

# Impact of Spill-over Effects of FDI and Technology Gap on IT Services Firms in India

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## ABSTRACT

Impact of FDI on the host economy is an important area of research. Studies are abound in manufacturing sector but those in services sector especially IT are relatively scarce. This study makes an attempt to estimate the impact of FDI on Indian IT sector. Specifically, it looks at horizontal spill-over effects where the impact is through competitive pressure on domestic IT firms. Additionally, capital intensity, labor quality and technology gap have also been considered as determinants of productivity of Indian IT firms. Data on 24 domestic IT firms over the period 2002 to 2016 have been used to analyze the impacts. All the determinants are found to have statistically significant impact on productivity of domestic IT firms.

**Key Words:** FDI, Spillover Effects, IT Services, JEL Classification: F21

## 1. Introduction

Developing and underdeveloped countries aspire to have Foreign Direct Investment (FDI) for their development needs. Even though it may be a necessity it has not always favorably impacted the host economy or all recipient sectors. The impact depends not only on the factors like, availability of resources like raw material and labor force, government policies and local government's commitment towards infrastructural growth, law and order, etc. but also on the industry type (human resources intensive, capital intensive or labor intensive) and the gaps (technological, skill level of labor force, etc.) between the countries. The capability and capacity of the work force depend on geographical conditions, political environment apart from their current education or skill level, the prevailing education or skill development system and policies. Different industry sectors demand different type and degree of skill levels of workers. As a result, impact of FDI differs across countries and more importantly varies across industry sectors within a country.

Number of studies have been carried out on impact of FDI across industries and countries. However, impact on Information Technology (IT) sector has not been probed much. Major reasons being relatively sparse data availability, complex mechanisms at work due to forward and backward linkages in this sector. Treatment of capital, whether knowledge professionals be categorized as capital or labor has been a contentious issue. Most of the organizations being networked it is also difficult to pinpoint the impact when it comes to particular geographical locations.

Being export intensive, Indian IT industry has seen few ups and downs due to fluctuations in the global economy. The demand of IT services originates from every sector, be it core services (Banking and Financial Services, Insurance, Telecom, Retail, Hospitality, Airlines, Healthcare, etc.) or

core manufacturing (Automobile, Heavy Engineering, Mining and Metal, Power Generation, etc.). Indian IT industry graduated from development of custom made software for various industries to implementation of packaged ERP products (e.g. Oracle Financials, SAP, People-soft, J D Edwards, etc.). Today, it is primarily a human capital intensive and knowledge centric (both technical as well as domain knowledge of core manufacturing and services) industry in contrast to IT infrastructure only. The emerging field of Business or Data Analytics requires expertise in Machine Learning, Artificial Intelligence, Robotics, Stochastic Analysis and in a niche field, Big Data Analytics Platform as IT infrastructure (MPP – Massive Parallel Processing), and domain or functional knowledge and experience.

### Foreign Direct Investment (FDI):

Inviting and allowing of FDI has become an imperative for all countries to grow and succeed economically, more so for the developing nations in order to catch up with the developed countries in terms of technology-level and economic development. The multinationals that arrive with FDI become a conduit to transfer capabilities to the developing economies. Probably, taking the cue from success of FDI in China and India, other developing economies have opened their gates for FDI. As a result, the share of non-OECD (Organization for Economic Cooperation and Development) countries in the global stock of inward FDI has risen from 22% in 1990 to 32% in 2005 (Das & Das, 2012).

Comprehensive literature highlights the benefits of FDI for the host developing countries citing growth of India and China as success stories. As noted by Feldstein (2000) the host country can have several advantages through the inflow of FDI. It helps in transfer of technology particularly that cannot be transferred through just financial investments or trade of goods and services. FDI also increases the productivity in the said sector in host country

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through increased competition due to the presence of new players with advanced or newer technologies and management or business processes. Another benefit that can be seen is human capital development associated with adoption of advanced technologies, business processes, etc. Again FDI profits add to the tax bottom line of the host country. Finally, if the share of the profit of the FDI firm is reinvested as part of growth strategy of the firm itself, total investment and economic growth of the host country is further influenced positively.

