DO PRODUCTIVITY SPILLOVERS FROM JAPANESE AND U.S. FDI DIFFER?

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ABSTRACT: FDI comes from different sources, with different levels of technology, different modes of transferring it and into different industries. The spillover effects of FDI may therefore differ. The paper attempts to study empirically the spillover effects of Japanese and U.S. FDI on the total factor productivity growth of the Indian firms, both at the firm and the industry level. The results show that the presence of Japanese equity in the industry has a positive spillover effect while the market share of Japanese firms is negatively associated with the productivity growth of the Indian firms. However, the net spillover effect at the industry level is positive. The spillover effects from U.S. FDI are however not significant.

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KEY WORDS: Productivity Spillovers, Japanese and U.S. FDI, Total Factor Productivity Growth, Technological Gap

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1. INTRODUCTION

Spillovers from FDI have widely been studied. Some studies (Caves 1974, Globerman 1979, Nadiri 1991, Blomstrom and Wolf 1994, Djankov and Hoekman 2000) have found positive spillovers of foreign firms on productivity of domestic firms. While, there are studies (Kokko 1994, Aitken, Hansen and Harrison, 1997, Haddad and Harrison, 1993) that suggest that foreign firms have negative effects on the productivity performance of the domestically owned firms. However no consensus has as yet been reached. A probable reason for this is that spillovers are FDI-industry-firm-host economy specific. The magnitude and direction of the spillovers will depend on many factors like the type of technology brought in by the FDI, the mode of transfer of the technology, the technological levels prevailing in the industry, the learning capabilities of the domestic firms, the absorptive capacity of the host economy which determines the rate of technical diffusion of the technology, etc.

While the industry, firm and host economy specific factors have been taken into account by the studies; hardly any of the studies on spillovers of FDI have tried to disaggregate the spillovers of FDI from different sources to compare them. It is generally believed that Japanese firms behave differently from other firms, either because of their protected domestic base or because they have different culture and institutional structure. (Graham and Krugman 1995). The Japanese FDI also differs in their industrial pattern from US FDI. US FDI in manufacturing is usually undertaken in most technologically sophisticated industries with not yet standardised products that are more capital-intensive in nature while Japanese FDI generally enters industries that are less capital-intensive producing standardised products that are less technology-intensive. Further, the transfer of technology from Japanese firms is termed as orderly transfer of standardised production that differs from the American "reverse-order" transfer of technology (Kojima 1978).

In specific case of Indian manufacturing it is found that US FDI concentrates in

Pharmaceuticals, Electronics, Chemicals-Organic, Personal Care, Dry Cells and Electric Equipment; which are technologically advanced sectors as compared to Japanese FDI which are prominently present in industries such as Auto-Ancillary, Automobiles-LCVs/ HCVs, Glass-Sheet/ Float and Rubber-Retreading. Given the differences in their industrial patterns and the belief that Japanese FDI differ from US FDI in terms of their levels of technology and modes of technology transfer it is expected that the spillover effects of Japanese and US FDI on Indian firms should differ. This paper attempts to identify the spillover effects of Japanese FDI and US FDI on total factor productivity growth of domestic firms in Indian manufacturing using panel data of seven years i.e., 1993-94 to 1999-2000. This period is of most significance for the Indian economy since it marks the post-liberalisation period.

The paper is divided into six sections. Section 2 of the paper discusses the empirical evidence; Section 3 presents the analytical framework and the hypotheses; Section 4 discusses the model, the variables and the sample. The empirical results are presented in Section 5 and finally Section 6 concludes the paper.

2. THE EMPIRICAL EVIDENCE IN THE LITERATURE

The empirical evidence on spillovers from FDI is mixed. Caves (1974) emphasised three potential spillover benefits as additional gains from FDI. These were improvements in allocative efficiency; higher level of technical or X-efficiency; and diffusion of technology and knowledge to local firms. Other positive effects on productivity of domestic firms, emphasised by studies, are via competitive pressures; learning by doing and diffusion of knowledge through demonstration effects, labour turnover or reverse engineering. (e.g., Caves 1974, Globerman 1979, Nadiri 1991, Blomstrom and Wolf 1994, Djankov and Hoekman 2000). However, there are others (e.g., Blomstrom and Kokko, 1997, Aitken, Hansen and Harrison, 1997, Haddad and Harrison, 1993) who find that foreign firms have negative effects on the productivity performance of the domestically owned firms.

