishment defined as a factory, store or service outlet with own accounting identity and formally registered with the Department of Trade and Industry<sup>7</sup>. For the purpose of this research the words establishment, firm and plant will be used interchangeably to refer to this conception. The Survey which covers a three year period from 2000 to 2002 is cross-sectional meaning that we are constrained into using cross-sectional data in this analysis. Plants included in the exercise are mainly those with employment figures of 10 or more, although there are few cases of microenterprises where staff strengths are below 10 in number. The sectoral orientation of the manufacturing establishments that are the focus of this analysis corresponds to the ISIC revision 3.1 and only plants from 11 sectors that include Garment & Textile, Paper, Printing & Publishing, Food & Beverages, Rubber & Plastic, Electrical & Electronics, Wood & Carpentry, Chemical & Allied Products, Machinery, Furniture, Motor Vehicle and Other Manufacturing are taken for the investigation. After dealing with the

problem of imperfect data we were left with 455 and 302 observations respectively for plant level and domestic level foreign presence estimations. Summary statistics with respect to variables used are provided in Table 1.

From the preliminary analysis of sampled evidence as revealed in the data we are able to confirm the validity of some of our underlining assumptions in this investigation. For instance, with respect to skills shortage, besides being the one environmental factor perceived by most South African manufacturing establishments as constituting the most serious obstacle to the smooth operation of their businesses, the problem is also found to have revealed the economy, as relatively uncompetitive among a comparator group of economies. A cursory look at Figures 1 and 2 below tells this story more. It is easy to observe from Figure 1 that more plants rated Workers' Skills as a Major or Very Severe Constraint to doing business in South Africa than any other investment climate constraint. Further, a multi-country comparison of plants identifying Labour Skill Level as a Major Constraint to their operation as given in Figure 2 also shows that nowhere except Brazil are more plants dissatisfied than South Africa.

It also appears that the two phenomena of capital intensity and plant productivity are positively associated with the incidence of foreign presence. In Figure 3 where distribution of foreign firms alongside sectoral line is given, it can be seen that two of the highly capital intensive sectors (Motor Vehicle and Chemical & Allied Products) reveal the highest levels of foreign penetration whereas the more labour intensive ones (Furniture and Wood & Carpentry Sectors) reveal some of the lowest levels. This is consistent with the finding in Fedderke and Romm (2006). Furthermore as contained in Figure 4 where the productivity dimension of this relationship is shown, it seems that there is a positive association between sector-level foreign presence and productivity: the three most productive sectors (Rubber & Plastic, Motor Vehicle and Chemical & Allied Products) are the sectors where foreign presence is most pronounced. On the other side, the lowest productivity performance is observed in the Furniture Sector with the least level of foreign penetration<sup>8</sup>.

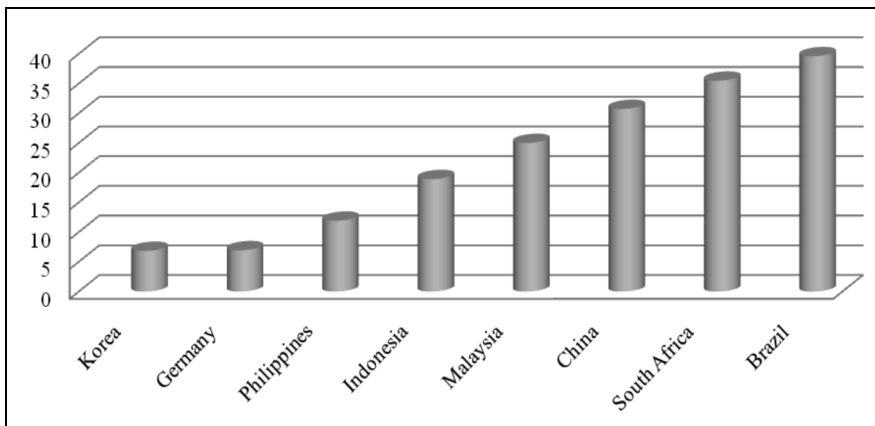
**Figure 1: Percentage of South African Manufacturing Firms in 2002 rating Investment Climate Factors as Major or Very Severe Constraints**



Source: World Bank Enterprise Surveys;

