Spill-over effects of foreign direct investment: an econometric study of Indian firms

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The channel through which the inflows of foreign direct investment (FDI) contribute to economic progress of the host economy like India can both be direct as well as indirect. Such pecuniary benefits resulting in improved productivity of local firms which cannot be fully appropriated by foreign investors are better known in the literature as spill-over effects. The paper is based on the following research question: what are the firm-level direct impact and indirect effects of FDI in India? This question is analysed with reference to a micro-level investigation which tests particularly for inter- and intra-industrial spill-overs from FDI by applying a Panel framework with Levinsohn-Petrin approach. The study envelops a rich firm-level dataset from 22 sectors of Indian Manufacturing industries and over a time period from 2006 to 2010. After controlling for firm-wise and year-wise effects, the paper finds marginal and insignificant direct impact and mixed spill-over effects of FDI inflow on the productivity of local firms.

Key words: FDI, spill-over effects, panel data, Levinsohn-Petrin approach.

JEL Classification: F21, C33, F23,

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Introduction

It is by now well recognized that inward foreign direct investment (FDI) can immensely benefit the host country and it is perhaps because of this the governments of many countries around the world formulate several strategic policies that soothe the Multinational Corporations (MNCs) to enter into their provinces. World Bank (1993) writes that "FDI brings with it considerable benefits: technology transfer, management know-how, and export marketing access. Many developing countries will need to be more effective in attracting FDI flows if they want to bridge the technological gap with high income countries, upgrade managerial skills, and develop their export markets." These claims have encouraged countries, irrespective of their development stage, to create conducive environments.

The mechanism of the contribution of foreign direct investment (FDI) in economic progress of the host economies can both be direct as well as indirect. FDI adds directly to employment, capital, exports, and new technology in the host country (Blomström et al., 2000). In addition, local firms may also benefit from indirect means. Such advantages or pecuniary benefits result in improved productivity of domestic firms which cannot be fully appropriated by foreign investors. These externalities are commonly known as spill-overs.

According to the theories, FDI spill-overs can work through a number of channels. First, domestic firms can benefit from the presence of FDI in the same industry, leading to intra-industry or horizontal spill-overs, through labour turnover, demonstration effects and competition effects. Second, there may be spill-overs from foreign invested firms operating in other industries, leading to inter-industry or vertical spill-overs. This type of spill-over effect is often attributed to buyer–supplier linkages and therefore may be from upstream sectors (forward spill-overs) or downstream industries (backward spill-overs). [For details see Figure 1]

[Insert Figure 1]

2. Literature Review

There exists a large body of empirical work with an objective to identify and quantify the existence of FDI spill-overs. A common methodology adopted in these studies is to infer the presence of spill-overs by examining whether the presence of foreign affiliated firms increases domestic firm productivity. However a point of caution is that the occurrence of FDI spill-overs is not automatic. The host country should characterise with certain "pre-requisites" needed for technology to flow from foreign companies to domestic firms. The literature has identified them as absorptive capacity.

If foreign firms introduce new products or processes to the domestic market, domestic firms may benefit from the accelerated diffusion of new technology (David J. Teece, 1976). In some cases, domestic firms may increase productivity simply by observing nearby foreign firms. In other cases, diffusion may occur from labour turnover as domestic employees move from foreign to domestic firms. Several studies have shown that foreign firms initiate more on-the-job training programs than their domestic counterparts (Ralph B. Edfelt, 1975; Gonclaves, 1986). If these benefits from foreign investment are not completely internalized by the incoming firm, some type of incentives could be justified.

The empirical evidence can broadly be categorised into three types in relation to the productivity spill-over due to the foreign presence either in the same industry (intra-industry spill-over effect) or in other industries with whom they transact with (inter-industry spill-over effect). They are:

A) Case studies

B) Industry-level studies

C) Micro-level analyses.

To start with the first category of case studies, a rich description about the general issues is offered. Such studies portray on the core issues of spill-over with suitable examples and episodic growth-charts. But one of the greatest disadvantages of such studies is that they are not backed by quantitative information which is quintessential for generalization. Moving to the second category of studies which focus on the sector-level or industry-level, the researchers like Caves (1971), Blomstrom (1986) and Driffield (2001) have found mixed evidence for the correlation between the productivity of an industry and the FDI flows into it. Many studies have documented a positive industry-level correlation between FDI inflows and productivity and a few have not supported the argument. Caves (1971) examined FDI in manufacturing sectors within Canada and Australia and found that productivity levels of those sectors were no way less than that of their foreign counter-parts. He even found that the domestic Australian firms dominate in the productivity sphere over others. Pitching in the same volume, Globerman (1979) also rejected the hypothesis of strong and significant positive spill-over effects of foreign presence. Summarizing the earlier findings, Blomstrom (1986) confirmed that foreign investment may and may not speed up the transfer of any specific technology while studying the industries of Mexico. The main disadvantage of these studies is that they all use industry-level data and cannot disencumber the direction of causality between foreign presence and productivity improvement. As a result of this, the possibilities can be manifold. It may so happen that inward FDI raises the productivity of a specific industry via spill-overs. But it may also be that since the foreign firms who are, on average, more productive, than their domestic-counterparts, foreign presence in an industry raises its productivity by forcing the low-productivity domestic plants to quit the market. As the “knowledge-capital” models of multinational firms suggest, it may be that multinationals tend to concentrate in high-productivity industries. It is so because these firms generate knowledge assets that can be installed in different countries costless. (e.g. Carr, et al, 2001).

The third category of studies is firm-level or plant-level or micro-level analyses. These studies examine whether the productivity of domestic plants (or firms) is correlated with FDI presence in the industry and/or region of the domestic plants. Haddad and Harrison (1993) examined the productivity of manufacturing plants of Morocco and found negative correlation between FDI inflow and plants’ productivity. That means as the industry-level FDI increased, the domestic-plant productivity in Moroccan manufacturing plants became lower. In the similar tune, Aitken and Harrison (1999) find negative results for Venezuelan manufacturing. They have also critically examined the earlier findings in support of positive spill-over and came to the conclusion that previous studies were likely to be driven by the endogeneity of FDI. Had such industry-specific factors are controlled for, there does hardly any evidence remain for positive spill-overs. Suggesting for the developing countries, they floated their opinion that there is always a tussle between the foreign firms and the local players. The foreign entrants want to grab the local advantages to supplement their economies of scale and scope in foreign market operation whereas the local firms find their low rank in the ladder of productivity as they are deprived of holding the absorptive capacity and at the same time do not want to behold their grounds. As a result, a severe competition emerge among them which leave the original incumbents of the market with a sole alternative at their hand, i.e. ‘perform or perish’.