Harrison (1994) suggests that in imperfectly competitive markets entry by foreign investors imply that domestic incumbents lose their market shares, impeding their ability to attain scale economies. Gagelmann (2000), in his study using firm level Polish data concludes that higher foreign presence within an industry affects local firms negatively. However, the effects differ between groups of firms and groups of industries. FDI has a negative effect on the performance of the most productive local firms in high competition industries. By contrast, the effect on the least productive state firms in low competition industries is positive. Grether (1999) in his study for Mexican manufacturing firms found that foreign capital is found to have a positive influence on productive efficiency at the plant level but contrarily to cross-industry studies it does not lead to significant spillovers at the sector level. Tsou and Liu (1998) used Taiwan manufacturing census data and concluded that in sectors where technology gap between foreign plants and locally owned plants is low a positive and statistically significant spillover effects occur, however if the technology gap is large there is no strong sign of spillovers.

The above studies are just a few in the vast literature on spillovers. However these studies together do establish the fact that productivity spillovers are industry-firm-host economy specific. In the Indian economy Kathuria (2000) and Basant and Fikkert (1996) have studied the spillover effects. Basant and Fikkert measured the influence of R&D expenditures, technology purchases, domestic and international R&D spillovers on productivity of the Indian firms. They found that spillovers from foreign subsidiaries have a positive effect that is independent of other channels.

However, these studies have failed to take into account the heterogeneity of FDI and the differences in their nature and behavior across sources. Hardly any of the studies on spillovers of FDI have tried to disaggregate the spillovers of FDI from different sources and compare them. This paper is an attempt in this direction of trying to bring out the inter-source differences in the productivity spillovers from FDI to the Indian firms.

3. THE ANALYTICAL FRAMEWORK AND THE HYPOTHESES

The debate about whether significant differences exist between Japanese and US FDI has a long if not altogether distinguished history. Many of the arguments made by early commentators, such as Kojima's (1978; 1986) distinguish between the trade-enhancing nature of Japanese FDI and the trade-undermining characteristic of US FDI. Ozawa's (1979) emphasized the importance of relative factor endowments in driving Japanese FDI. However, these studies have not withstood the test of time and empirical examination (for criticisms see Hill, 1988; Hill, 1990; Ramstetter, 1987).

Further, the presence of Japanese FDI in export-oriented manufacturing in different parts of Asia in the last decade appears to be little different from US FDI in its motivations. Along with this the importance of global trends to which all firms must respond regardless of home base, inspires caution in any attempt to make *a priori* comparisons between Japanese FDI and US FDI. However, the characteristics of Japanese corporations displayed in their domestic operations that are regarded as unique (Aoki, 1988; Womack, Jones and Roos, 1991) and which, if they are changing at all, are doing so only slowly (Yamamura, 1990; Yamamura, 1994) suggests that it is likely that the operations of Japanese FDI will continue to differ from those of US FDI. Some of these unique dimensions of Japanese corporations are inter-corporate relations, and the relations between corporations and the home government. Some of the unique production techniques like just-in-time sourcing, total quality management, FMEI, quality control circles, ringi system etc. if replicated in overseas affiliates, may benefit the host economy. Others, such as the *keiretsu* relations that link assemblers and suppliers and maximising market-share rather than short-term profitability may not lead to any potential benefits, in fact may lead to negative influences in the host economy.

Based on the literature on the characteristics of Japanese FDI that are unique in nature, we derive some hypotheses regarding the spillover effects of Japanese and US FDI.

HYPOTHESES:

HYPOTHESIS 1: Japanese FDI are expected to have larger positive spillover effects on total factor productivity growth (TFPG) of domestic firms as compared to US FDI.

The above hypothesis is derived on the basis of certain unique characteristics of Japanese FDI, i.e., its type of technology transfer, its mode of technology transfer and its industrial pattern. The unique characteristics of Japan's transfer of technology, as pointed out in the literature by many studies, is that it is an orderly transfer of technology of standardised production which begins in those industries where technical gap between the providing and receiving countries is the lowest. This should make transfer of technology easier and its spread effects larger. On the other hand, US FDI in manufacturing is seen to be undertaken in the most technologically sophisticated industries, with not yet standardised products that are more capital than labour intensive and rank on the top of the comparative advantage of the home economy. Kojima calls this "reverse-order" transfer of technology. This implies a large gap between the existing technology of the host developing country and that transferred to through the US FDI, which makes spillovers of the transfer of technology to the domestic firms difficult.

Furthermore, the mode of technology transfers starkly differs between Japanese and US FDI. It is often quoted that Japanese production models draws its strength more from human related dimensions of engineering techniques, workplace practices and corporate culture than through R&D or technology imports of capital goods or other disembodied technology imports. Organisational innovations and management practices have in recent times come to be accepted as one of the major aspects of technological development for enhancing productivity and growth.

In the specific case of India, the industrial pattern of Japanese and US FDI also differs. US FDI is concentrated in Chemicals and Pharmaceuticals industries, which involve process technology. This makes their technology less susceptible to the reverse engineering or imitation unlike the technologies in industries like Auto-Ancillary and Electrical where Japanese have a stronghold. These differential characteristics of the two FDI sources make Japanese FDI more susceptible to leakages or spillovers as compared to their overseas competitors. The Japanese firms are therefore expected to have larger positive spillover effects as compared to the U.S. firms.

