Literature Review: What's the Effect of FDI on Domestic Innovation Capability?

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As an important part of globalization, Foreign Direct Investment (FDI) plays an irreplaceable role in many aspects. FDI not only includes transnational flow of tangible capital, but also the international transfer of intangible capital such as technology and management methods. According to some countries' practical experience, it has many effects on host countries such as promoting technological progress, stimulating economic growth and updating the industrial structure. While it may be a different story in another country. But there is commonly accepted viewpoint that with deeper and further utilization of FDI, the technology spillover effects of FDI has increasingly become an important factor affecting regional technological innovation capabilities. However, whether FDI can enhance the level of regional technological innovation has not yet been formed consensus in the academic community. My research is expected to investigate the relationship of FDI and innovation capabilities in China considering the geographical correlation of regions and contribute to this issue from the spatial analysis perspective.

How have others answered the similar question?

The effect of FDI on Domestic Innovation capability has received a great deal of research attention since last decades. Scholars hold different views on whether FDI

can enhance the technological innovation capability of domestic countries. The mainstream viewpoints basically can be divided into three categories: promotion theory, inhibition theory and uncertain influence theory.

(1) Promotion Theory

Jonathan E. Haskel et al. (2002) use the plant-level panel for U.K. manufacturing covering 1973-1992 to estimate production function for domestic plants augmented with terms measuring foreign presence in the industry and region, they conclude that there is a significant positive correlation between a domestic plant's TFP and the foreign share of employment in that plant's industry, while no significant effects for foreign share of employment by region. From industrial level, Smarzynska Javorcik, Beata (2004) obtain the similar conclusion that there are positive productivity spillovers from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors. But the spillover effects are limited in the shared ownership. Based on the Mexican manufacturing industries data, Magnus Blomström (1986) proposes that foreign presence in an industry has positive effects on structural efficiency and the most important source of spillover efficiency is the competitive pressure induced by the foreign firms. Different form the previous literature, Magnus Blomström (1986) focuses more on the mechanisms of the spillover efficiency of foreign investment took place based on the analysis of the effects of FDI on the productive efficiency of the industrial structure in Mexico.

(2) Inhibition Theory

Bishop et al. (1999) examine the impact of ownership on the likelihood of innovation using a sample of UK defence related firms and the results show that foreign ownership has a negative indirect impact upon innovation. Similarly, Brain J. Aitken et al. (1999) analyze this problem on plants-level and find that the foreign equity participation is positively correlated with plant productivity, but this relationship is only

robust for small enterprises using panel data on Venezuelan plants. Furthermore, they test the spillovers from joint ventures to pure domestic plants and conclude that FDI has negative effects on the productivity of domestically owned plants. Taking these two offsetting effects into consideration, the net impact of foreign investment is quite small. By comparing the productivity of Russian firms that received foreign direct investments and pure domestically owned firms, Yudaeva, Ksenia et al. (2003) find that the spillover effects of FDI on small firms are negative. Further, Yudaeva, Ksenia et al. (2003) think that the main reason of negative effects is the severe competition drives out those small firms at the beginning of transition and it is predominant on the local level. The most interesting finding in Yudaeva's study is that the spillover effect depends positively on the level of education in that region. A possible explanation for this finding is that better educated workers have a great potential for absorbing technologies and innovations from foreign firms. Similarly, Jozef Konings (2000) also finds the negative spillovers to domestic firms in Bulgaria and Romania. In this study, the author uses firm level panel data to investigate the effects of FDI on the productivity performance of domestic firms in three emerging economies of Central and Eastern Europe: Bulgaria, Romania and Poland and concludes that "a negative competition effect that dominates a positive technology effect" (Jozef Konings, 2000, p.5). In a word, there are many factors leading to the uncertainty of spillover effects, including limited hiring of domestic employees in higher-level positions, little labor mobility between domestic firms and foreign subsidiaries, limited ability to study and few incentives for multinationals to diffuse their knowledge to local competitors

(3) Uncertain Theory

Scholars who hold this view believe that the impact of FDI on the technological innovation capability of host countries is uncertain and it has a complex and diverse nature. Borensztein et al. (1998) analyze the effect of FDI on economic growth in a cross-country regression framework with the data on "FDI flows from industrial coun-

tries to 69 developing countries over the last two decades" (Borensztein et al., 1998, p.116). Their results suggest that the positive effects of FDI holds only when the host country's human capital stock level is above the minimum threshold. Richard Harris et al. (2004) measure the indirect impact of FDI on the total factor productivity of domestic plants in a number of UK manufacturing industries. Based on their results, the competition and "absorption capacity" effect sometimes outweighs potential benefits, causing the negative spillovers. The most innovative part is that the authors take account of both intra-industry spillovers and inter-industry spillovers, and also includes an agglomeration measure to see if there are any locational spillovers from FDI. The estimated results indicate much heterogeneity in the impact of foreign ownership and the spillovers could be positive as well as negative.