The researchers have been looking for positive FDI spill-overs in the wrong place as noted by Javorcik (2004). It is so because that multinationals have an incentive to prevent information leakage that would otherwise enhance the relative performance of their local competitors who reside both in the upstream or down-stream sector and obviously not in the same sector. But at the same time, they may find it beneficial for them to transfer the knowledge to their local suppliers or clients. Therefore, a negative spill-over effect from FDI is more likely to be horizontal and a positive spill-over effect is more likely to be vertical in nature. Javorcik uses firm-level data from Lithuania to show that positive FDI spill-overs take place through backward linkages and there is hardly any robust evidence of positive spill-overs occurring through either the horizontal or the forward linkage channel.

After going through the above mentioned studies, an indomitable interest emerges on the part of researchers regarding whether the FDI inflows do positively affect the performance or productivity of domestic firms. Do the domestic firms get any productivity spill-over when the foreign firms present in the same industries in which domestic firms operate? What is the effect on the productivity of domestic firms when foreign multinationals are present in the up-stream and down-stream sectors with which the former has either forward or backward linkages? These research questions prompts for a detailed study in Indian context.

3. Data and Methodology

In this section, a description is made in relation to the analytical framework, estimation of equation, and measures for constructing the key spill-over variables that are used. The key features of the firm-level panel data set and its summary statistics are discussed in the subsequent section. The data for the present study has been extracted from the 'Prowess', a firm-level database from the Centre for Monitoring Indian Economy (CMIE), Annual Survey of Industries (ASI) and National Accounts of Statistics (NAS). In order to capture the inter-industry transaction coefficients, the input-output table is used, published by the Ministry of Statistics and Programme Implementation available by latest 2006-07. Keeping in view with the availability of data, twenty-two Manufacturing industries are selected, the broad classification of which is backed by National Industrial Classification (NIC), published by the Central Statistical Organization (CSO) under the same Ministry of in 2008.

3.1 Analytical Framework

To examine the impact of intra- and inter-industry FDI spill-over effects on firm productivity, we employ the following basic model, inspired by Aitken and Harrison (1999) and Javorcik (2004):

$$\ln Y_{ijt} = \alpha + \beta_1 \ln K_{ijt} + \beta_2 \ln L_{ijt} + \beta_3 \ln M_{ijt} + \beta_4 E_{ijt} + \beta_5 Forpart_{ijt} + + \beta_6 Horizontal_{jt} + \beta_7 Backward_{jt} + \beta_8 Forward_{jt} + \beta_9 HHI_{jt} + \alpha_i + \alpha_t + \varepsilon_{ijt} \quad (1)$$

Y_{ijt} is the quantity produced by firm i in sector j at time t. It is calculated by deflating the output value (sales volume plus change in inventories) by the Wholesale Price Index (WPI) of the total manufacturing goods. K_{ijt}, capital, is defined as the value of fixed assets, which is deflated by the same Wholesale Price Index (WPI) of the total manufacturing goods (Dua et al. 2011). L_{ijt} is the total number of man-days per firm. This information is not directly available and is computed by dividing expenses of firms on salaries and wages on the average wage rate of the industry into which the firm belongs to. Again the average wage rate of the industry is calculated by dividing total emoluments on total man-days of the industry. The industry data are used from ASI database. M_{ijt} represents the intermediate inputs, like raw materials, stores and spares purchased by firms to use for production of final products, which is deflated by the Wholesale Price Index (WPI) of the total manufacturing goods. E_{ijt} represents the energy inputs, like power, fuel and water charges purchased by firms to use for production of final products, which is deflated by the WPI series of fuel and power products. HHI_{jt} indicates the Herfindahl-Hirschman Index which is a measure of the size of firms in relation to industry or simply an indicator of market concentration. It indicates the actual position of competition among the firms in which the firms operate in. As far as the Structure-Conduct-Performance paradigm of Industrial Organization is concerned, the conduct of a firm in terms of its incentive for innovation and technological upgrading is immensely affected by the intensity of the market concentration. The variables with *ln* actually indicate the natural logarithm transformation of those variables.

Foreign Share (Forpart) is defined as the share of the firm's total equity owned by the foreign promoters. Following Javorcik (2004), we define two-digit sector-level (in companion with NIC broad-classification) FDI variables. First, $Horizontal_{jt}$ captures the extent of foreign presence in sector *j* at time *t* and is defined as foreign equity participation averaged over all firms in the sector, weighted by each firm's share in sectoral output. In other words,

$$Horizontaljt = \left[\sum_{i \in j} ForeignShareit * Yit \right] / \sum_{i \in j} Yit \quad (2)$$

Second, $Backward_{jt}$ captures the foreign presence in the sectors that are supplied by sector j[3]. Therefore, $Backward_{jt}$ is a measure for foreign participation in the downstream industries of sector j. It is defined as

$$Backward_{jt} = \sum_{jifk \neq j} \alpha_{jk} Horizontal_{kt} \quad (3)$$

[3] For instance, let there be three types of industries, say X, Y and Z. Both industries X and Y use the products of industry Z. Suppose the industry Z sells 1/3 of its output to industry X and 1/2 of its output to industry Y. Let us again assume that there is no foreign presence in industry X but 1/4 of the output of industry Y comes from foreign affiliates, then the *Backward* variable for the industry Z will be calculated as follows: 1/3*0+1/4*1/2=1/8.

[6] Input-Output Transaction Tables [Absorption and Make Matrix] of India (2006-07).

The value of α_{jk} is taken from the 2006-07 input-output tables[4] representing the proportion of sector j's production supplied to sector k. Finally, $Forward_{jt}$ is defined as the weighted share of output in upstream industries of sector j produced by firms with foreign capital participation. As Javorcik points out, since only intermediates sold in the domestic market are relevant to the study, goods produced by foreign affiliates for exports (X_{it}) shouldbe excluded. Thus, the following formula is applied:

$$Forward_{jt} = \sum_{m if m \neq j} \sigma_{jm} \left[\left[\sum_{i \in m} ForeignSare_{it} * \left(Y_{it} - X_{it} \right) \right] / \left[\sum_{i \in m} \left(Y_{it} - X_{it} \right) \right] \right] \quad (4)$$

The value of σ_{jm} is also taken from 2006-07 input-output tables. Since $Horizontal_{jt}$ already captures linkages between firms within a sector, inputs purchased within sector j are excluded from both $Backward_{jt}$ and $Forward_{jt.}$

We proxy the share of a firm's output sold to foreign firm by the share of an industry output sold to foreign firms in different downstream industries. We can construct this variable using an input-output table. Input-Output table provides details about the amount supplied by an industry to downstream industries. We use an input output table for the year 2006-07 provided by the Central Statistical Organisation (2005) for the same. From the firm level data we can obtain the share of foreign firms output in each industry. Where α_{ij} is the proportion of output of sector i supplied to sector j from the 2006-07 input output matrix. We exclude the inputs sold within the sector since this effect is captured by the horizontal spill-over variable.

