FOREIGN DIRECT INVESTMENT AND TECHNOLOGY SPILLOVER:
AN ANALYSIS WITHIN OR BETWEEN SELECT INDUSTRIES OF
INDIAN MANUFACTURING SECTOR

ABSTRACT SUBMITTED TO THE UNIVERSITY OF DELHI
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Abstract

The study attempts to explore the different aspects of the technology spillover effect of foreign direct investment (FDI) across Indian manufacturing Industries. Initially, the study attempts to examine the role and presence of FDI and its horizontal technological spillovers effect on domestic firms’ labor productivity across sixteen organized Indian manufacturing industries. Foreign presence by way of FDI reflects the horizontal spillover across manufacturing industries in India. To measure the FDI and its horizontal technology spillover effect, sixteen manufacturing industries have been selected, out of which twelve are broad 2-digit level and four allied industries which are part of chemicals, transportation, electronics, and rubber and plastic products. The study has undertaken an industry-level analysis of sixteen manufacturing industries out of which 2148 firms are considered as domestic firms and 231 firms are considered as foreign firms, so that the total firms in these sixteen selected industries are 2379. Data has been collected from the various sources for example: the principal source is CMIE based Prowess data set, while other data sources are the Annual Survey of Industries (ASI), National Accounts of Statistics (NAS), RBI Bulletin, and Handbook of Statistics on Indian Economy, etc.

The analysis gives a long-run relationship of labor productivity with respect to the set of explanatory variables, which further leads to technology spillovers across Indian manufacturing industries. To estimate the long-run relationship the study has employed the methodology of Pedroni panel cointegration, group fully modified OLS (GFMOLS), fully modified OLS (FMOLS), and dynamic OLS (DOLS) techniques. By employing Pedroni (2000, 2004) cointegration tests, we find a significant long-run relationship between labor productivity in large size domestic firms and its determinants in the empirical model. However, from the different empirical models estimated, there is indication of the presence of cointegration and the existence of technology spillovers among not only large firms, but also among relatively smaller firms. These cointegration results, based on panel data from 1990 to 2007 across sixteen Indian manufacturing industries suggested that foreign presence played a
significant role in lifting the level of technology of the domestic firms through technological spillovers. We find that foreign presence has been positively associated with labor productivity, knowledge and technology spillovers. Foreign presence by way of FDI brings new channels of knowledge and technology to the domestic firms and further, it can facilitate higher productivity and technology spillovers.

From empirical results we find that TFP is a positive function of R&D intensity of domestic and foreign firms and technology import intensity (TMI) of both domestic and foreign firms. Technology spillovers can be transmitted via different types of intermediate factors, and from this result it was evident that a rise in the TMI gained momentum for the improvement of labor productivity over domestic firms and technology spillovers across Indian manufacturing industries. Both R&D intensity and TMI can facilitate in raising the knowledge and technology spillovers through the channel of imports. The results also highlight the important role of TMI of the foreign firms in increasing the labor productivity of the domestic firms. Our findings indicate that the higher the TMI of the foreign firms, the higher would be the TMI of the domestic firms in order to compete in the market. Thus, the TMI of the foreign firms can in an indirect way generate positive externality for the domestic firms to improve their labor productivity. Technological differences between foreign firms and local firms has had a negative effect on the productivity of domestic firms, and our findings suggest that higher the technological differences, the greater will be the imitation problem and hence the lower the absorptive capacity of the domestic firms leading to lower technology spillovers.

Secondly, the study empirically examines the FDI and its dynamic spillovers effect across Indian manufacturing industries. It discusses the dynamic panel data models and its application to Indian manufacturing industries. It discusses the theoretical intuition behind the methods of GMM while focusing on the multivariate autoregressive distributed lag models. The study analyzes the lagged effect of the dependent variables (labor productivity) and other level and lagged form of explanatory variables, which corresponds to the dynamic spillovers across sixteen Indian manufacturing industries. The difference GMM and system GMM has been exerted in our autoregressive distributed lag models (ARDL) with variables in level and lagged difference forms. The size of the firms can act as a major determinant for the technology spillovers because the absorptive capacity of the large-size firms might be higher in comparison to the small-size firms. Thus, two separate ARDL panel data models one for small size firms, the other for large size firms have been estimated to examine the idea of the absorptive capacity and dynamic technology spillover at the industry level.
The study finds that the higher the technological differences between the domestic and foreign firms the lower would be the labor productivity and technology spillovers across Indian manufacturing industries. Our results indicate that the degrees of technology spillover are not subject to the size of the firms rather it can be affected by some other factors. Further, we found that dynamic technology spillover is present across all types of firms of Indian manufacturing industries. It is crucial to draw attention to the fact that labor productivity spillovers are subject to the autoregressive parameter (lagged labor productivity) and lagged exogenous variables. This is an important finding in this study. The study suggested that higher foreign establishments in an industry augment the productivity of the domestic firms and enhance the technology spillover across Indian manufacturing industries. In some cases, the lagged foreign presence accelerates the productivity and technology spillovers across Indian industries. The study further finds that dynamic spillover arises from the previous year intra-industry foreign presence and other prominent past shock factors. By examining the influential variables in spillover analysis like R&D intensity and technology import intensity, the study find that to some extent these variables did contribute to increases in labor productivity and led to dynamic technology spillover across Indian industries.