HYPOTHESIS 2: The Market Share of foreign firms is expected to be negatively associated with the total factor productivity growth (TFPG) of the domestic firms.

The earlier studies have tested the hypothesis that productivity spillovers are strictly proportional to foreign presence but Kokko (1996) argues that this is not always the case. Spillovers from competition, in particular, are not determined by foreign presence alone but rather by the simultaneous interaction between foreign and local firms. Hence, it is possible that the spillovers are larger in case where a few foreign firms stir up a previously protected market than in a situation where foreign affiliates hold large market shares, but refrain from competing hard with local firms. In fact, sometimes large foreign presence may even be a sign of weak local industry, where local firms have not been able to absorb any productivity spillovers at all and have therefore been forced to yield market shares to foreign MNCs. Harrison (1994) also suggests that in imperfectly competitive markets entry by foreign investors implies that domestic incumbents lose market share, impeding their ability to attain scale economies. Based on these studies we derive our second hypothesis that market-share of foreign firms is negatively associated with the ability of domestic firms to raise their productivity growth rates, since they are unable to reap economies of scale.

HYPOTHESIS 3: The initial productivity gap between domestic firms and Japanese firms will be positively related to the TFPG of domestic firms and therefore support the "catch-up" theory, however the initial productivity gap between domestic firms and US firms may not be positively associated.

There are conflicting views on the relationship between the rate of diffusion and the gap between the level of technology in MNC's home country and the country hosting FDI. In Findlay (1978) and Wang and Blomstrom (1992) the rate at which new technology is diffused is an increasing function of the gap. The larger the gap is the greater the potential for "catch-up", on the other hand, some studies argue that spillovers are negatively related to the technology gap between the relatively "backward" host country and the "advanced" home country, due to the fact that the superior technology may not be appropriate for the backward country.

Taking an evolutionary approach, Perez (1983) argued that the ability of indigenous firms to "catch-up" depends on their level of technical competence. This competence is characterized by "path-dependency", i.e., the absorptive capacity of indigenous firms depends on their past accumulation of technology. The influence of these multiple factors suggests a non-linear relationship between spillovers and the size of the technology gap. Spillovers increase as the technology gap widens up to a certain critical level. Beyond this level spillovers begin to fall because technical competence by indigenous firms will be too low to exploit fully the technical opportunities arising from foreign presence and at still higher level may become negligible or even negative.

It is observed that US FDI in manufacturing is usually undertaken in most technologically sophisticated industries. We therefore expect the technological gap between US and Indian firms may fall below the critical levels. However, Japanese FDI generally enters industries that are less capital-intensive producing standardised products that are less technology-intensive. The technological gap between Japanese and Indian firms is therefore expected to be within the critical level. The "catch-up" theory can be expected to hold for the Indian firms vis-à-vis Japanese firms but not vis-à-vis US firms.

HYPOTHESIS 4: At the industry level, presence of Japanese FDI and US FDI is expected to be positively associated with TFPG of the industry if the net spillovers are positive.

Whether FDI leads to higher TFPG in industries or is FDI attracted to industries with higher productivity levels is a debatable issue. In this study since Japanese and US FDI follow a different industrial pattern therefore this issue is no longer debatable. At the industry level it is expected that the TFPG of industries will increase with the presence of Japanese and US firms since they are expected to have higher TFP levels. However, in some studies (Grether 1999) foreign capital has been found to have a positive influence on the productive efficiency at the plant level but it does not lead to significant spillovers at the sector level. To see whether our firm level analysis is also supported at the industry level we derive the above hypothesis.

4. THE MODEL; THE VARIABLES; AND THE SAMPLE

THE MODEL: FIRM-LEVEL ANALYSIS

The basis of our analysis here is a firm. We start with a four input production function i.e., with output Y and inputs as material inputs M, labour L, Fuel and Power E (Energy) and capital K. The production function can be written as

$Y_{it} = F(Lit, K_{it}, M_{it}, E_{it})$

Typically the model to be estimated is Cobb-Douglas representation of technology relating factor inputs and output for a given industry i.e.,

$$\text{Ln } y_{it} = \alpha + X'_{it}\beta + v_{it} - u_{it} \qquad (1)$$

Where i index firm and t index time periods. v_{it} is the usual normally distributed statistical noise with null mean and standard error (σ_v) accounting for random disturbances, measurement error and factors beyond the control of firms. u_{it} represents a time-varying productive inefficiency of the firm. u_{it} implies that the output of the firm must lie on or below the frontier $\alpha + X'_{it}\beta + v_{it.}$ From the firms' point of view, it may observe u_{it} and take the level of u_{it} into account while choosing its inputs. This violates the assumption of linear model of uncorrelated regressors with the error term and renders the estimation inconsistent. However, if u_{it} is included as regressor (i.e., fixed effects model), it would remove any biases that would have resulted from correlation between u_{it} and the regressor. If we assume that technical efficiency is time-invariant the model becomes