The latest Input-Output table available for India pertains to the year 2006-07. The input-output table is provided by the Central Statistical Organisation (http://mospi.nic.in). The input-output table consists of two matrices: absorption matrix (commodity*industry) and make matrix (industry*commodity). For the purpose of our study, we need to create an industry*industry matrix. The procedure for constructing an industry*industry matrix is explained in detail below.

The absorption matrix (of order 130×130) consists of values of commodities supplied to different industries for final use as well as intermediate inputs. The make matrix (of order 130×130) represents the values of output produced by different industries. As mentioned above our purpose is to construct an industry*industry matrix (again of order 130×130). Firstly, a matrix of coefficient (we call it matrix X) has been created by dividing each row of the absorption matrix by the total output of the commodity. We create another matrix Y (using the make matrix) by dividing the each row by the total output produced by the respective industry. As a final step, we create a new matrix Z = YX. The new matrix Z is nothing but an industry*industry matrix. We need to segment the input-output table for the manufacturing sector in accordance with the two-digit NIC classification and then extract the requisite matrix (say *Z'*) of order 22×22 only. Each row of the matrix *Z'* represents the total industry output delivered to different industries in the economy. The coefficients like: α_{jk} *and* σ_{jm} are obtained from the matrix *Z'*.

3.2 Empirical Strategy for Computation of firm-level Productivity

The sole objective of the present work is to estimate whether the foreign presence, irrespective of the streams, do affect the productivity of the firms. That's why from the very outset, an estimation of total factor productivity (TFP) is essential. The empirical strategy adopted is to primarily compute the estimates of TFP at the firm level and observe how these changes over time for each firm and how much is due to the spill-over effect. The firm-level estimates of TFP are computed using the Ordinary Least Squares (OLS) as well as the Levinsohn and Petrin (L-P) (2003) methodologies.

In examining the productivity of a production unit, one of the significant question that strikes to our mind is that how can we measure changes in productivity? There are several procedures to measure the productivity, the changes in it and by its source too. One of these procedures is to compute by an index number, which is the ratio of an index of output change and an index of input change. But such procedure is plagued with some severe limitations, e.g; it does require knowledge of quantity and prices of input used and output produced. However, there is an alternative method available, i.e. through the econometric estimation. This method is a better one in comparison to the previous one because it does not require any assumption regarding technology or behaviour. For this precise reason, the study uses the second approach to measure the productivity change.

The econometric estimation can be done by considering both production function approach and even not considering any specific functional form. But the former approach gives certain advantages over other computational methodologies. Primarily, the assumptions like constant returns to scale, perfectly competitive market structure are not required. As a result, the estimation of TFP using the production function methodology allows us to capture more accurate estimates, which control for more of the situational biases. Basically, the OLS approach and the Levinsohn-Petrin (L-P) approach are used in this study.

3.2.1 The OLS approach:

The technique entails estimating output as a function of the inputs and then subtracting the estimated output from actual output to capture productivity as the residual. However, concerns have been raised that this traditional estimation technique may suffer from simultaneity and selection bias.

Suppose we have a random sample of firms with information on output, labour, material, energy and capital. If we estimate the Cobb-Douglas function in logs, we would have:

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_e e_{it} + \beta_m m_{it} + \Omega_{it} + u_{it} \qquad (5)$$

Where y is the logarithm of output, i is the index of the firm, l is the log of labour, k is the log of capital, e is the log of energy and m is the log of materials. Ω_i refers to the productivity shock known to the firm, but unobserved by the econometrician. u_i refers to all other disturbances such as measurement error, omitted variables, functional form discrepancies and any other shocks affecting output that are unknown to the firm when making input decisions. The basic computation methodology used for measuring TFP then, is as follows:

$$\ln TFP_{it} = y_{it} - \beta_l l_{it} - \beta_m m_{it} - \beta_e e_{it} - \beta_k k_{it} \qquad (6)$$

The inputs like quantity l_i and k_i chosen by the firm are based upon some optimizing behaviour that is known to the producer but not to the researcher. But the selections of the factors are affected by productivity shock and these shocks are either contemporaneously or serially correlated with inputs or both. Contemporaneous correlation will occur if the firm hires more workers or invests more funds in the on-going operation based on its current productivity with an anticipation of future profitability. Serial correlation between productivity and factor selection will also lead to biasedness. Hence there will be a problem of endogeneity in the estimation equation, which would cause the OLS estimates to be biased and inconsistent.

The second issue is with regard to the selection bias. The econometrician only has knowledge of the firms that stay in the market in each period. A firm's decision to stay in the market is contingent upon its productivity and expected future profitability, then firms with higher capital stock, at any productivity levl, will have a higher survival rate in the market. The expectation of productivity, contingent upon the firms' survival, would then be decreasing capital. The OLS estimates of the production would thus lead to a negative bias in the capital coefficient.

3.2.2 Levinsohn and Petrin (L-P) Approach

This alternative approach was devised by L-P to build upon the methodology used by Olley and Pakes (OP) (1992) which addresses the issues of simultaneity and selection bias. The authors hypothesize that while producers observe information about their firm's productivity, this information is unavailable to the econometrician. Such asymmetry in information introduces the simultaneity bias. If a firm is more productive then it is likely to hire more workers and invest in capital due to profitability. Thus Least Square estimation of a production function may lead to biased estimates of the coefficients of inputs. This is because, when using OLS, factor quantities are treated as exogenous variables, and yet there is a very good chance that input choices are endogenous. In other words, it is likely that the regressors and the error term are correlated, which would make the OLS estimates biased and inconsistent.

Producers make decisions regarding whether or not to stay in the market based on productivity information coupled with their level of capital stock. The authors explain that if there is a correlation between exit of a firm from the sample and quantity of input used by the firm, then this will lead to the input coefficient estimate carrying a bias. Sometimes, firm-level data sets contain missing values due to some firms dropping out of the sample.