Note: Values are in Percentage

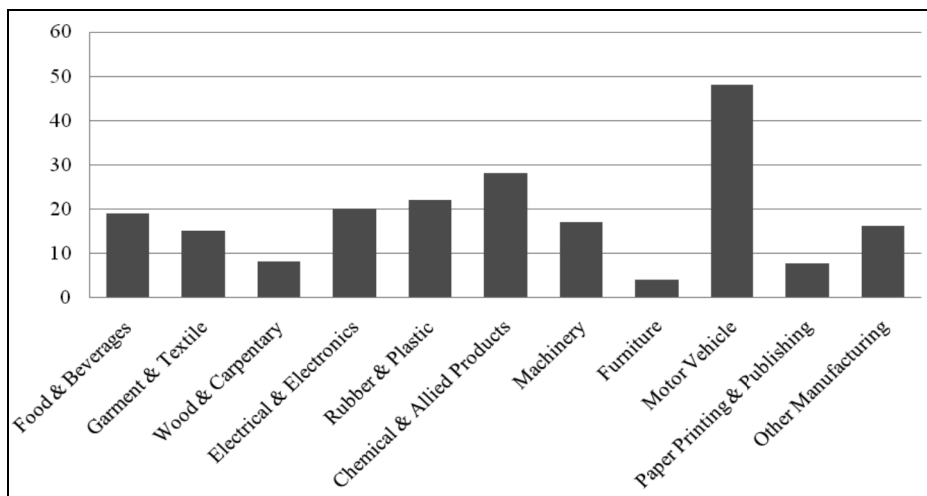
**Figure 2: Percentage of Firms in each Country identifying Labour Skill Level as a Major Constraint**



Source: See: <http://www.enterprisesurveys.org/>

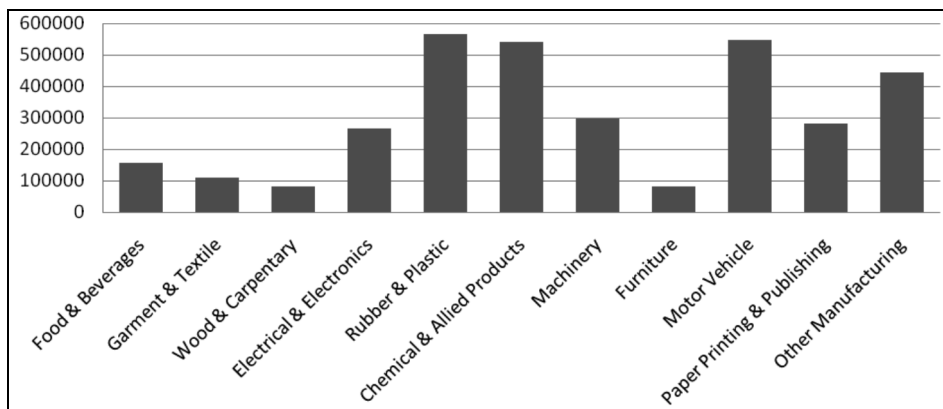
Note: For all countries data are for 2003 except Germany and Korea (2005) as well as Malaysia (2002)

**Figure 3: Percentage number of Foreign Firms in each Sector**



*Note:* Firms with ten percent or more foreign equity participation are classified as foreign

**Figure 4: Average Productivity in each Sector**



*Note:* Figures which are defined as market value of output divided by total number of workers are for the year 2002 only.

**Variable Construction:** Following standard practice the dependent variable is defined as the value of output. As measures of input factors, three variables have been included in the estimation. These are capital, labour and material. Capital is generated using information on plant fixed assets. It is calculated as the value of rent paid for machinery and equipment or value of depreciation incurred on owned assets. Labour is as usual defined in terms of the average number of workers (temporary and permanent).

Other productivity influencing variables that the literature suggests can be thought of as comprising various forms of knowledge factors that confer marketplace competitive advantage on firms over their rivals. Such knowledge can be acquired either through exposure gained as a result of exporting activities or through transferred technology from investment in plant and machinery. It could also become incumbent on an organization because such organization is driven by employees with more sophisticated skill background. The inclusion of this variable is very central to our analysis. These different sources have been captured by three different measures of productivity enhancing variables, viz, export intensity, investment in plant & machinery and human capital. Export intensity is defined as the percentage of establishment's sales exported directly. We measured investment in plant and machinery as the ratio of plant's new expenditure on machinery and equipment to output. Finally, proceeding from the logic that skilled workers attract relatively high wage compensation and that we should naturally expect the two events (skill and high wage bill) to coincide, human capital has been captured as the average wage bill of the firm. It is expressed as the ratio of a firm's wages to total number of employees. All these measures like measures of production input are expected to show positive associations with productivities.

