

# *Does Transportation Infrastructure Technology Evolution Improve Producer Surplus?*

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**Abstract:** This paper introduces the variable of transportation infrastructure technology evolution on the basis of existing research. It is found that the technology evolution accelerates the knowledge spillover between regions, and the spillover effect reduces the variable cost of technology in backward regions, leads to the transfer of technology services from developed regions to backward regions, and increases the profit of technology services in backward regions. In addition, the knowledge stock of developed regions, the degree of inter-regional technology correlation, and the technology absorption capacity of underdeveloped regions are the important factors affecting the relative accessibility and knowledge spillover.

## 1. Introduction

A large number of studies have confirmed that the evolution of transportation infrastructure technology can stimulate the development of knowledge-intensive industries in cities along the route and realize the upgrading of industrial structure. However, from the perspective of a country (region), the government is more concerned about how to maximize the welfare level of a country or region. If the welfare level of cities along the belt and road has been improved obviously while promoting the upgrading of industrial structure, then the technological evolution contains certain policy significance. On the basis of the above, this paper investigates the impact of technological evolution on the welfare level of the two regions by analyzing the changes of welfare level before and after technological evolution.

## 2. Theoretical Analysis

The level of welfare consists of consumer surplus and producer surplus.  $I$  and  $A$  both belong to perfect competition market, technical service market is monopolistic competition market. The production surplus of the region comes from the production profit of the technical service industry in the region  $G$ . The producer surplus of the region before technological evolution is

$$\pi^* = 0 \quad (1)$$

With the evolution of technology, the knowledge spillover from the region  $D$  also increases. The spillover effect reduces the variable cost of technology in the region  $G$ , and some technology

services are transferred from the region  $D$  to the region  $G$ . The total profit of regional technology service industry is:

$$\pi^{*'} = \left( \frac{\alpha c^* \omega^* (1 - \lambda) \tau_{\theta}^2 \Lambda'}{\lambda \Pi' n^{* \frac{(1-\lambda)}{\lambda}}} - n^* F^* \right) \frac{1 + t T_A^*}{T_A^*} - R \quad (2)$$

Comparing (1) and (2),  $\pi^{*'}$  >  $\pi^*$  is obvious. After technological evolution, the producer surplus in the region  $G$  has been improved to some extent. Through the first-order condition of profit maximization and the condition of satisfying  $P_s < P_s^* < P_s + \eta$  and  $\pi^* > 0$ , the optimal overflow quantity is obtained. Knowledge spillover depends on the evolution factors and relative accessibility level of transportation infrastructure. When  $R \in (0, \bar{R})$ , under the condition of constant relative accessibility, the higher the degree of technological evolution is, the larger the producer surplus is, until  $R = \bar{R}$ ,  $\pi^{*'}$  reaches the optimal.

Proposition one: Technological evolution speeds up the knowledge spillover between regions, and the spillover effect reduces the variable cost of technology in backward regions, leads to the transfer of technology services from developed to backward regions, increases the profit of technology services in backward regions, and improves the producer surplus in backward regions. The producer surplus is optimal at  $\bar{R}$

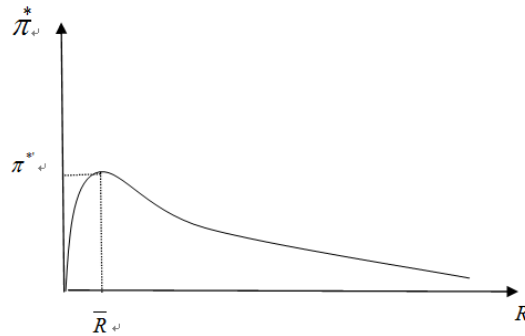


Fig.1 Producer Surplus Changes with Knowledge Spillover

Knowledge spillovers are not only related to technological evolution, but also affected by relative accessibility. The level of relative accessibility depends on the knowledge stock of developed regions, the degree of inter-regional technology correlation and the technology absorption capacity of underdeveloped regions. The higher the stock of knowledge in developed regions, the higher the amount of knowledge spillover to backward regions. The absorption of knowledge spillovers in backward regions is also affected by the degree of technology correlation. A high degree of technology correlation means that backward regions are more likely to use knowledge spillovers to improve their own technologies. No matter the knowledge stock or technology correlation degree of developed regions, it is necessary to ensure that backward regions have good technology absorption capacity. As mentioned above, the upgrading of industrial structure in backward regions driven by spillover effect requires more labor force. If the initial labor force, especially skilled labor force, is insufficient to meet such increased demand, spillover effect will limit the play of industrial structure improvement. Proposition 2 can be obtained:

Proposition two: The knowledge stock of developed regions, the degree of inter-regional technology correlation, and the technology absorption capacity of underdeveloped regions are important factors affecting relative accessibility and knowledge spillover. Accessibility can improve producer surplus and social welfare through knowledge spillover.

### 3. Conclusion

Based on the model of intra-product division of labor as the basic framework, this paper establishes a theoretical model including technological evolution and industrial structure, and draws the following conclusions through mathematical model derivation.

First, the evolution of technology accelerates the regional knowledge spillovers, the spillovers reduces the technology of variable costs in underdeveloped regions, triggered a technical services from developed regions to backward area, increase the profit of the backward area technology services, improve the producer surplus of underdeveloped regions, and producer surplus to achieve the optimal.

Secondly, knowledge stock in developed regions, inter-regional technological correlation and technological absorption capacity in underdeveloped regions are important factors affecting relative accessibility and knowledge spillover. Accessibility improves producer surplus and social welfare through knowledge spillover.

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