Plethora of work has been done on direct and indirect effects of Foreign Direct Investment (FDI) in India. The direct impact of FDI is often measured through the growth in GDP achieved as a result of FDI in the host country (Kumar, 2014). Studies on FDI performance in a specific industry (Kumar, 2013) or FDI performance in one or more geographical areas have also been conducted. Most of these studies claim that the direct effect of FDI has been positive for the Indian economy overall citing reasons like increased GDP, higher salaries, better job options, availability of quality products, to name a few.

Like any other sector, manufacturing can experience spillover effects due to FDI. Sasidharan (2007) studied around 2700 Indian manufacturing firms for the period 1994-2002, and found that both the vertical and horizontal spillover effects are negative.

**Spill over Effects of FDI**

FDI-spillover is the indirect impact of FDI in the host country. The jury is divided on beneficial impacts of spillover. The findings depend on factors like host country type, specific industry, geographic location, etc.

Love and Lattimore (2009) postulated that technological spillovers from trade and FDI are due to three reasons:

- Their more advanced production methods and technology.
- Their network of international suppliers, customers and contracting firms, involving contacts with skilled people all over the world with knowledge-sharing and international training programs.
- Their intangible assets that are the source of their value creation, such as management and marketing skills.

The spillover effect can be of two types viz; **Horizontal Spillover and Vertical Spillover.**

**Horizontal Spillover**

Horizontal Spillover can be defined as the benefit achieved as a result of knowledge brought in with FDI into the same industry segment (Intra-industry) of the specific industry vertical wherever it is applicable, be it technical, improved processes or human resource skill or competency enhancement. Intra-industry (horizontal) spillovers result from the presence of MNCs in a particular sector and its influence on the host industry's competitors. Five transmission channels, through which intra- industry spillover effects might occur, are (i) competition (ii) demonstration and imitation effects (iii) transfer of technology and R&D (iv) human capital and labour turnover (v) industrial management (Blomström et al. 1999).

The employees working in FDI invested firms learn new or advanced skills or technologies or processes. They bring in these skills acquired in their previous role and use them directly or indirectly for their new employer or their own venture. The table 1 shows the various spillover channels and productivity gain of domestic firms through Horizontal Spillover effects.

**Table 1: Drivers and Sources of Productivity Gain**

Drivers	Sources of Productivity Gain
Competition	<ul style="list-style-type: none"> <li>◆ Faster adoption of new technology</li> <li>◆ Reduction in inefficiency</li> </ul>
Demonstration and imitation	<ul style="list-style-type: none"> <li>◆ Improvement of new production methods</li> <li>◆ Improvement of new management practices</li> </ul>
Transfer of technology and R&D	<ul style="list-style-type: none"> <li>◆ Adoption of new technology</li> <li>◆ Scope of productivity convergence</li> </ul>
Human capital and labour turnover	<ul style="list-style-type: none"> <li>◆ Tactical knowledge</li> <li>◆ Increased productivity of labour</li> </ul>
Industrial management skills	<ul style="list-style-type: none"> <li>◆ Increased access to international markets</li> <li>◆ Increased knowledge in promotional activities</li> <li>◆ Adoption of higher quality standards</li> </ul>

Source: Authors' own

### **Vertical Spillover**

Vertical Spillover on the other hand affects the suppliers (Upstream Sectors) and the customers (Downstream Sectors) of the firm having foreign presence (FDI venture, solo or joint with Indian partner). The domestic suppliers / customers learn new or improved skills, technology, management processes, business processes, operational processes, etc. and apply them in their domain or industry. The spillover that impacted domestic suppliers' firm from an FDI customer firm and applied to their business is called backward spillover and that learnt by a domestic customers firm of an FDI firm and then applied in their business are called forward spillover.

### **FDI Spillover Effect in Indian Context**

Sasidharan (2007) attributed the negative spillover effect of FDI in Indian Manufacturing to the lack of the confidence of the multinationals in the quality of domestic suppliers. Kathuria (2010) using panel data of nearly 1800 firms between 1994 and 2005 found that a large number of domestic firms are more productive than foreign firms, thereby precluding the spillover to all the sectors regardless of the reason(s). It is observed by several researchers that the spillover effect of FDI investment in India is mixed leading to an overall negligible effect.