The other environment specific constraints which appear to be of equal importance as skill in the data that were controlled for are: macro economic instability, labour regulation and crime. From the information provided in Figure 1 at least 29 per cent of firms interviewed rated each of these factors as Major Obstacle. Three variables captured in categorical terms *ecm*, *ecl*, and *ecc* proxy for the different influences of macroeconomic instability, labour regulation and crime respectively. A value of 1 was assigned if respondents considered any of the three factors a severe or very severe constraint and 0 otherwise. All these variables should be negatively related to productivity.

With respect to the spillover variables, foreign presence at plant level (*fpp*) is defined as the level of foreign participation or percentage of equity share capital owned by foreigners in a plant. The value varies between 0 and 100 per cent. Its coefficient is expected to turn up with a positive sign. The industry level version capturing the degree of foreign penetration in an industry (*fpind*) is measured by the share of foreign firms' employment in industry employment<sup>9</sup>. It can be gleaned from our previous argument in hypothesis 2 that this variable will not ordinarily impact positively on domestic firms' productivities unless it is adjusted for skill influence. Consequently it is interacted with the human capital factor to produce another variable termed *fpind\*human k*. Unlike the expectation we have for the impact of its less refined counterpart this one should positively associate with productivity. Finally, to capture the influence of regional concentration of foreign firms we introduced the variable termed *aggl* which is defined as the proportion of sectoral employment accounted for by foreign firms in a region. Consistent with its motivation, if regional agglomeration matters for FDI Spillover, its coefficient should be positive.

**Table 1: Summary Statistics**

<b>Variables</b>	<b>Observation</b>	<b>Mean</b>	<b>Std. Dev</b>
output	455	2.66	1.79
output (dmstc)	302	3.01	2.56
k (capital)	455	2.97	1.68
l (labour)	455	3.34	0.33
m (material)	455	4.67	1.50
human k	455	2.82	1.97
invest in mach	455	0.49	0.67
export Intensity	455	-0.45	0.37
ecl	455	0.18	0.25
ecm	455	0.15	0.30
ecc	455	0.37	0.44
spillover (fpind)	455	1.43	1.14
spillover (fpp)	455	0.96	0.12
aggl	455	0.39	1.74

## **5. Results**

Results of regressions estimated to address issues raised above are presented in Tables 2, 3 & 4. In the estimation that was carried out heteroscedasticity problem was dealt with by estimating variance-covariance matrices along the line suggested by White. From the output of all three regressions, the Ramsey RESET set assures us that misspecification should not be a major worry. Having said these, we can now proceed to comment on the results. Regression output for the own plant technology transfer (i.e. plant level channel) is first presented in Table 2 before estimates for possible industry wide spillover to domestic firms are presented in Table 3 (industry level channel). Table 4 reports the verdict for the regional effect. For all specifications the input variables are statistically significant and all turned up with expected signs.

Beginning with Table 2, results indicate that our variable of interest (*spillover (fpp)*) is positively signed and statistically significant at 1 per cent level. This suggests that domestic firms with foreign equity participation benefit from their cross border association. A ten-percentage point increase in foreign ownership increases firm productivity by 0.4 per cent. In other words, for an establishment where foreign participation increased from zero to ten per cent, productivity performance gains would be 0.4 per cent higher than for comparable domestic plants. We interpret this to mean a confirmation of our first hypothesis (hypothesis 1) which has also been affirmed in a previous study (Aitken and Harrison, 1999). The fact that sampled firms are reaping efficiency rewards from the presence of foreign assets in their equity mix is confirmative of the widely held, but controversially substantiated view that there is a technological spillover return to FDI<sup>10</sup>.

**Table 2: Foreign Direct Investment Spillover (Own-Plant Effect)**

Variables	Plant Level
spillover(fpp)	0.04 (2.53)***
k (capital)	0.26 (2.58)***
l (labour)	0.11 (8.23)***
m (material)	0.19 (1.89)*
human k	0.12 (2.63)***
invest in mach	0.01 (1.74)*
export Intensity	-0.08 (1.80)*
ecm	0.96 (1.42)
ecl	-1.84 (1.58)
ecc	-1.01 (1.88)*
Adjusted R <sup>2</sup>	0.78
White Test	2.77***
Ramsey RESET	1.14
Observations	455

Notes: (1) The *t*-statistics are in parentheses; (2) Significant at \*\*\*1 per cent, \*\*5 per cent and \*10 per cent

