



# Foreign investment, innovation capacity and environmental efficiency in China

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## ABSTRACT

Traditional research discusses the impact of foreign investment on the technology diffusion effect or environment individually. In fact, foreign capital can promote environmental efficiency of the funded region by improving the local innovation capacity through technology diffusion. This article analyzes the path relationship between foreign investment, innovation capacity and environmental efficiency by using structural equation models, the results of which show that, on the one hand, foreign investment can directly promote local environmental efficiency; on the other hand, it is also effective in enhancing local innovation capacity, which is conducive to the improvement in local environmental efficiency. Finally, corresponding countermeasures are put forward in line with the above results.

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## 1. Introduction

Since the reform and opening up, especially in the 1990s, due to the deepening of China's marketization and improvement of the investment environment, foreign investment has increased rapidly, and actually utilized value of foreign investment has increased from US \$3.487 billion in 1990 up to US \$90.033 billion in 2009. Since 2000, the yearly growth rate of actually utilized value of foreign investment has increased to be at more than 24.57%. On the one hand, the constant influx of foreign capital has provided much-needed capital for China's economic construction, effective in making up the capital gap; on the other hand, foreign enterprises have brought advanced technology to enhance their own competitive ability, which can improve the technology level of local industry through the demonstration effect and diffusion effect as well. In addition, technological advancement can better environmental efficiency by improving the efficiency of resource utilization and reducing pollution emissions. At present, the majority of scholars have studied the effect of foreign investment on innovation capacity or environment separately; however, they ignore that the constant influx of foreign capital can improve the environmental efficiency through enhancing innovation capacity.

Although current research methods vary greatly, structural equation modeling can reflect the causal relationship and effect paths among different elements, making it effective in demonstrating the contribution and effect paths of foreign investment on regional innovation capacity and environmental efficiency. This study will analyze the relationship among foreign capital level, innovation capacity and environmental efficiency in all Chinese provinces, and test the path and contribution level of foreign investment on regional development by using structural equation model, the results of which will provide reference for the future practice of attracting more foreign investment.

The rest of the paper is organized as follows: Section 2 is the literature review; Section 3 is construction of the models based on theoretical analysis; Section 4 includes the data and the results; Section 5 is the conclusion and implication.

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## 2. Literature review

With the development of international trade and increase in foreign investment, many scholars joined to study the impact of foreign investment on the economic development of the host country; their work mainly concentrated on two fields: the impact of foreign capital on the host country's innovation capacity and on the environment quality.

Concerning the impact of foreign investment on innovation capacity, there mainly exist three kinds of viewpoints: theory of inhibition, theory of promotion and theory of the "double-edged sword". Even though the conclusions are not identical, spillovers of FDI can occur through various channels, for example: demonstration effect, labor turnover effect and competition effect [1]. Scholars have mainly examined the impact from the perspectives of competition pressure, the association between upstream and downstream industries, imitation and learning and human capital. If factors, such as the pressure of competition, the association between upstream and downstream industries, imitation, learning and investment in and mobility of human capital can enhance the technical level and production efficiency of the host country, the effects are positive; otherwise they are negative. Domestic and foreign scholars have analyzed and verified the actual effects with different methods.

The study of Lichtenberg and Pottelsberghe [2] showed that FDI, as an important channel of international technological diffusion, played an important role in 13 OECD countries [2]. Vahter [3] found that there was positive association between the entry of FDI and the direct measurement of spillovers. FDI inflow to a sector was associated with more knowledge flows to domestic firms and increase in their innovation activities [3]. Lin and Eric [4] confirmed that an increase in industry-level FDI would raise the competition in domestic markets and enhance the competitiveness of domestic firms by promoting them to actively engage in innovation activities [4].

While Aitkin [5], found that generally FDI had a negative spillover effect on the country by using the panel data of Venezuelan manufacturing enterprises covering the period of 1976–1989 [5]. Keller [6] showed that the scale of spillover effects from knowledge transfers was geographically limited, and the scope of technology diffusion was severely limited by distance [6]. Zhang and Rogers [7] found that FDI appeared to have a negative effect on the patenting of domestic firms, at least until foreign market demand for domestic production was established [7]. Damijan et al. [8] also suggested that FDI did not generate positive intra-industry spillovers for domestic firms [8].

Scholars have not only recognized the effect of technology diffusion of foreign investment, but also have studied the factors that may influence the degree of the diffusion effect from different aspects, including human capital [9], the R&D of the host enterprises [10], openness of trade and so on. Liu's [11] study showed that the R&D activities of multinational companies would bring a positive effect on local enterprises' innovation capacity only when the local enterprises had absorption abilities [11]. Damijan [8] indicated that technology was mainly transferred to local enterprises through direct connection. Foreign direct investment failed to have a positive technical spillover effect on local enterprises [8].

While the impact of foreign investment on the technical level and innovation capacity in the funded region is studied, another line of literature discusses the environmental effect of foreign investment on the funded region. Views also vary regarding the effects of foreign investment on the environment quality in the host country. One is the "pollution haven theory", namely, the developed country will try to avoid the high cost of pollution and stringent environmental regulations by transferring the pollution-intensive industries to the developing country where environmental control is loose, making the local environmental quality inevitably worse. However, the opposite thought is that strict environmental standards of international corporations have a spillover effect, and at the same time, foreign capital can bring technology diffusion, which is helpful to improve the productivity of the host country and consequently becomes beneficial to the improvement of environmental quality of the host country [12,13].

Foreign investment affects the environment through many channels. For instance, foreign investment can affect pollutant discharge and the utilization efficiency of resources by definitely affecting the production scale of the industry, industrial structure and technical level. In this scenario, the Porter hypothesis – that regulation brings cost-reducing innovation – is often invoked as the explanation finds a positive link between regulatory stringency and exports. Meanwhile some scholars' researches support the "pollution haven theory", namely, foreign direct investment has significant negative effect on the ecological environment of the host country [14–16]. While some scholars draw the opposite conclusion. By the mid-1980s empirical studies on trade and investment effects of the new strict environmental regulations in Western countries firmly rejected the pollution haven theory [17].

Most of the present studies verify the technical and environmental effects of foreign investment independently. In fact, some scholars are aware that the impact path of foreign investment on the environment of the funded region may be linked to technical effect, namely, foreign investment probably affects both the innovation capability and technological level of the funded region, thereby affecting the local environment. Unfortunately relevant in-depth and meticulous research is scarce, rendering it necessary to connect the two kinds of impacts of foreign investment together.

Data Envelopment Analysis (DEA) and stochastic frontier analysis (SFA) were often used in Efficiency analysis [18,19]. However, neither DEA nor SFA could reflect the relationships among many groups of variables. On the basis of the previous research, this paper uses the structural equation model and the relevant data of 30 Chinese provinces to examine the relationships among foreign investment, innovation capacity and environmental efficiency with causal analysis and path analysis.

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