### **FDI Spillover Effect specific to Indian Service (IT) Industries**

Outsourcing of Indian services started in the 80s with outsourcing of Information Technology (IT) jobs, and in early 90s when the Indian economy moved to a more open and free economy it created a new chapter for IT technology transfer.

The initial IT projects in India were software development projects where the Indian software team, whether onsite or in India, worked on the projects designed mostly by the clients. This can be considered equivalent of the manufacturing unit set-up in China which were used to manufacture goods in accordance to the design provided by their clients in the developed countries.

The Indian workforce engaged in these projects learnt about the technology and processes that are used by the overseas clients. The vertical spillover effect could be seen as this transfer of knowledge from the clients to the service providers. This is mostly due to two factors - 1) Indian professionals learnt about these software as part of executing jobs for their clients and 2) Indian firms working for their domestic clients proposed implementation of these software to local business, particularly to large manufacturing, banking, telecom, etc. houses during the initial phase. This led to learning of the driving principles behind design and implementation of such software. Thus, Indian professionals working on these products

could move up vertically in the value chain to understand the best processes adopted by the industry and provide consultancy to firms both at local and global level for implementation of these applications. As the industry gained experience in implementation of these products, there was demand from other industries for the implementation of such products in domains like insurance, pharmaceuticals, refineries etc. to name a few. This further led to recruiting domain experts by the IT industry from various sectors and it started the cascading effect across the length and breadth of the economy.

The global consulting players (IBM, Accenture, Deloitte, etc.) were already in this space. They started their Indian operations (FDI) to avail of the comparative advantages of cheap labor. Today a big section of Indian IT firms is not limited to just IT consulting, rather they have gone up the value chain and are involved in business consulting which involves implementation as well through software development or ERP implementation (which were their core competencies). This creates stiff competition for global business consulting firms like IBM, Accenture, Deloitte, Capgemini, etc. With the evolution of enterprise systems, the IT consulting teams evolved to be in the forefront of other applications that followed the suite including Customer Relationship Management (CRM) software like Microsoft Dynamics, Salesforce, NetSuite, etc. and Business Intelligence software like Tableau, IBM Cognos, Spotfire, etc. Of late the IT firms like TCS, Infosys, Wipro, etc. have carved a niche in areas of Business Analytics where they are doing consulting on advanced statistical, mathematical and econometrics models to gain insights for their clients' business. This is done collectively by a team of Business Domain experts, Mathematicians, Statisticians, Economists and ubiquitous Information Technology professionals. The field is known as data science/ data analytics and the professionals are known as data scientists. Hence, the above can be construed to be falling within Vertical Spillover effect of FDI where Indian IT firms went up the value chain and are engaged in higher segment of the value chain in IT consulting industry.

Many global industries (Banking, Manufacturing, Airlines, Hotels, Payroll Processors, Insurance, etc.) have their captive or joint-venture firms in India to execute some of their non-core low end activities. These Business Process Outsourcing (BPO) firms are also examples of vertical spillover of FDI in Information Technology Enabled Services (ITES) industry. India has become an FDI destination for these reasons and opportunities are growing further (the whole new Business Analytics world; e.g. banks - HSBC, RBS, Citibank, retailers - Target, TESCO, etc. are having their captive data analytics centre in India).

Horizontal spillover is visible in the improved operational and business/ quality processes adopted by the Indian IT

firms. The operations of IBM, Accenture etc. from India, made Indian IT firms focus on cost optimization in terms of resource utilization, productivity enhancement through cross functional training (domain knowledge, PMI, Prince2 Project Management certification, soft skill training to technical resources) and adopting and/or getting certified on quality processes like Capability Maturity Models (CMM or later version CMMI). Whether it is CMM or CMMI certifications, today Indian IT firms are at the forefront of any such certifications that create a brand value for them in their ventures with clients across the globe and made them eligible for penetrating into elite customer bases in USA while competing with other global giants like IBM, Accenture, etc.