$$\text{Ln } y_{it} = \alpha + X'_{it}\beta + v_{it} - u_i$$

Where $u_{it} = u_i$ for all t

However, with the presence of foreign firms and their spillover effects due to increased knowledge, awareness of better technology and accumulated learning experience and increased competitive pressures, it becomes important to look at the changes in efficiency overtime. Using standard panel data estimation techniques Cornwell Sickles and Schmidt (1990) have outlined the procedure for estimating equation (1) without making any distributional assumptions regarding the firm-specific error terms.

Equation (1) can be rewritten as

$$\text{Ln } y_{it} = \alpha - u_{it)} + X'_{it}\beta + v_{it}$$

$$\text{Ln } y_{it} = \alpha_{it} + X'_{it}\beta + v_{it} \qquad (2)$$

Where α_{it} is the time variant productivity level of a firm and is modeled as

$\alpha_{it} = \theta_{i1} + \theta_{i2} + \theta_{i3}\ t^2$

Equation (2) can be written as

$Ln\ y_{it} = x'_{it}\beta + \omega'_{it}\delta_{i1} + v_{it}$

Where $\omega'_{it} = [\ 1\ t\ t^2]$

And $\delta'_i = [\theta_{i1}\ \ \theta_{i2}\ \ \theta_{i3}]$

This specification allows efficiency levels to vary both overtime and across firms. The model selected is Fixed-Effect model. The estimation procedure for the present model is to estimate δ_i by regressing the residuals ($yit - x'_{it}b$) for firm i on unity, time, and time squared. The predicted values from this regression provides an estimate of α_{it} that is consistent for all i and t as $t \rightarrow \infty$. Thus the change in productivity level (or productivity growth) of the firm can be estimated as

$$\Delta\hat{\alpha}_{it} = \hat{\alpha}_{it} - \hat{\alpha}_{it-1}$$

To test the hypotheses that TFPG of domestic firms is affected by the productivity spillover effects a cross-section model is applied taking seven year averages for the firm-specific and industry-specific variables and three-year averages are used for the spill variables since data is available only for three years for these variables. The model applied is as follows:

$TFPG_i$= f (spill variables; firm-specific variables; and industry-specific variables) + error term

Where i denotes domestic firms. The final model is linear in form.

VARIABLES: FIRM-LEVEL ANALYSIS

The spillover effects of FDI on the domestic firms in the host country are generally considered to be positive by most of the studies. However, recently some studies have shown that spillover effects of FDI can also be negative. The proxies used for the presence of foreign firms have generally been either the foreign equity in the industry or the market share of the foreign firms. To take into account both positive as well as negative spillover effects we have used the ratio of Japanese and U.S. equity invested in the industry to total equity invested in the industry along with the market share of Japanese and U.S. firms in the industry as spill variables.

The type of technology imported by Japanese and U.S. firms may also have a differential impact on the productivity growth of the domestic firms. To take this into account interaction terms are considered, i.e., technology imported by the Japanese firms* proportion of Japanese equity in the industry and technology imported by the U.S. firms* proportion of U.S. equity in the industry. The spill variables are defined as follows:

SPILL-VARIABLES:

a) Foreign equity as a ratio of total equity invested in the industry (FOREQ)
b) Japanese Equity as a proportion of total equity invested in the industry (JE)
c) US Equity as a proportion of total equity invested in the industry (USE)
d) Market Share of Japanese firms i.e., sales by Japanese firms/total sales in the industry (MKTSHJ)
e) Market Share of US firms i.e., sales by US firms/total sales in the industry (MKTSHUS)
f) Technology imports by Japanese firms*Japanese equity in the industry (TECHM*J)
g) Technology imports by US firms*US equity in the industry (TECHM*US)

The productivity growth of the firms is also dependent on some firm-specific variables like size of the firms, age of the firms, R&D intensity of the firms, etc. To control for firms specific variables the following variables are considered:

FIRM-SPECIFIC VARIABLES:

a) Size of the firm i.e., log of sales of the firms (SIZE)
b) Age of the firm (Age_i)
c) R&D Intensity of the firm i.e., R&D expenditure/sales ($R\&D_i$)
d) Export Intensity of the firms (XI_i)
e) Import Intensity of the firm (MI_i)
f) Capital-Intensity of the firm (KI_i)

g) Gap between initial productivity levels of domestic firms and average productivity levels of foreign firms (GAP)
h) Gap between initial productivity levels of domestic firms and average productivity levels of Japanese firms (GAPJ)
i) Gap between initial productivity levels of domestic firms and average productivity levels of US firms (GAPUS)