Thus, OP develop a model where they use investment as a proxy to control for the correlation between the error term and the quantity of input used that arises due to unobserved productivity shocks. This allows them to control for simultaneity. They obtain consistent estimates of capital and then use these to estimate survival probabilities of the firm which in turn controls for the selection bias. However, using the OP model requires the Investment variable to be non-zero and non-missing. L-P point out that in the case of most developing countries, it is observed that plant-level data for investment can be missing or zero in many instances. So, L-P provides an alternative methodology to overcome this problem. They suggest that instead of using investment as the proxy variable, intermediate inputs be used to control for simultaneity. The primary advantage of this approach is that even firms with zero investment can be retained in the dataset. Another theoretical benefit of this approach, highlighted by L-P is that since it may be a better indicator of changes in productivity.

4. Results and Discussion

In this section, we discuss about the results of the impact and spill-over effects of FDI based on different model specifications. The results are discussed in the following tables. Table 1 explains the spill-over effects of different manufacturing industries in descending order. The industries are coded according to the NIC two-digit classification. From the table it is clear that over the last five years Manufacture of electrical equipment has the Highest Horizontal Spill-over effect (HS) and other manufacturing has the Lowest HS. Manufacture of food products has the Highest Backward Spill-over effect (BS) and Manufacture of furniture has the Lowest BS. Manufacture of wearing apparel has the Lowest Forward Spill-over effect (FS) and Manufacture of other transport equipment has the Highest FS. The tables 2 and 3 explains the equation 1 estimated by using the baseline OLS method. Since there is possibility of biasedness in equation (1) due to the endogeneity problem (simultaneity and selection bias), we take the help of Levinsohn-Petrin approach in tables 3 and 4 which is estimated for total factor productivity.

[Insert Table 1]

4.1 Baseline Estimation

To get a first feeling of the impact and spill-over effects of FDI, we start with the baseline regression results in table 2 and 3. In this table the results are estimated with lnY as the dependent variable and keeping in view eight alternative linear models (its details are discussed below) for panel-data. The table 2 indicates fixed effect with robust estimation and table 3 similarly for random effects with robust estimation. The reason behind the robust estimation is that the estimators are usually based on the assumption of idiosyncratic error ε_{it} ~ $(0, \sigma_{\varepsilon}^{2})$. The assumption is often not satisfied in panel application and results in the occurrence of the problem of heteroscedasticity. The robust estimation aims to solve the problem.

However for the sake of simplicity we introduce eight alternative models. Model 1 describes the relationship between the factor inputs, i.e. labour, capital, material and energy with output. No other variables are considered. Table 2 considers the additional variable of foreign partnership along with the 4 factor inputs. Model 3 considers all the three types of spillover effects except impact factor and market concentration. Model 4 considers the effect of market concentration over the output except impact and spillover variables. Model 5 considers the effect of impact and spillover variables on the output performance except the market concentration. The next model 6 represents the spillover effects and market concentration over the output of firms except the impact factor. The model 7 considers the impact factor and market concentration and except any of the category of spillover effects. Lastly all the factors, i.e. the impact, three types of spillover effects and market concentration along with the 4 types of factor inputs are considered as a whole in model 8. However, all the four types of factor inputs are considered throughout the eight models.

[Insert Table 2]

[Insert Table 3]

Table 2 and 3 reports the estimation results with ln Y as the dependent variable. Although the Hausman test favours the fixed effect model (see appendix), in all eight alternatives, all the four types of factors of production do not indicate a uniform relation with the variable output. Among the four factors, the coefficients of material input remain positive and significant but the labour factor in some models become significant and in some cases become insignificant and also changes the sign. One surprising element is noticed, i.e. the coefficients of capital for fixed effect estimation are found to be negative. Therefore, one implication can be derived that the production function of the Indian Manufacturing industries is material driven and not capital or labour- specific.

Progressing to additional factors along with the factor inputs, we start with the impact factor. The foreign partnership is modelled 4 times in our analysis, such as: (1) in model 2 where only impact factor is estimated, (2) in model 5 where impact factor is estimated along with spillover variables., (3) in model 7 where the same factor is estimated with the presence of HHI and finally (4) in model 8 where it is estimated with the entire set of variables. Surprisingly the impact factor coefficient is negative, marginal ranging between -0.002 to -0.003 and insignificant. That means, the direct foreign participation in any firm do not significantly contribute to the output performance.

Moving to the spill-over effect, the coefficient of HS support for positive and statistically significant with an exceptional insignificant coefficient of 0.342 in the model 8 where all the variables are considered as a whole. In model 3, where only the spillover variables are examined, the coefficient of HS is 1.084. In models 5 and 6, the coefficients of HS are 1.267

and 0.788. This indicates that there is a positive correlation between foreign presence in a given sector and performance of all the firms in the same sector. That means the package of intangible assets that an MNC brings with her impact positively on the performance of the domestic firms which are working in the same sector in which the MNC rush into. Such indirect effects are also supported by the statistical significance with some exceptions; its implication boosts the confidence of the propagators of those economists who support the intra-industry spill-over effect of FDI.

Among the vertical spill-over components, both FS and BS indicate negative impact and are also backed by statistically significance. The coefficients of BS are -4.306 in model3, -5. 228 in model6, -7.238 in model 5 and finally in model 8 it figures to -9.841. This means that if the foreign presence in the downstream sector increases by a single percentage then it will adversely affect the performance of the domestic firms by the amount of the same range, i.e. -4.306%, -5. 228%, -7.238%, -9.84%. %. In other words the adverse effect may result in even up to nine times deterioration of the domestic performance. This is an alarming finding and draws the immediate attention of the policy-makers that unprecedented growth of MNCs operating at the downstream sector, to which our domestic firms supply their goods, will create havoc among our domestic players. These concerns become more intense when we draw our attention towards FS. The coefficients of FS are -10.637 in model 6, -10.867 in model 3, -12.915 in model 8 and finally in model 5, it figures to -13.652. This means that if the foreign presence in the upstream sector increases by a single percentage then it will adversely affect the performance of the domestic firms by the amount of the same range, i.e. --10.637%, -10.867%, -12.915% and -13.652%. In other words the adverse effect may result in even more than thirteen times deterioration of the domestic performance. This is even more alarming than the previous one. If such unprecedented growth takes place for the MNCs, which operate at the upstream sector and which supply to our domestic firms will create more intense chaos among our domestic players. Thus one consensus can be reached that inter-industry spill-over effect is negative for Indian Manufacturing industries. The performance of the domestic firms get adversely affected when it receives goods and services from the sectors which is marked by the presence of foreign multinationals or serves to them. However such deteriorating effect is more immense in the former case than the latter one.