Moving further to Table 3 we find that the coefficient of the spillover variable through the industry channel, though positive, is insignificant. This suggests that the positive impact of foreign capital on own plant productivity that was confirmed in hypothesis 1 above and would under normal circumstances be expected to diffuse to domestic firms effortlessly could not be confirmed. Failure to establish this sort of industry wide spread of foreign technology that some previous studies have established (Buckley *et al.*, 2007; Sinani and Meyer, 2004) is consistent in part, with the motivation of our hypothesis in 2. That is, in an environment where the requisite skills needed to facilitate the diffusion process is in short supply like South Africa, domestic enterprises are, to borrow Abramovitz’s term, ‘socially incapable’ of internalising the externalised technological know-how of their foreign counterparts. It does appear that in general their inability to compete with foreign firms for the engagement of skilled employees have left them with the only option of relying on workforces that practically lack capacities to learn, copy, imitate and adapt the supposedly advanced practices of the foreign companies for their plants use.

To prove legitimacy of the above conclusion the argument put forward in hypothesis 2 further suggests that all domestic firms may not be equally unable to attract moderately skilled workforce that can help

facilitate the technology appropriation process. As long as some of them are ready to make the right investment in human capital accumulation they should be able to increase their capacities to absorb and it follows that some amount of technology may diffuse to the locals through this group of firms. Thus if we can refine our analysis to take account of this fact we may observe a positive coefficient for the spillover variable. It turns out that after interacting the same spillover variable with human capital proxy the coefficient of the resulting variable (*spillover\*human k*) is positive and significant at 5 per cent level suggesting that the diffusion process truly has a skill accent. Basically, what this finding confirms is that technology of resident MNCs does not spread effortlessly to domestic firms. A minimum level of skill capacity is required before successful absorption can take place. Thus our suspicion that skill matters for the spread of technology to domestic firms and that those with relatively more sophisticated workforce will be more successful in the absorption process is borne out in evidence

Finally, results from our exploration of the possibility of a regional dimension to the level of appropriated spillover by domestic firms as revealed in Table 4 below lend some faint support to our claim. The evidence is weakly present as estimated coefficient for the variable of interest (*aggllo*) shows up with a positive value that is significant at barely 10 per cent.

**Table 3: Foreign Direct Investment Spillover (Domestic Plant Effect)**

Variables	Industry Level
<i>spillover (fpind)</i>	0.01 (1.53)
<i>spillover (fpind)*human k</i>	0.08 (1.96)**
<i>k (capital)</i>	0.02 (2.09)**
<i>l (labour)</i>	0.35 (8.03)***
<i>m (material)</i>	0.22 (2.11)**
<i>human k</i>	0.01 (1.09)
<i>invest in mach</i>	0.01 (1.38)
<i>export Intensity</i>	-0.27 (0.40)
<i>ecm</i>	1.74 (0.65)
<i>ecl</i>	1.03 (0.08)
<i>ecc</i>	-0.12 (1.81)*
<i>Adjusted R<sup>2</sup></i>	0.72
<i>White Test</i>	2.19**
<i>Ramsey RESET</i>	0.11
<i>Observations</i>	302

Notes: (1.) The *t*-statistics are in parentheses; (2) Significant at \*\*\*1 per cent, \*\*5 per cent and \*10 per cent

**Table 4: Foreign Direct Investment Spillover (Regional Effect)**

Variables	Industry Level
<i>Agglo</i>	0.02 (1.71)*
<i>k (capital)</i>	0.09 (1.99)**
<i>l (labour)</i>	0.15 (4.00)***
<i>m (material)</i>	0.54 (4.51)***
<i>human k</i>	0.01 (0.74)
<i>invest in mach</i>	0.01 (1.00)
<i>export Intensity</i>	-0.25 (0.90)
<i>ecm</i>	1.12 (0.32)
<i>ecl</i>	0.9 (1.44)
<i>ecc</i>	-0.12(1.91)*
<i>Adjusted R<sup>2</sup></i>	0.73
<i>White Test</i>	1.89**
<i>Ramsey RESET</i>	0.09
<i>Observations</i>	302

Notes: (1.) The *t*-statistics are in parentheses; (2) Significant at \*\*\*1 percent, \*\*5 percent and \*10 percent

## **6. Conclusions**

Despite the nearly half a century old attempt to understand and explain the phenomenon of FDI spillover, the debate on whether or not host economies do benefit technologically from the activities of MNCs is still far from over. Precisely with respect to the role of country specific environmental factors that promote or inhibit FDI related technology transfer as well as the influence of regional factor evidence is especially lacking for South Africa. We have attempted in this paper to produce insight into this challenging problem by investigating the issues using firm level evidence.