The fact that Japanese and US FDI may have a different industrial pattern it becomes important to control for the industry specific effects. The following industry-specific variables are considered:

INDUSTRY-SPECIFIC VARIABLES:

a) Capital imports by the industry (IMPCAP)
b) R&D intensity of the industry (R&D)
c) Export-Intensity of the industry (XI)
d) Import intensity of the industry (IMPI)
e) Effective Rate of Protection in the industry (ERP)
f) Advertisement Intensity of the industry (ADVT)
g) Capital-Labour Ratio in the industry (KL)

VARIABLES:INDUSTRY-LEVEL ANALYSIS

A similar analysis is also done at the industry level. A cross-section model is used to analyse the impact of FDI on TFPG of industries. The model uses the presence of Japanese and US equities along with total foreign equity in the industries, controlling for the industry-specific effects, to see whether the presence of Japanese and US FDI have similar impact on the TFPG of the industries. The variables used are as follows:

1. Foreign equity as a ratio of total equity invested in the industry (FOREQ)
2. Japanese equity as a ratio of total equity invested in the industry (JE)
3. U.S. equity as a ratio of total equity invested in the industry (USE)

4. Capital-labour ratio (K/L)
5. Import of embodied technology or capital goods in the industry (IMPCAP)
6. The import of disembodied technology, i.e., royalty and technical payments in the industry (ROY, TECHPAY)
7. The export-intensity of the industry (XI)
8. The research and development intensity of the industry (R&DI)

THE SAMPLE: FIRM LEVEL ANAYSIS

In order to estimate the production frontier and the final models at the firm level, we have collected data from Capitaline package, various issues of Annual of Survey of Industries (ASI), various issues of National Accounts Statistics and some publications of Ministry of Industry. A balanced panel is used for 153 firms for the year 1993-94 to 1999-2000 across 25 three-digit level industries. The criteria used for selecting industries is that only those industries are selected where at least 15% of the total equity invested in the industry is from Japan and/or US. Not much spillover effect is expected in the industries where this is less than 15%. A matching of industries from Capitaline package to ASI is done so as to construct data on variables that are not provided by the Capitaline package, e.g., data on number of employees.

All the variables used in the panel data estimation are measured at constant prices of 1993-94. The earlier studies estimating production function in the Indian manufacturing have used the wholesale price indices to deflate the series on output and inputs of the firms to arrive at the constant prices. However, we have used the actual prices of the major outputs and inputs of the firms to arrive at the indices for deflating output and input series of the firms. The variables constructed are as follows:

OUTPUT: The Capitaline package provides data on total sales and finished goods inventory of the firms. Total value of output of the firms is the sum of the two. In most of the earlier studies on Indian manufacturing the wholesale price indices are used as deflators for output. However, Capitaline package provides data on the major outputs of the firms along with their prices.

A weighted output price index series is constructed using the prices of two major outputs of the firms. The value (price*quantity) of the output is used as the weights in the series.

INPUTS: Capitaline package also provides data on the major inputs used by the firms along with their prices. The total raw-materials consumed by the firms is deflated by the weighted input price index series, which is constructed using the total cost of the inputs as the weights.

LABOUR: The series on labour is constructed using data from ASI. The data on total employee cost of the firms is collected from the Capitaline package and the series on number of employees is constructed using the wage-rate in corresponding industries estimated from ASI (Total Emoluments/ number of employees).

CAPITAL: The methodology used to estimate capital is that used by Srivastava (1996). However, the deflators used for deflating different series of capital are more disaggregated. Capital stock is taken to consist of Plants and Machinery, Land & Building and other Fixed Assets. Two separate series of capital are constructed i.e., one for Plants and Machinery along with other fixed assets and the other for Land & Building. These are deflated separately to arrive at estimates of capital stock in the base year i.e., 1993-94 for each firm. Data on Gross capital formation in plants & machinery and construction at current and constant prices are collected from NAS and an implicit deflator is arrived at. Applying this implicit deflator, capital stock in the year 1993-94 is estimated. However, since in the base year the firm's asset mix is valued at historic cost, the value of capital at replacement cost for the current year is arrived at by revaluating the base year of capital. Implicit deflators are constructed for last 15 years in case of plants and machinery of the firms and for last 25 years for construction in the firms or the date of incorporation of the firm, if it is after these years.

A revaluation factor (as used by Srivastava) is then applied to each series to obtain capital stock at replacement costs at current prices. Deflating these values we arrive at capital stock in real terms for the base year. Subsequent years investment is then added i.e., Gross fixed assets $_t$ - Gross fixed assets $_{t-1}$ to the capital stock existing at every time period using the perpetual inventory method. The capital stock series is hence arrived at for the firms.