The industry concentration effect is mixed in different models. The positive coefficients indicate that higher is the market concentration more will be the performance and vice-versa and on the contrary, the negative coefficients indicate that less is the market concentration more will be the performance and vice-versa. From our results, it is very difficult to choose a single stand on the firms' performance over the market concentration.

The output from the above models also includes estimates of the standard deviations of the error components. The combined error can be decomposed into sigma_u and sigma_e. The sigma_u gives the standard deviation of the individual effect and sigma_e gives the standard deviation of the idiosyncratic error. If the individual-specific component of the error is dominant over the idiosyncratic component, then rho (ρ) will tend towards unity. The rho is indicating the intra-class correlation of the error which is defined as follows:

$$\rho_u = corr(u_{it}, u_{is}) = \frac{\sigma^2{}_\alpha}{\sigma^2{}_\alpha + \sigma^2{}_\varepsilon}$$

In our findings, the intra-class correlation is higher in FE estimation in comparison to RE estimation. The model 2 shows the highest value (0.662) for ρ_u and model 3 shows the lowest value (0.55).

R^2 is defined as the correlation between the actual and the fitted values of the dependent variable. In the present panel framework, R^2 is defined in three different categories which have been discussed as follows:

Within R^2 : $\rho^2\{(y_{it} - \overline{y_i}), (X'_{it}\hat{\beta} - \overline{X'_i}\hat{\beta})$

Between R^2 : $\rho^2(\overline{y_i}, \overline{X'_i}\hat{\beta})$

Overall R^2 : $\rho^2(y_{it}, \overline{X'_i}\hat{\beta})$

The three R^2 measures are respectively, 0.066, 0.821, 0.693 in model 1, 0.033, 0.548, 0.413 in model 2, 0.077, 0.861, 0.733 in model 3, 0.067, 0.836, 0.708 in model 4, 0.052, 0.804, 0.634 in model 5, 0.078, 0.858, 0.73 in model 6, 0.0336, 0.642, 0.494 in model 7, 0.054, 0.772, 0.607 in model 8 for the within or fixed estimator in table 1. Among these models, model 3 gives the highest values and model 2 gives the lowest values for all three types of R^2. The similar results are also obtained for random effects estimation mentioned in table 4.3. Since the Hausman test supports the fixed effects estimation, therefore we ignore the analysis in table 4.3 in detail. So the within estimator best explains the within variation and it has a low overall R^2 because it neglects the individual effects.

4.2 Results of L-P Method

In tables 4 and 5 the dependent variable is TFP, which is calculated through Levinsohn-Petrin procedure. Although the estimation results reported in tables 1 and 2 are biased due to the endogeneity problem of firm's input decision, we find that the results of this method are qualitatively similar to those of the previous findings except for market concentration. In this table the results are estimated with TFP as the dependent variable and keeping in view seven alternative linear models (its details are discussed below) for panel-data. The table 4 indicates fixed effect with robust estimation and table 5 similarly for random effects with robust estimation. The reason behind the robust estimation is the same as before, i.e. the robust estimation aims to solve the problem of heteroscedasticity.

[Insert Table 4]

[Insert Table 5]

However for the sake of simplicity we introduce seven alternative models. Model 1 describes the relationship between foreign partnerships, i.e. direct impact factor and TFP without considering any other variables. Model 2 considers all the three types of spill-over effects except impact factor and market concentration. Model 3 considers the effect of market concentration over TFP except impact and spill-over variables. Model 4 considers the effect of impact and spill-over variables on the firms' factor productivity except the market concentration. The next model 5 represents the spill-over effects and market concentration over the TFP of firms except the impact factor. The model 6 considers the impact factor and market concentration and except any of the category of spill-over effects. Lastly all the factors, i.e. the impact, three types of spill-over effects and market concentration are considered as a whole in model 7. However, all the four types of factor inputs, i.e. labour, capital, material and energy along with the dependent variable output are internalised in the figures of TFP and therefore not considered explicitly throughout the seven models.

Tables 4 and 5 report the estimation results with TFP as the dependent variable. The direct foreign participation in any firm does not have much contribution to the TFP of firms as it can be observed that the impact factor coefficient is negative, marginal ranging between -0.004 to -0.005 and insignificant throughout except in model 1 where it is significant but at a very high level of significance.

In the analysis of spill-over effect, the coefficients of HS support for positive but victim of not statistically significance. This indicates that there is a positive correlation (though not supported by statistical tests) between foreign presence in a given sector and productivity of all the firms in the same sector to a large extent with some exceptions. That means the package of intangible assets that an MNC brings with her marginal positively impact on the productivity of the domestic firms which are working in the same sector in which the MNC rush into. Such indirect effects are not in line with the previous findings where only output of firm is considered as dependent variable.

Among the vertical spill-over components, both FS and BS indicate negative impact and are also backed by statistically significance. This means that if the foreign presence in the downstream sector increases by a single percentage then it will adversely affect the performance of the domestic firms by the amount of -3.20%, -3.906%, -6.72%, -9.492%. In other words the adverse effect may result in even up to more than nine times deterioration of the productivity of domestic firms. This is a similar alarming finding as found before and draws the immediate attention of the policy-makers that unprecedented growth of MNCs operating at the downstream sector, to which our domestic firms supply their goods, will create chaos among our domestic players. These concerns become more intense when we draw our attention towards FS. This means that if the foreign presence in the upstream sector increases by a single percentage then it will adversely affect the performance of the domestic firms. In other words the adverse effect may result in even more than thirteen times deterioration of the domestic productivity. This is even more alarming than the previous one and in corollary with the previous findings. Thus one consensus can be reached that inter-industry spill-over effect is negative for Indian Manufacturing industries. The productivity of the domestic firms get adversely affected when it receives goods and services from the sectors which is marked by the presence of foreign multinationals or serves to them. However such deteriorating effect is more immense in the former case than the latter one.

The industry concentration effect is mixed in sign and lack of statistical significance in some of the models. From our results, it is very difficult to choose a single stand on the firms' productivity over the market concentration. Therefore, as the market is characterised by less but powerful players, they start dominating the domestic players who can't stand by the giants and as a result their performance sinks down to the gutter. Had it been a competitive market structure where a large number of players thrust upon each other, the domestic players compete with them to sustain and improve their performance in the process. Thus asymmetry in relative size and market control play a crucial role in the performance of the firms.