Thirdly, the study analyzes the horizontal and vertical technology spillovers effects of FDI across ten selected clusters in the north, south, east and west regions in India. In order to measure the technology spillover across industries in a particular cluster the study has taken seven broad 2-digit level industries like chemicals, metal products, non-metallic mineral products, non-electrical machinery, electrical machinery, transport equipment and textiles. To measure the technology spillover of a particular cluster the analysis here develops an innovative production function along with a conventional production function, which measures the FDI and technology spillover in a cluster and simultaneously it accounts for the inter-cluster technology spillover. In fact, the specification of the production function is to measure the technology spillovers across ten selected clusters in India and its inter-cluster spillover analysis with respect to some basic parameters in the model. The technology spillover across ten selected clusters and its inter-cluster technology spillover analysis can be empirically examined by applying the panel data methods of pooled OLS estimate, within group estimate (WG) and Generalized Method of Moments (GMM) estimates.

We find that all four selected clusters from the northern region show a positive spillover from their regional foreign presence rather than from their own cluster-specific foreign presence. This suggests that domestic firms in a cluster get benefits from their northern region foreign counterparts rather than from their own cluster-specific foreign firms. The
technology stock of a cluster does not in general exert a strong positive influence on the productivity of the domestic firms across northern region clusters. But, the technology stock of the region matters in some cases. Similarly, cluster specific R&D investment increases labor productivity in some cases. The technology stock in Kolkata cluster affects positively the productivity of domestic firms through technology spillover. Therefore, domestic firms get benefit by devoting more funds for R&D. From the analysis undertaken for the Kolkata cluster, it is apparent that domestic firms get benefit from their region-specific foreign firms rather than the foreign firms which are located in the Kolkata region. The study does not get any proper evidence regarding the possible productivity enhancing effect of investment climate in the Kolkata cluster. Rather, it appears from the empirical results that firms plant locations in the core area of a cluster or nearer to the core areas of a cluster does not give any significant advantage to firms located in the Kolkata cluster. It seems location of the firms in the Kolkata cluster has little impact on the ability of the firm to gain information and knowledge spillover from the foreign firms in the cluster or in other clusters of the region.

From the study we find that cluster/region specific technology stock and cluster/region specific foreign presence do not seem to have much effect on the domestic firms’ productivity across the western region clusters. In the Ankleswar and Thane clusters, technology spillover is quite insignificant, probably because of the low presence of foreign firms in this region. It appears from the study that technological spillovers to domestic firms in southern region clusters are relatively high in comparison to clusters of other regions in India. This is probably because of the relatively greater presence of foreign firms in the southern region. Further, in a comparison among Bangalore, Chennai and Hyderabad, the extent of technology spillover seems to be relatively greater for the domestic firms in the Bangalore cluster. This is probably attributable to the significant level of foreign presence in this cluster. From the southern region clusters, we do not get much empirical support for the hypothesis that if a firm is located in urban areas of a cluster or in the core part of the cluster, it will have greater scope for gaining from the technological spillovers. Rather, the empirical results seem to suggest that, both rural and city area located firms are almost equal gainer from their foreign counterparts in terms of knowledge and technology spillovers.

Finally, the study empirically examines the horizontal and vertical spillover of FDI across Indian manufacturing industries. In order to empirically examine the intra-industry and inter-industry technology spillover the study has taken twelve broad 2-digit level industries namely, food products, beverages and tobacco, cotton textiles, textiles, woods products, paper and paper products, leather products, chemicals, non-metallic mineral products, metal
products, non-electrical machinery and electrical machinery. The intra-industry and inter-
industry technology spillovers from FDI are transmitted via different kinds of intermediate
factors and it gives an equilibrium relationship between the variables over long-run dynamics
such that labor productivity of the domestic firms becomes higher.

The study analyze the significant role of intermediate factors in the production process
which is integrated in diverse ways such that it can act as a catalyst to augment the labor
productivity and technology spillover across Indian manufacturing industries. Pedroni panel
cointegration approach has been used to find out the long-run relationship between endogenous
and exogenous variables. By implementing Pedroni test the study analyzed that technology
spillover can be transmitted by the constructive role of the intermediate factors. We found that
the pivotal cointegrating vectors should include intra-industry/horizontal foreign presence and
other/inter-industry foreign presence, since these have exclusive penetration effect to spur
labor productivity and technology spillover across Indian industries. Further, on decisive note,
technology import intensity, inter-industry technology import intensity, R&D intensity and
inter-industry R&D intensity promote labor productivity and technology spillover. Moreover,
the study underscores the significant function of R&D intensity and inter-industry R&D
intensity, in so far as both factor enhance absorptive capacity of a localized firms and drive
labor productivity and technology spillover.

The study examined the within or between industry technology spillover effect of FDI
across Indian manufacturing industries. The study found evidence for the occurrence of
horizontal and vertical technology spillover in eight industries out of twelve manufacturing
industries. Empirical findings reveal that the industries like cotton textiles, textiles, woods
products, paper and paper products, leather products, chemicals, non-metallic mineral products
and electrical machinery experience both intra-industry and inter-industry technology
spillovers effect of FDI.