### **Difference in Spillover Effects in Manufacturing and IT Service Industries in Indian context**

One of the factors that affect FDI spillover is the technology gap between the domestic industry (host country) and that of the FDI industry (source country). Depending on the level of this difference in technology being used, the magnitude of spillover effect varies. Manufacturing is capital intensive industry that requires large investment upfront, long gestation periods for the project to go on live and also requires investment for technological up gradation. If this difference of technology is large (true even for non-manufacturing), then often the local/ domestic firms of the host countries find it difficult to compete.

Service industry, consisting mainly of Telecom, Hospitality, IT, Banking and Financial Sector on the other hand is relatively less capital intensive and can be scaled up much easily compared to steel, cement, pharmaceutical, etc. Also the technology gap in the service sector is found to be much lower than that of the manufacturing industry. Hence, vertical spillover for service firms (especially in case of IT) is likely to be positive.

One of the strongest points in favor of growth of service industry (especially IT) in India is the availability of large English speaking professionally educated or trained workforce in Engineering, Management, Mathematics, Computer Science, Computer Application, Statistics, Economics, etc. The quality of education and competency in English is also compatible with the requirements of developed country in industry needs and those resources are readily available to MNCs in India at a lower cost. Many new institutes have come up both due to Government initiatives (new IITs, NITs, IIITs, IIMs, etc.) as well as private Engineering and Management institutes to meet specific demands of the knowledge-based industries. Little training can easily transform this workforce into productive manpower.

On the contrary, India is in short supply of blue-collared

workers trained in high-end manufacturing processes or machines. Sufficient resources are not available in the country to train these people as it requires capital - the machines being very expensive. Current institutes for apprenticeship or diploma or degree lack the infrastructure and trained faculty to conduct these kind of trainings.

IT requires relatively smaller capital upfront as compared to hospitality (setting up a hotel, real estate, etc.), telecom (hardware /exchange / towers, etc.) and easy to export. Banking and Financial Services (BFS) depend on the growth of the domestic market and there is a bigger challenge in exporting BFS products to other economies due to relatively stringent trading rules worldwide compared to IT.

IT has emerged as an important domain for its unique business model (e.g. onsite-offshore outsourcing model) established by Indian firms making it conducive to the resource requirements. The requirements are of English literate and education that develop logical and analytical ability/ skills or specific training in areas like Telecommunication, Computer Science or Application, Management, etc. In most of the cases, this potential workforce does not necessarily need long on-the-job training to be employable. This is unlike machinists or workers in manufacturing, infrastructure who can be made employable only after comparatively longer on the job training. The nature of job, logical and analytical ability of the workforce and programming techniques (that may be learnt easily by the workforce outside or before entering the industry through academic or professional institutes), have made countries like India with its large qualified people gain the comparative advantage in situations like Y2K crisis (Year 2000). Dot Com boom further helped India take a permanent place on the world map of IT industry. Today, if we visit any city in any developed country globally we will find Indians working in their IT industry and the average income of those Indians is much higher than the average per capita income of that region. This has been possible because this potential workforce is competent enough to be groomed and made employable in a short period of time. Hence, the academic curriculum in India can make the students employable immediately or after a short training period.

The Indian IT Industry giants or pioneers (Tata Consultancy Services, Infosys, Wipro, etc.) have created a differentiator through an onsite offshore business model. This unique model has made the IT services very economical for international clients in developed countries (USA, Canada, UK, Germany, Japan, Singapore, etc.). This is due to low cost labor compared to equivalent ones abroad and no need for them to travel and stay in those countries to provide the corresponding service. The advent of

telecommunication engineering further aided this model. Resources need to travel only for need assessment and final implementation and probably during functional testing.

Another critical point is the 'Production Support' or 'Maintenance Support' in IT sector from India to developed countries during their non-working hours (night time) by Indian workers. Post a day of work, the client can find the job done before they get to work next day. This made them feel that the problem has been solved in no time.

A large proportion of such workforce is also working for foreign clients or foreign employers (through FDI - be an offshore development centre or captive centre or consultancy services) while being in India, earning high salaries. Their frequent visits abroad add further to their earnings through on site wages - thereby improving their standard of living.