5. Conclusion

The economic development of the emerging nations like India has been witnessing gradual but intensive interest in FDI. However, the dearth and inaccessibility of firm-level data result in a few studies which empirically test for FDI spill-overs in India. This paper is based on a rich firm-level dataset from Indian Manufacturing industries which tests particularly for inter- and intra-industrial spill-overs from FDI by applying the approaches of Javorcik (2004) and Du, Harrison and Jafferson (2011). After controlling for firm-wise and year-wise effects, the chapter finds marginal, negative and insignificant direct impact of FDI inflow on the performance and/or productivity of domestic firms. On the contrary, we find negative productivity spill-overs from FDI which take place between foreign affiliates in the upstream sectors or suppliers and their local clients (forward linkages) and that there is also evidence for the negative productivity spill-overs from foreign affiliates in the downstream sector or consumers and their local suppliers (backward linkages).

With respect to productivity spill-overs, this paper finds positive and significant evidence (insignificant results are also found in some models) in support of productivity spill-overs from foreign firms to local firms through horizontal channels. Results indicate that productivity of local firms' decreases as foreign presence in the upstream or downstream sector increases, which may be an indication of inefficient absorptive capacity and adaptive capacity.

The concept of absorptive capacity was first defined as a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends by Cohen and Levinthal (1990). It is studied on multiple levels (individual, group, firm, and national level). Potential Absorptive Capacity as pointed out by Zahra and George (2002) makes the firm receptive to acquiring and assimilating external knowledge. On the other hand, realized Absorptive Capacity is made up of capability with respect to transformation and exploitation. Adaptive capacity, on the other hand, is the capacity of a system to adapt if the environment in which the system exists is changing. It is determined by several factors and can be enhanced by learning to cope with change and uncertainty; combining different types of knowledge for learning; and creating opportunity for self-organization towards socio-economic sustainability.

Generally, the foreign firms have an incentive to facilitate knowledge and/or technology transfer to local firms to enable them produce intermediate inputs more efficiently, thereby making them available to foreign firms upstream at a lower cost. But such knowledge or technology cannot be optimally transferred as the local firms lack the necessary absorptive and adoptive capacity. There is also evidence to suggest that regional concentration of foreign investment facilitates rapid technology spill-over from foreign firms to domestic firms in the manufacturing sector.

From the entire analysis, it can be concluded that the different layers of production-chain is characterised by the foreign presence. In order to internalise their spill-over effects and its succeeding positive contribution on the productivity of domestic firms, the existing linkages among firms (both domestic and foreign) need to be cemented and at the same time, the absorptive as well as the adaptive capacity of domestic firms must be strengthened. To achieve this, the development of domestic parts and suppliers would be crucial. The absence of an efficient industry supply base has constrained the anticipated spill-over effect of FDI flows that the country has aspired of. With the country's narrow participation in the production networks of MNCs and gradual opening up of the foreign participation cap for these industries, they are likely to create opportunities for either negative or insignificant spill-overs into the local economy.

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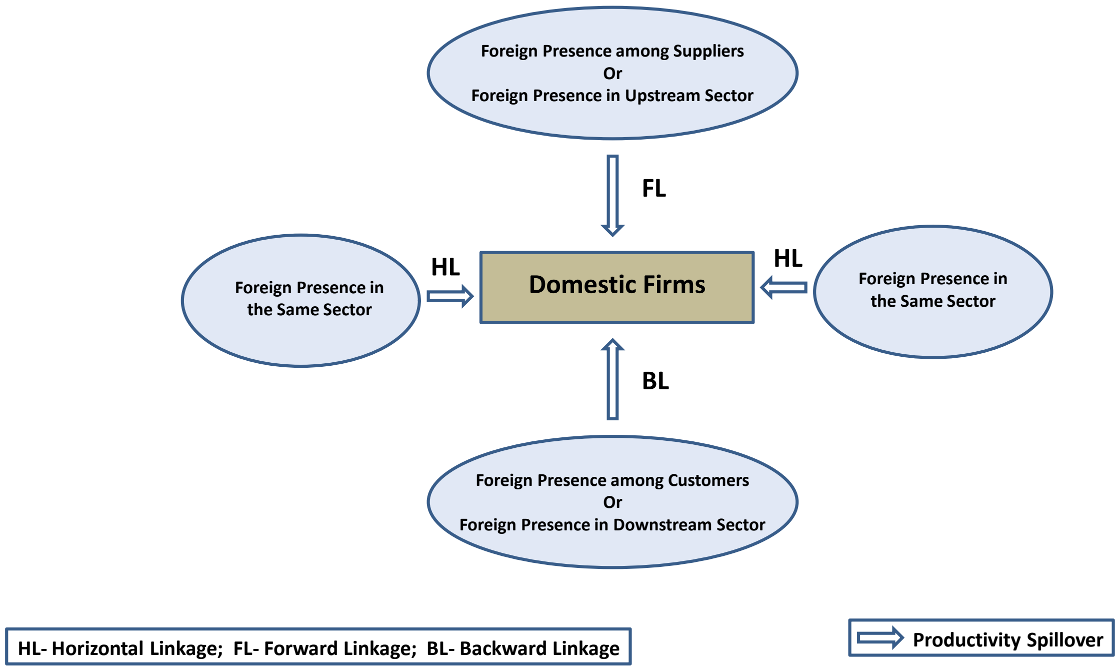
Figure 1

Defining spill-overs and linkages



FDI spill-overs: An increase in the productivity of domestic firms as a consequence of the presence of foreign firms in the domestic economy.

FDI spill-overs via horizontal linkages: An increase in the productivity of domestic firms resulting from the presence of foreign firms in the same industry.

FDI spill-overs via forward linkages: An increase in productivity resulting from the foreign presence among the suppliers of the industry in which the domestic firm operates (i.e., upstream sectors).

FDI spill-overs via backward linkages: An increase in productivity resulting from the foreign presence among the customers of the industry in which the domestic firm operates (i.e., downstream sectors).