FUEL AND POWER: Energy is an important input in firms' output. Capitaline package provides data on expenditure on fuel and power. A weighted price index is constructed to deflate the expenditure on fuel and power. This is done by using wholesale price indices for electricity for industrial purposes and furnace oil from CMIE publications. Weights used are the firms' expenditure on oil and power. Since the data for some of the series is available only till the year 1997-98 extrapolation has been used to arrive at the index numbers for recent years. Data for the firm-specific, industry-specific and spill variables are collected from the Capitaline package.

THE SAMPLE: INDUSTRY LEVEL ANALYSIS:

A cross-section model is applied using three year averages (1997-98 to 1999-2000) to analyse the impact of FDI on TFPG in industries. Capitaline package provides data for 315 industries, these are further aggregated and matched to ASI three digit level industries and finally data on total 230 industries is used. The variables are constructed as follows:

OUTPUT: The data on output of the industries are collected from Capitaline package. These are deflated by the wholesale price index of output for that year available from CMIE data.

MATERIAL INPUTS: The data on raw materials used in industries are deflated using wholesale price indices for materials of industrial products, collected from Handbook of Statistics (1997) CII, Office of the Economic Advisor, Ministry of Industry.

LABOUR: The data on employment is constructed using the Total Emoluments and Number of Employees data from matched industries in ASI. Using this data the wage-rate in the industries is estimated. Since data is available only till 1997-98, the growth rate of cost of living index is for the years 1997-98 to 1999-2000 is applied to the wage-rate from ASI. Data on cost of living index are collected from CMIE data.

CAPITAL: The data on Gross Block in industries are collected from Capitaline package and separate deflators are used for Construction and Plants and Machinery. The data are collected from various issues of NAS.

POWER AND FUEL: The data on Power and fuel consumption in an industry is collected from Capitaline package and it is deflated using the price index for power and fuel collected from the Index Number of Wholesale Prices. Data on other variables used in the industry-level analysis like Imports of Capital, Exports, R&D, Imports of Disembodied Technology,
Advertisement Intensity, Japanese Equity, US Equity and STO are collected from the Capitaline package.

5. EMPIRICAL RESULTS ON FIRM-LEVEL ANALYSIS:

Table 1 presents the descriptive statistics of the study. The total number of the firms considered is 153; out of which around 51% of firms are domestic firms. Table 2 presents the results of firm level analysis of productivity spillovers in four different equations, taking care of firm-specific as well industry-specific variables that may affect the TFPG of domestic firms. Though a number of variables have been used, the equations with the best fit are presented.

Equation (1) of Table 2 presents the results with foreign equity (FOREQ) as one of the spill variables. We find that FOREQ, as an aggregate has no significant impact on the TFPG of the domestic firms. Equation (2) presents results by disaggregating FOREQ into Japanese equity and US equity invested in the industry. We find that JE has a significant positive spillover effect on the TFPG of the domestic firms, after controlling for the firm and industry specific effects. US equity has no significant effect on the TFPG of the domestic firms. This shows that FDI from different sources may have differential spillover effects. Therefore aggregating FDI to estimate the spillover effects, as has been done by most of the studies on spillover, may not reflect the true picture.

Equation (2) of Table 2 presents the results of the effect of market share of foreign firms on the TFPG of the domestic firms. We find that the average market share of foreign firms is negatively associated with TFPG of domestic firms supporting the hypothesis that foreign firms may capture larger market share as a result of which the domestic firms may not be able to attain scale economies.This is in line with the findings of Harrison (1996). However, market share held by Japanese firms have a significantly larger negative impact as compared to the US FDI. (Equation 3, Table 2) A probable reason for this could be that Japanese FDI have entered smaller industries as compared to US FDI as a result of which it has been easier for the Japanese firms to have large market shares. Also, their marketing strategy of emphasizing market share rather than short-term profits may have led them to have large market shares.

Spillover effects of Japanese FDI on the TFPG of domestic firms are therefore both positive as well as negative in nature. However, spillover effects of US FDI are not significant. One of the reasons for this could be the nature of technology brought in by the Japanese and US firms. To test this an interaction term is considered i.e., the import of technology (both embodied and disembodied) by Japanese and US firms with the amount of Japanese and US equity invested in the industry respectively. Equation (4) of Table 2 shows that the impact of the technology imported by Japanese firms and US firms on TFPG of domestic firms differs. Technology import by Japanese firms has a significant positive impact on TFPG of domestic firms while that of US has a negative impact though it is not significant. From this it can be said that the domestic firms are learning from the technology brought in by the Japanese firms in the industries. However, the TFPG of domestic firms is not affected by the technology imports of the US firms. Given the type of industries where US FDI have entered this seems to be possible since the chemicals and pharmaceutical industries involve process technology which makes their technology less susceptible to reverse engineering or imitation unlike auto-ancillary and electronic technology which is the stronghold of Japanese FDI in India. .