Based on the literature above, I find there are different opinions about the technology spillover effect of FDI. Most of these differences are closely related to the problems of data selection, variable selection and empirical models. China's innovation system is composed of regional innovation systems (provinces), which have the characteristics of unbalanced regional development level and obvious regional differentiation. Although some domestic researches have a deep understanding of China's practical situation, most of them implement traditional econometric models without considering the geographical correlation of regions. Motivated by the facts above, my research is expected to investigate the relationship of FDI and innovation capabilities in China considering the geographical correlation of regions and contribute to this issue from the spatial analysis perspective.

Data, Methodology and Model

Zheng Li et al. (2017) use spatial panel model and perspective from administrative region to analysis the FDI' impact on China's regional innovation efficiency. Based on the data of 30 provinces during 2000-2014, the estimation result shows that FDI can improve the regional innovation efficiency significantly in general while there

exist the regional differences. This paper follows a general standard procedure of spatial model analysis. The authors select the spatial weights matrix based on binary weight criterion, then they implement Global Moran's I to test the global spatial autocorrelation and confirm that regional innovation efficiency has significant spatial dependence. Based on this test, the authors set up the spatial panel model to estimate the effect of FDI on regional innovation efficiency.

Inspired by this article, I adopted the same scope and data to analysis this problem. Because of the large number of missing data in Tibet, I finally select 30 provinces as my research objects. Different from this literature, my test results of model setting (Lagrange Multiplier (Lag), Robust LM (Lag), Lagrange Multiplier (Error), Robust LM (Error) are all statistically significant which suggests SDM model is a more proper way to estimate. This is mainly because we select the different variable to represent regional innovation capability. I mainly use the "Domestic Patent Application Authorization Quantity " in China to represent the regional innovation capability.

LeSage (2008) demonstrates the principles of spatial panel model. In terms of Spatial Autoregressive model (SAR) (SDM model has the similar theoretical explanation):

$$y = \rho W y + X\beta + \varepsilon \tag{1}$$

$$y = (I_n - \rho W)^{-1} X\beta + (I_n - \rho W)^{-1}\varepsilon \tag{2}$$

Denotes $S_r(W) \equiv \beta_r (I_n - \rho W)^{-1}$, then we can rewrite the (2):

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \begin{pmatrix} S_r(W)_{11} & S_r(W)_{12} & \cdots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & \cdots & S_r(W)_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ S_r(W)_{n1} & S_r(W)_{n2} & \cdots & S_r(W)_{nn} \end{pmatrix} \begin{pmatrix} x_{1r} \\ x_{2r} \\ \vdots \\ x_{nr} \end{pmatrix} + (I_n - \rho W)^{-1}\varepsilon \tag{3}$$

$S_r(W)_{ij}$ is the (i, j) element of $S_r(W)$, So we can get the following equation:

$$\frac{\partial y_i}{\partial x_{jr}} = S_r(W)_{ij} \tag{4}$$

(4) means the variable x_{jr} in region j may have effects on the dependent variable in region j.

This is the key characteristic in the spatial econometrics. Then we can get the average direct effect and average total effect:

$$Average\ Direct\ Effect = \frac{1}{n}\, trace[S_r(W)] \tag{5}$$

$$Average\ Total\ Effect = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} S_r(W)_{ij} \tag{6}$$

Based on the average direct effect and average total effect, then we can compute the average indirect effect. LeSage (2008) also compares different spatial models in this paper. He assumes that the original data satisfy the data generation process of SAR, SEM, SDM and SAC respectively and analyzes the estimation results caused by model misspecification. The result shows that SDM model is the only model that can obtain unbiased estimation. This also provides the theoretical support for the model selection in my research.

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