Table 1

Ranking of Industries on the basis of average value of HS, BS and FS

NIC	HS AVG	NIC	BS AVG	NIC	FS AVG
27	0.080762	10	0.035866	30	0.022842
29	0.076499	12	0.03129	17	0.020208
20	0.049423	11	0.01865	21	0.011137
21	0.046781	17	0.013609	24	0.010733
14	0.038355	15	0.009089	27	0.010422
30	0.035722	13	0.007962	11	0.009711
28	0.03548	16	0.006717	13	0.009625
23	0.03423	14	0.005587	28	0.008754
26	0.025235	18	0.003036	31	0.005687
15	0.024398	21	0.001746	15	0.004794
10	0.023239	22	0.001688	29	0.003845
22	0.023042	19	0.001671	12	0.00368
24	0.020002	20	0.001613	18	0.003177
11	0.016169	23	0.001344	23	0.003164
12	0.013918	24	0.000736	26	0.003081
25	0.013711	25	0.000404	19	0.002546
13	0.012931	27	0.000193	22	0.001957
19	0.005576	26	9.84E-05	10	0.001678
17	0.00464	30	8.98E-05	16	0.001536
16	0.002348	28	8.1E-05	25	0.001468
32	0.001041	29	4.54E-05	20	0.000906
18	0	31	1.99E-06	14	0.000568
31	0	32	0	32	0

Here:

NIC Division Name of the Industries

Division 10	Manufacture of food products (Highest BS)
Division 11	Manufacture of beverages
Division 12	Manufacture of tobacco products
Division 13	Manufacture of textiles
Division 14	Manufacture of wearing apparel (Lowest FS)
Division 15	Manufacture of leather and related products
Division 16	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
Division 17	Manufacture of paper and paper products
Division 18	Printing and reproduction of recorded media
Division 19	Manufacture of coke and refined petroleum products
Division 20	Manufacture of chemicals and chemical products
Division 21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
Division 22	Manufacture of rubber and plastics products
Division 23	Manufacture of other non-metallic mineral products
Division 24	Manufacture of basic metals
Division 25	Manufacture of fabricated metal products, except machinery and equipment
Division 26	Manufacture of computer, electronic and optical products
Division 27	Manufacture of electrical equipment (Highest HS)
Division 28	Manufacture of machinery and equipment
Division 29	Manufacture of motor vehicles, trailers and semi-trailers
Division 30	Manufacture of other transport equipment (Highest FS)
Division 31	Manufacture of furniture (Lowest BS)
Division 32	Other manufacturing (Lowest HS)

Table 2

Baseline Results of Impact and Spill-over effects of FDI

(Within or Fixed Effect Model)

Variables	**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**		**Model 8**	
Dependent Variable Y	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**
L	.0321	0.98	-.1952***	-3.18	.146***	4.15	.068**	2.02	.013	0.19	.147***	4.17	-.135**	.064	.017	0.25
K	-.1102***	-3.09	-.1395**	-2.20	-.074**	-2.13	-.102***	-2.88	-.096	-1.54	-.072**	-2.07	-.133**	.063	-.091	-1.45
M	.3678***	15.57	.391***	8.41	.355***	15.00	.365***	15.45	.357***	7.51	.354***	14.99	.386***	.047	.355***	7.51
E	.1238***	3.84	.144***	3.09	.084***	2.61	.110***	3.41	.089*	1.90	.085***	2.64	.125***	.047	.088	1.90
For Part			-.003	-1.08					-.002	-0.88			-.002	.003	-.003	-1.07
FS					-10.867***	-4.96			-13.652***	-4.05	-10.637***	-4.80			-12.915***	-3.80
BS					-4.306**	-4.62			-7.238***	-4.39	-5.228***	-3.95			-9.841***	-4.35
HS					1.084**	2.54			1.267*	1.78	.788*	1.82			.342	0.48
HHI							.577***	4.34			-.397	-1.44	.765***	.2201228	-1.127**	-2.55

sigma_u	1.137	1.463	1.017	1.098	1.218	1.019	1.388	1.231
sigma_e	0.93	1.069	0.919	0.929	1.058	0.919	1.067	1.057
rho	0.599	0.652	0.55	0.583	0.57	0.551	0.628	0.576
R^2:within	0.066	0.033	0.077	0.067	0.052	0.07	0.036	0.054
R^2:between	0.821	0.548	0.861	0.836	0.804	0.858	0.642	0.772
R^2:overall	0.693	0.413	0.733	0.708	0.634	0.73	0.494	0.607
No. Obs	21315	8528	21259	21315	8507	21259	8528	8507
No. Groups	5644	2057	5643	5644	2057	5643	2057	2057
	F(4,5643) =122.98	F(5,2056)=22.04	F(7,5642)=83.57	F(5,5643)=103.12	F(8,2056)=21.16	F(8,5642)=73.41	F(6,2056)=20.07	F(9,2056)=19.59
	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000

Here '*' '**', '***'indicate significant value at 10%, 5% and 1% level of significance respectively.

Table 3

Baseline Results of Impact and Spill-over effects of FDI

(Random Effect Model)

Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
Dependent Variable Y	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic
L	**.203*** **	23.61	.189***	12.35	.217***	25.22	.208***	26.68	.209***	13.54	.219***	25.31	.199***	12.95	.212***	13.76
K	**.119*** **	10.70	.136***	6.42	.117***	10.53	.118***	10.86	.131***	6.13	.117***	10.48	.132***	6.19	.130***	6.05
M	**.518*** **	55.54	.519***	30.01	.520***	55.42	.514***	66.83	.520***	29.49	.518***	55.05	.512***	29.67	.516***	29.40
E	**.049*** **	6.00	.041***	2.67	.042***	5.00	.050***	6.21	.031**	1.98	.043***	5.10	.041***	2.70	.032**	2.07
For Part			.002**	2.35					.002**	2.43			.002	2.08	.002**	2.29
FS					-9.910***	-4.71			-13.042***	-3.87	-9.887***	-4.70			-12.963***	-3.85
BS					-3.806***	-4.83			-6.215***	-4.47	-3.637***	-4.61			-6.038***	-4.36
HS					.237	0.58			.181	0.26	.435	1.07			.597	0.85
HHI							.596***	10.45			.267***	4.18	.989***	9.15	.529***	5.25

sigma_u	0.416	0.358	0.423	0.417	0.368	0.423	0.358	0.367
sigma_e	0.930	1.069	0.919	0.929	1.058	0.919	1.067	1.057
rho	0.167	0.1	0.175	0.167	0.108	0.175	0.101	0.108
R^2:within	0.06	0.02	0.074	0.063	0.042	0.074	0.025	0.042
R^2:between	0.876	0.876	0.876	0.876	0.873	0.876	0.876	0.875
R^2:overall	0.743	0.691	0.747	0.743	0.698	0.748	0.694	0.699
No. Obs	21315	8528	21259	21315	8507	21259	8528	8507
No.Groups	5644	2057	5643	5644	2057	5643	2057	2057
	Wald chi2(4)=24458.84	Wald chi2(5)=8678.21	Wald chi2(5)=25696.68	Wald chi2(5)=22274.63	Wald chi2(8)=8953.93	Wald chi2(8)=25835.82	Wald chi2(6)=9138.79	Wald chi2(9)=9104.83
	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000		Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000	Prob > F=0.0000

Here '*' '**', '***'indicate significant value at 10%, 5% and 1% level of significance respectively.