As already mentioned above there are many studies on the spillover effects of FDI in India. A few among them have been in services sector. Most importantly rigorous studies on the Spillover effect of FDI in IT industry is at best absent. Bratt (2006) worked on the FDI spillover effects in the IT in India. It was a qualitative study based on interviewing 14 Bangalore-based Indian IT firms' officials. To the best of our knowledge no quantitative analysis has been carried out to determine the spillover effects of FDI in the Indian IT sector. Few of the findings based on these qualitative (interview based) studies are interesting. Domestic firms do benefit from FDI Spillover effects during the initial phase of the development. Most important channel through which spillover happens is labor/ human mobility, client and partner relationships. It was also found that reverse productivity spillovers to the foreign firms also exist.

### Role of Technology Gap

Study by Fagerberg (n.d.) reveal a significant correlation between the development of an economy and 'Technological Gap' it has with other technologically advanced economies. Also, the rate of growth of economic development is positively impacted by the rate of growth of Technological prowess. The factors that influence the movement of technological gap are - ability to mobilize resources for transforming social, institutional and economic structures. It is also influenced by growth in innovative activities as well as imitation of technology.

Glass and Saggi (1996) studied the quality of technology transfer from Developed Countries to Under Developed Countries through FDI. Imitation of technology is evident through FDI. Firms from developed countries invest through FDI in less developed countries where cost is lower and technology transfer takes place.

FedrikSjoholm (1997) found that larger the technology gap higher is the technology spillover effects in

manufacturing sector in many developing countries including Indonesia.

One of the objectives of FDI is to reduce this technology gap or enhance the technological level of a country as a part of its economic development. Initiatives this study we would like to explore whether Technology Gap between foreign firms and domestic firms in the context of FDI in Indian IT industry has any impact on their productivity.

## 2. Objective

Taking clue from the study by Bratt (2006) we would like to estimate Horizontal Spillover effects of FDI in Indian IT industry. Further, the impact of capital investment (Capital Intensity) and quality of labor force (Labor Quality) would also be attempted. Capital is a critical factor for the small and medium scale domestic firms and India is one of the most favored destinations for tapping cheap IT workers.

The expected relationships are as follows:

- i. Horizontal Spillover Effect: Impact on performance (Productivity/ Revenue/ Profit Margin) of domestic firms because of the Competitive Pressure from Foreign Firms
- ii. Capital Intensity: host country is not financially very strong and assuming Foreign Firms belong to financially strong countries and capable of investing outside their country of origin, and that's why host country encourages FDI; Foreign firms may be more capital-intensive and larger than domestic firms, and these characteristics may account for some of productivity differentials between foreign and the domestic firms
- iii. Labour Quality: it is assumed that employees of Foreign Firms are more skilled and hence their salary / wages/ compensation package is higher than that of Domestic Firms; it is also assumed that due to availability of more skilled resource transfer of human resources between Domestic and, Foreign firms will help/ enable the domestic firms and hence the domestic economy enhance its national skill level of human resources
- iv. Technology Gap: To enhance its skill level following study by (Bratt 2006), we would like to prove in the context of FDI in Indian IT industry, whether 'Technology Gap between foreign and domestic firms' has any impact on productivity of domestic firms controlling for 'Technology Spillover (specifically Horizontal Spillover) effect' along with impacts of 'Capital Employed (Capital Intensity)' and quality of labor force (Labor Quality).

## 3. Empirical Model

Various scholars have used different models to quantify the effect of spillovers - vertical and horizontal. Havranek and

Irsova (2012) have conducted a meta-analysis of 57 papers and concluded that the spillovers are mostly measured using either Total Factor Productivity (TFP) or labor productivity as the response variable. Various control variables in the context of FDI spillover as identified by various studies ((Liang 2009), (Molly Leshar 2008) and (Hoi Quoc Le 2011)) are Labor Quality, Scale, Concentration, Technology Spillover Effects and Technology Gap.