Taking the initial gap in the productivity levels of the domestic firms and the average productivity levels of foreign firms in the industry, we find that gap has no significant effect on the TFPG of the domestic firms (Equation 1, Table 3). However, if the initial gap between the productivity levels of domestic firms is compared to the average productivity levels of Japanese and US firms separately, we find that the gap with the Japanese firms has a significant positive impact on the TFPG of the domestic firms supporting the "catch-up" theory while the gap with the US firms does not have any significant effect on the TFPG of the domestic firms. Since the ability of indigenous firms to "catch-up" depends on a large extent on their level of technical competence and Japanese firms have entered low technology industries where this gap is lower as compared to industries where US firms have entered, this result seems to be possible. The result is in line with the results of Blomstrom & Wolff (1994) and Kokko et al (1996). While Blomstrom found that domestic producers' productivity increases more rapidly and the gap from competing foreign producers' productivity grows narrower, the larger the initial productivity gap, Kokko found positive and statistically significant spillover effects only in a sub sample of locally owned plants with moderate technology gaps vis-à-vis foreign firms.

To see whether the net spillover effects of Japanese FDI on the TFPG of domestic firms is positive or not a dummy variable is created which takes the value unity if the concentration ratio i.e., ratio of Japanese equity invested in the industry to US equity invested in that industry is greater than 0.5, otherwise it takes the value zero. This variable allows us to test whether higher presence of Japanese firms in the industry vis-à-vis US firms positively affects the TFPG of the domestic firms or not. Equation (2) of Table 3 presents the results and we find that this variable is positive and significant. The net effect of Japanese presence in the industry on the TFPG of domestic firms can therefore be said to be positive.

The overall results at the firm-level more or less support our hypotheses and it can be said that Japanese FDI in the Indian manufacturing have positively contributed to the TFPG of the domestic firms though the same cannot be said for the US FDI. The reasons for this may be the differences in the type of industries that Japanese FDI and US FDI have entered, the type of technology brought in by them, the modes of transferring the technologies and also the technological capabilities of the domestic firms in the industries they have entered.

EMPIRICAL RESULTS ON INDUSTRY-LEVEL ANALYSIS:

To see whether firm-level analysis is supported by the industry-level analysis, we run separate regression for industry-level data. The results are presented in Table 4. At the industry-level it is expected that the presence of foreign firms should positively affect the TFPG of the industry since these firms have ownership advantages and are expected to have better technology and so higher TFPG rates. We find that at the industry level, foreign capital and import of technology, both embodied and disembodied, positively affect the TFPG of the industry. However, if the foreign capital is disaggregated into Japanese equity and US equity invested in the industry we find that JE has a positive and significant impact while US equity has a negative impact on TFPG of the industry though this is not significant. Since the overall value of adjusted R^2 is not very high, we cannot lay lot of emphasis on this result.

6. CONCLUSION

Productivity Spillovers appear to be FDI-firm-industry-host economy specific. FDI from different sources enter different industries. They come with different levels of technologies and different modes of transferring technologies. The receptivity of technologies further differs amongst the domestic industries. Taking all this into account there is a reason to believe that the spillovers from FDI from different sources may differ. The paper contributes to the literature on productivity spillovers from FDI by differentiating productivity spillovers from FDI from different sources. An attempt is made to compare the productivity spillovers from Japanese and US FDI to domestic firms in Indian manufacturing using the panel data for the period 1993-94 to 1999-2000 to estimate the average annual total factor productivity growth rate. An attempt is made to control for firm-specific and industry-specific effects. The analysis is done using both firm level and industry level data.

The results show that foreign capital, as an aggregate, may not have any significant productivity spillovers. However when disaggregated into Japanese equity and US equity invested in the industry we find diverse results. Japanese equity has a significant positive impact on the total factor productivity growth of the domestic firms but US equity has no significant effect. The spillovers effects of FDI may also negative. Negative spillovers occur due to large market share of the foreign firms, which may not allow the domestic firms to attain scale economies. It was found that the market share of Japanese firms is negatively associated with the TFPG of the domestic firms. However, the net spillover effect of Japanese FDI seems to be positive. This is also supported at the industry-level analysis. The productivity spillovers from US firms appear to be negative both at the firm level as well as the industry level, though the results are not significant.

The study suggests that a number of factors contribute to raise the absorptive capacity of the host country. Amongst them are the local competence, the types of technology brought in by the foreign firms and the competitive environment created by the foreign firms. In addition to explaining some of the differences in different sources of FDI and industries when it comes to productivity benefits of FDI, the study also suggests the possible role for economic policy in the host countries. It appears that policies supporting a more competitive environment should be followed in those industries where the local firms have higher competence levels and there are fewer chances for the foreign firms to capture the market share. A more protective environment would lead to higher TFPG of domestic firms in industries where local firms do not have the competitive ability. Therefore a useful policy mix is required for maximising the productivity benefits from the FDI.