Table 4
Impact and Spill-over effects of FDI using L-P Model

(Within or Fixed Effect Model)

Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Dependent Variable TFP	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**	**Coefficient**	**t Statistic**
For Part	-.005*	-1.74					-.004	-1.22			-.004	-1.38	-.004	-1.38
FS			-9.595***	-4.57			-13.118***	-3.94	-9.413***	-4.44			-12.273***	-3.66
BS			-3.20***	-3.36			-6.720***	-3.92	-3.906***	-2.93			-9.492***	-4.06
HS			.263	0.60			.243	0.32	.043	0.10			-.735	-0.97
HHI					.712***	5.33			-.304	-1.12	1.138***	5.01	-1.203***	-2.63
sigma_u	1.222		1.417		1.408		1.233		1.421		1.216		1.258	
sigma_e	1.16		1.015		1.025		1.144		1.016		1.157		1.142	
rho	0.526		0.66		0.653		0.537		0. .662		0.525		0.548	
R^2:within	0.0003		0.01		0.003		0.025		0.01		0.006		0.027	
R^2:between	0.008		0.01		0.003		0.013		0.01		0.0001		0.013	

R^2:overall	0.004	0.0001	0.005	0.002	0.0002	0.0007	0
No. Obs	9115	23813	23879	9089	23813	9115	9089
No. Groups	2176	6304	6304	2176	6304	2176	2176
	F(1,2175) =3.03	F(3,6303)= 27.27	F(1,6303 =28.40	F(4,2175)= 22.18	F(4,6303)=20.70	F(2,2175)=13.78	F(5,2175)=18.80
	Prob > F= 0.0819	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000

Here '*' '**', '***'indicate significant value at 10%, 5% and 1% level of significance respectively.

Table 5

Impact and Spill-over effects of FDI using L-P Model

(Random Effect Model)

Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Dependent Variable TFP	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic	Coefficient	z Statistic
For Part	.005***	3.62					.005***	3.97			.005***	3.66	.005***	3.96
FS			-7.731***	-3.83			-11.764***	-3.64	-7.896***	-3.91			-11.862***	-3.66
BS			-1.883**	-2.15			-4.919***	-3.23	-1.101	-1.14			-4.481***	-2.80
HS			-.129	-0.30			-.168	-0.23	.205	0.48			.086	0.12
HHI					.764***	6.77			.445***	3.03	1.125***	6.08	.305	1.39
sigma_u	1.041		1.277		1.281		1.044		1.276		1.038		1.044	
sigma_e	1.161		1.016		1.025		1.143		1.015		1.157		1.142	
rho	0.445		0.612		0.609		0.454		0. 612		0.446		0.455	
R^2:within	0.0003		0.01		0.003		0.023		0.008		0.005		0.022	

R^2:between	0.008	0.008	0.003	0.0001	0.0002	0.012	0.001
R^2:overall	0.004	0.0002	0.005	0.009	0.002	0.011	0.012
No. Obs	9115	23813	23879	9089	23813	9115	9089
No. Groups	2176	6304	6304	2176	6304	2176	2176
	Wald chi2(1) =13.12	Wald chi2(3)= 62.91	Wald chi2(1)= 5.85	Wald chi2(4)=89.52	Wald chi2(4)= 70.72	Wald chi2(2)= 51.51	Wald chi2(5)=91.05
	Prob > chi2=0.0003	Prob > chi2=0.0000	Prob > chi2=0.0000	Prob > chi2=0.0000	Prob > chi2=0.0000	Prob > chi2=0.0000	Prob > chi2=0.0000

Here ‘*’ ‘**’, ‘***’indicate significant value at 10%, 5% and 1% level of significance respectively.

Table 5

Correlations Matrix for Baseline Estimation

		Output	FS	BS	HS
Output	Pearson Correlation	1	-.003	.016(**)	.005
	Sig. (2-tailed)		.463	.000	.314
	N	49039	48832	48832	49039
FS	Pearson Correlation	-.003	1	.103(**)	.716(**)
	Sig. (2-tailed)	.463		.000	.000
	N	48832	48833	48833	48833
BS	Pearson Correlation	.016(**)	.103(**)	1	.445(**)
	Sig. (2-tailed)	.000	.000		.000
	N	48832	48833	48833	48833
HS	Pearson Correlation	.005	.716(**)	.445(**)	1
	Sig. (2-tailed)	.314	.000	.000	
	N	49039	48833	48833	49040

** Correlation is significant at the 0.01 level (2-tailed).

Table 6

Correlations Matrix for L-P Model

		FS	BS	HS	TFP
FS	Pearson Correlation	1	.103(**)	.716(**)	-.025(**)
	Sig. (2-tailed)		.000	.000	.000
	N	48833	48833	48833	23813
BS	Pearson Correlation	.103(**)	1	.445(**)	.017(**)
	Sig. (2-tailed)	.000		.000	.008
	N	48833	48833	48833	23813
HS	Pearson Correlation	.716(**)	.445(**)	1	-.025(**)
	Sig. (2-tailed)	.000	.000		.000
	N	48833	48833	49040	23879
TFP	Pearson Correlation	-.025(**)	.017(**)	-.025(**)	1
	Sig. (2-tailed)	.000	.008	.000	
	N	23813	23813	23879	23879

** Correlation is significant at the 0.01 level (2-tailed).

Table 7

Hausman Test for L-P method

	Coefficients			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
forshr	-0.004	0.005	-0.009	0.003
fs	-12.273	-11.862	-0.412	0.692
bs	-9.492	-4.481	-5.011	0.697
hs	-0.735	0.086	-0.822	0.257
hhi	-1.203	0.305	-1.508	0.219

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 70.86

Table 8

Hausman Test for Baseline Estimation

	Coefficients			
	(b)	(B)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	fe	re		
l	0.017	0.212	-0.195	0.052
k	-0.091	0.130	-0.221	0.051
m	0.355	0.516	-0.161	0.031
e	0.088	0.032	0.056	0.041
forshr	-0.003	0.002	-0.005	0.003
fs	-12.915	-12.963	0.048	1.040
bs	-9.841	-6.038	-3.803	0.830
hs	0.342	0.597	-0.255	0.361
hhi	-1.127	0.529	-1.656	0.246

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 204.31

Prob>chi2 =0