*Proposed Empirical Framework*

Following Hoi Quoc Le (2011), we propose the production function of domestic firm to be Cobb-Douglas and homogeneous of degree one:

$$Y_{jt} = (K_{jt})^\alpha (L_{jt})^{1-\alpha} e^{Z_{jt}} \quad (1)$$

Where  $Y_{jt}$ ,  $K_{jt}$  and  $L_{jt}$  are output, capital and labor of domestic firm  $i$  in industry  $j$  at time  $t$ , respectively.  $Z_{jt}$  represents exogenous shocks (or control variables) to production. Dividing both sides of Equation (1) by  $L_{jt}$  gives the following function for labor productivity of domestic firm  $i$

$$\frac{Y_{ijt}}{L_{ijt}} = \left( \frac{K_{ijt}}{L_{ijt}} \right)^\alpha e^{Z_{ijt}} \quad (2)$$

The total factor productivity describes  $Z$  as 'a measure of elements such as managerial capabilities and organizational competence, R&D, inter-sector transfer of resources, increasing returns to scale, embodied technical progress and diffusion of technology'. Hence, labor productivity of domestic firm  $i$  can be expressed as follows:

$$\frac{Y_{ijt}}{L_{ijt}} = \left( \frac{Y_{ijt}}{L_{ijt}}, \text{Labour Quality}_{ijt}, \text{Technology Gap}_{ijt}, \text{Technology Spillovers}_{ijt} \right)$$

Where  $\frac{Y_{ijt}}{L_{ijt}}$  is the average labour productivity of a domestic firm  $i$  in industry  $j$  and is measured as the ratio of gross output to total employees.

$\frac{Y_{ijt}}{L_{ijt}}$  Capital Intensity $_{ijt}$ , is domestic firm  $i$ 's capital intensity, which is measured as the ratio of capital employed (Total Asset – Current Liability) to total employees in firm  $i$  in time  $t$ . Foreign firms may be more capital-intensive and larger than domestic firms, and these characteristics may account for some of the productivity differentials between them.

The empirically estimable equation can thus be derived by taking natural logarithm on both sides of equation (3) for a particular firm  $i$ :

$$\ln(\text{Productivity}_{ijt}) = e_0^K \ln(\text{CapitalIntensity}_{ijt}) + e_0^L \cdot \ln(\text{Horizontal Spillover}_{ijt} + \alpha \cdot \ln(\text{Controls}_{ijt} + \alpha_i + u_{ijt}) \dots \dots (4)$$

Where 'i' denotes domestic firms.

and represent semi-elasticity of Horizontal spillover, and Capital Intensity respectively.

Controls $_{ijt}$  is capturing effect of other control variables such as labor quality in our case.  $\alpha_i$  is the firm specific impact invariant over time. It basically captures the unobserved firm-specific effects impacting productivity.  $u_{ijt}$  is the error term. As we would like to explore the impact of Labor Quality, Capital Intensity and Horizontal Spillover effects on productivity of IT firms in India in this study, the following empirical model is estimated

$$\ln(\text{Productivity}_{ijt}) = e_0^K \ln(\text{CapitalIntensity}_{ijt}) + e_0^L \cdot \ln(\text{Horizontal Spillover}_{ijt} + \alpha \cdot \ln(\text{Labor Quality}_{ijt} + \text{Technology Gap}_{ijt} + \alpha_i + u_{ijt}) \dots \dots (5)$$

$i=1$  to 24 and  $t=1$  to 15

*Labor Quality $_{ijt}$*  represents the skills of workers that affect the productivity of firm  $i$  in period  $t$ . As the data on number of skilled workers are not available at firm level in PROWESS (or other databases for IT firms), labor costs (personnel expense that includes wages and training costs) per employee are used as a proxy for the Labor Quality. The assumption is firms with higher average labor costs are employing more skilled workers.

*Capital Intensity $_{ijt}$* , (Capital Employed per employee): Capital invested by a firm per employee in a specific year of operation. Capital employed is measured by subtracting Current Liability from Total Asset.