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TABLE 1: DESCRIPTIVE STATISTICS	
1. Number of industries	**25**
2. Number of firms	**153**
3. Number of domestic firms	**78**
4. Number of Japanese firms	**32**
5. Number of U.S. firms	**35**
6. Number of other foreign firms	**8**

TABLE1 1. PRODUCTIVITY SPILLOVER FROM JAPANESE AND US FIRMS:

FIRM LEVEL ANALYSIS

VARIABLES	(1)	(2)	(3)	(4)
CONSTANT	**0.007** **(-0.449)**	**-0.011** **(-0.693)**	**-0.003** **(-0.208)**	**0.003** **(0.241)**
FOREQ	**0.001** **(0.313)**	**–**	**–**	**–**
JE	**–**	**0.012***** **(1.67)**	**–**	**–**
USE	**–**	**-0.009** **(-0.244)**	**–**	**–**
SIZE	**0.003** **(1.21)**	**0.003** **(1.12)**	**0.002** **(1.07)**	**0.002** **(0.744)**
XI	**-0.133** **(-1.28)**	**-0126** **(-1.22)**	**-0.134** **(-1.29)**	**-0.09** **(-0.878)**
KI_i	**0.001*** **(2.62)**	**0.001*** **(2.72)**	**0.001*** **(2.85)**	**0.001*** **(2.76)**
MKTSHFF	**-0.028** **(-1.25)**	**-0.052**** **(-1.98)**	**–**	**–**
IMPI	**2.47** **(1.45)**	**3.04***** **(1.79)**	**3.9*** **(2.08)**	**–**
MKTSHJ	**–**	**–**	**-0.058*** **(-2.159)**	**-0.062*** **(-2.25)**
MKTSHUS	**–**	**–**	**-0.304** **(-1.271)**	**-0.130** **(-0.72)**
TECHM*US	**–**	**–**	**–**	**-0.009** **(0.015)**
TECHM*J	**–**	**–**	**–**	**0.006*** **(2.74)**
ADJ R2	**0.115**	**0.140**	**0.141**	**0.116**
N	**78**	**78**	**78**	**78**

*indicates significant at 1%

**indicates significant at 5%

***indicates significant at 10%

TABLE 3: PRODUCTIVITY SPILLOVER WITH INITIAL PRODUCTIVITY GAP FROM JAPANESE AND US FIRMS: FIRM-LEVEL ANALYSIS

VARIABLES	EQUATION 1	EQUATION2
CONSTANT	**-0.002**	**-0.13**
	(-0.193	**(-0.934)**
R&D	**0.02**	**0.03**
	(1.02)	**(1.40)**
XI	**-0.142**	**-0.089**
	(1.41)	**(-0.91**
KI_i	**0.001***	**0.001***
	(3.01)	**(2.88)**
GAP	**0.016**	**–**
	(1.22)	
GAPJ	**–**	**0.004***
		(2.22)
GAPUS	**–**	**-0.008**
		(-0.006)
MKTSHJ	**-0.04****	**–**
	(-1.73)	
MKTSHUS	**-0.285**	**–**
	(-1.35)	
IMPI	**397.5***	**434.3***
	(2.11)	**(2.22)**
PRESENCEJ	**–**	**0.016***
		(2.45)
ERP	**–**	**-0.051***
		(-3.29)
ADJ R2	**0.12**	**0.14**
N	**78**	**78**

*indicates significant at 1%

**indicates significant at 5%

***indicates significant at 10%

TABLE 4: PRODUCTIVITY SPILLOVER: INDUSTRY LEVEL ANALYSIS

VARIABLES	**EQUATION1**	**EQUATION2**
CONSTANT	**-0.077*** **(2.78)**	**-0.075*** **(-2.8)**
FORCAP	**0.002***** **(1.84)**	**–**
JE	**–**	**0.006***** **(1.81)**
USE	**–**	**-0.001** **(-0.429)**
K/L	**0.057** **(0.77)**	**0.054** **(0.74)**
IMPCAP	**1.01*** **(2.18)**	**0.98** **(2.11)**
XI	**0.04** **(0.35)**	**0.07** **(0.59)**
R&DI	**0.173** **(0.106)**	**0.11** **(0.06)**
TECHPAY	**3.59*** **(2.64)**	**3.57*** **(2.62)**
ROY	**12.89*** **(2.53)**	**13.51*** **(2.67)**
ADJR2	**0.09**	**0.08**
N	**230**	**230**

***** indicates significant at 1%
****** indicates significant at 5%
******* indicates significant at 10%