Results from estimated regressions reveal that, despite the problem of skill supply deficit that the business environment imposes, firms with foreign equity participation are able to generate technological spillover for their host. Successful diffusion to domestic firms is however mediated and significantly circumscribed by the skill factor. Furthermore, evidence in support of the claim that level of FDI spillover relies on regional presence is present, though further research is needed to shed helpful insights that may be fed into policy learning.

From both analytical and policy perspectives these findings are instructive in the sense that they underscore the importance of unbundling spillover into its constituent channels of manifestation. At least in the context of South Africa, we now know that all firms are not equally inhibited by the environmentally imposed skill shortage constraint. Foreign firms are by virtue of their endowment able to get around it and deliver on their potentials. It is the domestic firms that are paying heavy technological price as a result. But whether this suggests a need for policy initiative to help domestic firms develop capacity to absorb spillover from MNCs should not be the issue. Rather what should concern us is finding how to increase the supply of human capital into the economy in general.

In the final analysis though, the message needs not be lost that the strength of our claim on the basis of revealed evidence is obviously weakened by limitations of the data we have used as well as econometric technique adopted. Robustness of cross-sectional based findings, we all know too well, is circumscribed by methodological inability to deal with such key challenges as endogeneity of factors, opportunistic investment behaviour, time variance etc. We cannot but admit being humbled by these considerations to say that evidence presented is at best suggestive

and more sophisticated approaches especially the use of panel data would be required to take this further.

## Notes

- <sup>1</sup> Some of these Reports include: The National Enterprise Survey (1998); The World Bank Large Manufacturing Firm Survey (1999); The World Bank Small, Medium and Micro Enterprise Firm Survey (1999); The Human Sciences Research Council (HSRC) Survey of Skills (2003). For a review, see Reza, C. D. (2007)
- <sup>2</sup> MacDougall (1960) is widely recognised as the first author to explicitly acknowledge technology spillover as one of the potential benefits from FDI in his analysis of the welfare effects of foreign investment. Other early authors who followed in the direction of McDougall to argue that productivity spillover is among the list of many positive impact of FDI were Corden (1967) and Caves (1971). In describing the works of these authors Blomstrom and Koko (1997, p. 10) noted: "The common aim of these studies was to identify the various costs and benefits of FDI and spillovers were discussed together with several other indirect effects that influence the welfare assessment, such as those arising from the impact of FDI on government revenue, tax policies, terms of trade, and the balance of payments. The fact that spillovers were taken into account was generally motivated by empirical evidence from case studies rather than by comprehensive theoretical arguments"
- <sup>3</sup> A number of authors have argued that MNCs pay higher wages than their domestic counterparts in order to attract and retain high quality staff (Lipsev and Sjöholm, 2004; Sinani and Meyer, 2004; Glass and Saggi 2002; Fosuri *et al.*, 2001; Aitken *et al.*, 1997).
- <sup>4</sup> This argument is only relevant if we are interested in vertical linkages which will involve a specification of inter-industry spillover model. In the present circumstance, our hypothesis and econometric specification are restricted only to intra-industry analysis.
- <sup>5</sup> According to one recent study economic activities in South Africa are geographically unequally distributed and concentrated with an estimated 70 percent of GDP being produced in only 20 per cent of places (Krugell *et al.*, 2005). Another work further finds that the phenomenon of industry concentration in certain provinces of the country is explained by provincial endowment in some aspects of economic attributes that are mentioned here. For instance, attributes such education, skill levels and road transport infrastructure density are shown to be important in the cases of Gauteng and KwaZulu-Natal while education and skill levels explains the case of the Western Cape Province (Naude, C. M. 2003).
- <sup>6</sup> See: <https://www.enterprisesurveys.org/>.

- 7 More than 80 per cent of respondents claim their establishments are single entities with no other separately owned operating establishments elsewhere in the country.
- 8 While it is tempting to argue that there is a prima-facie evidence, on the basis of this revelation, that foreign firms tend to be more productive than their domestic counterparts, the possibility that these firms (foreign) could just be engaging in opportunistic behaviours by investing only in the more productive sectors weakens the appeal of such argument.
- 9 Foreign firms are defined as firms with 10 per cent or more foreign equity participation.
- 10 This finding should however be interpreted with caution as decisions to invest in an economy by foreigners are sometimes driven by some perceived productivity potentials in a targeted establishment. It is therefore possible that the revealed performance superiority of these foreign owned enterprises is picking up this exogenous influence.

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