*Horizontal Spillover (HS $_{ijt}$ )* is measured as the ratio of Capital Employed in year  $t$  by an IT firm  $i$  to Total FDI invested in the Indian IT sector in that year:

$$HS_{ijt} = \frac{\text{CapEmployed}_{ijt}}{\text{FDI}_t} \quad (6)$$

This is the estimate of the pressure and/or the presence of foreign firms in the domestic market. Where, Capital Employed $_{ijt}$  is the Total Asset minus Current Liability in that year which is representing the amount of capital the firm invested in the year,  $t$ . When the same is divided by the total FDI in the same year in that sector, it gives the measure of the benefits of the pressure or the presence of foreign firm in this sector.

*Technology Gap $_{ijt}$*  for each domestic firm is measured as the percentage difference between the labour productivity of the domestic firm from the average productivity of the foreign firms in the country in the same industry:

$$\text{Technology Gap}_{ijt} = \left( \text{AverageLP}_{jt} - \text{LP}_{ijt} \right) / \text{LP}_{ijt}$$

**4. Data and Model Estimates**

We have collected financial data from Balance Sheets, Profit & Loss Statements, Financial Ratios, etc. for various foreign and domestic firms in the IT sector operating in India from their annual reports.

In order to ensure continuous data time wise for each firm for creation of panel data to be used for estimating equation (5), we could finally consider data for 15 years (from the year 2002 to 2016) on 24 Domestic Firms.

Following are the final variables (original or collected directly from data sources and derived using those raw variables) that have been used for analysis as shown in table 2:

**Table 2: Variable Definitions**

1. "Organization Name" - Firm's Name	
2. "Year" -	Year of operation
3. "Total Revenue" -	As in Balanced Sheet for a year
4. "Total Employee..." -	As in Annual Report for a year
5. "Avg. Employee" -	Average number of employee employed in a year = Average of Opening and Closing numbers of employees of a year
6. "Total Asset" -	As in Balanced Sheet for a year
7. "Avg. Asset" -	Average of opening and closing of Total Asset of a year
8. "Total Current Liabilities" -	As in Balanced Sheet for a year
9. "Avg Current Liabilities" -	Average of opening and closing of Current Liabilities of a year
10. "Capital. Employed" -	Difference of Avg. Asset and Avg Current Liabilities
11. "Total Salary" -	As in Profit & Loss Account for a year
12. "Productivity" -	Revenue by Avg. Employee
13. "Labour. Quality" -	Total Salary divided by Avg. Employee
14. "Capital. Intensity" -	Ratio of Capital Employed and Avg Employee
15. Technology Gap -	Ratio of (Average Productivity of Foreign Firms – Productivity of the Domestic Firm) / Productivity of the Domestic Firm

Following were the steps followed to estimate the model:

Step 1: Regression was run using Pooled Cross Section, Fixed Effect and Random Effect Models.

Step 2: LM Test was carried out to find out the significance between Pooled and Fixed Effect Model, which resulted in favor of Fixed Effect

Step 3: LM Test was carried out to find out the significance between Pooled and Random Effect Model, which resulted in favor of Random Effect

Step 4: Hausman Test was carried out to find out the significance between Fixed Effect and Random Effect Model, which resulted in favor of Fixed Effect

The final model results are shown in table 3, 4, and 5:

**Table 3: Fixed Effects Regression Results: Independent Variable - Productivity**

	Estimate	Std. Error	t-value	Pr(> t )
Ln Capital. Intensity:	0.258	0.039	6.4765	7.827e-10 ***
Labour. Quality:	0.244	0.028	8.5943	3.045e-15 ***
Technology Gap:	-0.034	0.0024	-14.0802	< 2.2e-16***
Horizontal Spillover CurrentFDI	-0.00086	0.00032	-2.6500	0.008728 **

(\*\*\*significant at 1%level, \*\*significant at 5%level)

**Table 4: Diagnostics**

Total Sum of Squares:	17.1
Residual Sum of Squares:	4.185
R-Squared:	0.75526
Adj. R-Squared:	0.72048
F-statistic:	146.581 on 4 and 190 DF; p-value: < 2.22e-16

**Table 5: Firm Wise Fixed Effect (a)**

Organization Name	α (Fixed Effect)
Acropetal Technologies Ltd (ACRO IN)	0.08964942
All sec Technologies Ltd (ALLT IN)	0.86400290
Aurion Pro Solutions Ltd (AUPS IN)	0.78880617
AXISCADES Engineering Technologies Ltd (AXET IN)	0.69779789
Blue Star Infotech Ltd (BLSI IN)	0.64171974
Cyient Ltd (CYL IN)	0.45945695

Datamatics Global Services Ltd (DATA IN)	0.47545692
eClerx Services Ltd (ECLX IN)	0.55042319
Firstsource Solutions Ltd (FSOL IN)	0.33659447
Geometric Ltd (GEO IN)	0.71186733
HCL Technologies Ltd (HCLT IN)	0.71561667
Hexaware Technologies Ltd (HEXW IN)	0.59700454
Infosys Ltd (INFO IN)	0.60499798
Mastek Ltd (MAST IN)	0.57541785
Mindtree Ltd (MTCL IN)	0.65487272
Mphasis Ltd (MPHL IN)	0.48426600
NIIT Technologies Ltd (NITEC IN)	0.71075691
Persistent Systems Ltd (PSYS IN)	0.48432855
Sasken Communication Technologies Ltd (SACT IN)	0.48421502
Sonata Software Ltd (SSOF IN)	1.29195594
Tata Consultancy Services Ltd (TCS IN)	0.80143421
Tech Mahindra Ltd (TECHM IN)	0.65588883
Wipro Ltd (WPRO IB)	0.72547371
Zylog Systems Ltd (ZSL IN)	1.02473761

## 5. Discussion:

The results show that horizontal spill-over effect is present in the Indian IT sector. FDI has been found to have statistically significant positive impact on productivity of Indian domestic IT firms. Further, labour quality is statistically significant for productivity enhancement in case of such firms and the same holds true for Capital Intensity. The sign of the coefficients for these three variables are found to be as per theory. The coefficient for Horizontal Spill over Effects variable has turned out to be negative. The Total FDI in IT sector in a year is the denominator of the variable. Hence, if the FDI increases then absolute value of the said variable decreases and with the negative sign it has a positive impact on the productivity.

Higher the Labour Quality, the productivity is expected to be higher. The coefficient for Labor Quality has a positive sign.

Developing and underdeveloped countries' economy lack finances for investment. This is one of the most critical reasons why FDI is sought by those governments. More importantly, if it is proven that Capital Intensity (Capital Employed per Employee) is a major factor in influencing

productivity in a specific industry sector, encouraging FDI in that industry sector is beneficial for the economy of the host country. The coefficient for this variable came out to be positive. Thus, as expected for the Indian IT sector capital and quality of labor have helped enhance productivity of the firms.

As per Bratt (2006) domestic firms are found to benefit from FDI Spillover effects during the initial phase of the development. Our study is based purely on financial data in which we have considered data from year 2002 to 2016 for 24 domestic IT firms. Indian IT industry is quite matured now, most of the firms we have considered are established IT firms (e.g. TCS, Infosys, Wipro, TechMahindra). Our result shows that Horizontal Spillover effect exists even at this matured stage.

We have found that the Technology Gap has a statistically significant impact on productivity of domestic firms. Hence, lower the gap more is the enhancement of productivity. This implies that controlling for other factors the presence of foreign firm benefits the local firms more when the technology gap is lower.

Another outcome we looked at is the fixed effect at firm level (Table 5). This means different firms get impacted by the FDI differently. Alternatively, there is a fixed bias for each firm in its productivity. This indicates the management style (e.g. HR policy in recruitment, leadership quality in leveraging to avail of FDI environment, etc.), culture, environment, etc. may cause benefits from FDI to be different across firms.

## 6. Conclusion

The study attempted to estimate the horizontal spillover effect of FDI in the Indian IT sector. The results show that even at this matured stage of the sector there is a strong evidence of positive horizontal spillover effect of FDI. The domestic firms have tried to compete with their foreign counterparts by improving their processes which is reflected in their higher productivity. Additionally, skilled manpower and higher capital intensity have also enhanced productivity of IT firms. Further, controlling for other factors, the presence of foreign firm benefit the local firms more when the technology gap is lower. Relaxation of FDI norms, skill-enhancement initiatives and endeavors to increase ease of doing business by the government seems to be efforts in the right direction.

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