Public–Private Partnership Infrastructure Investment

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Contributor: Bingyao Chen

Interconnected infrastructure is an essential foundation for sustainable economic development. As China's economy enters the new normal, the contradiction between the continuously growing demand for public goods represented by infrastructure and the insufficient supply efficiency and quality of single government-led investment mode under downward economic pressure and fiscal constraints has profoundly changed the supply and investment mode of infrastructure. Public–private partnership (PPP) has become the most important means of investing in infrastructure. PPP, an innovative mode of infrastructure investment, has been widely applied in China and has become an essential policy tool with which to promote sustainable economic development.

: public–private partnership   infrastructure investment   sustainable development

input–output efficiency

1. Impact of PPP on Input–Output Efficiency of Infrastructure

In economics, efficiency is the ideal maximum possible output with the same input or the ideal minimum possible input with the same output. The input–output efficiency of infrastructure evaluates the configuration state between infrastructure input and economic output within the concept of sustainable economic development. In the past, infrastructure investment was carried out by local Chinese governments, which led to monopolies. It was not until 2014 that PPP was applied on a large scale and gradually replaced single government-led investment, and the marketization of infrastructure investment gradually emerged.

According to public goods theory, in the new political economy, public good related to the national economy cannot be completely provided by a profit-maximizing market, but needs government intervention. The theory of welfare economics further points out that the government's powerful macro control should be limited to taxes and subsidies, and the task of optimizing the allocation of market resources should be left to private parties through market competition. Against the background of the Chinese system, PPP, as a mixed semi-organizational and semi-market economic form, can improve the efficiency and optimize the structure of resource allocation in infrastructure investment and promote the input–output efficiency of infrastructure through a synergistic effect.

On the one hand, the core mechanism of PPP is to introduce market mechanisms to infrastructure provision, letting the market participate in the allocation and management of public resources, which can effectively avoid the drawback of the "grabbing hands" of local governments caused by long-term administrative monopolies [1]; this is

conducive to eliminating the inefficiency of the pattern of government-only status [2]. On the other hand, under the organic combination of the dual efficiencies of government and market, the competitive mechanism will further guide local governments' financial resources to other areas and weak links of people's livelihoods, and build a mechanism for more favorable cooperation between governments and private parties. This can promote the structural adjustment of resource allocation in government financial expenditure and the participation of private parties, in order to form a long-term sustainable supply mode that pursues infrastructure quality and efficiency [3]. Furthermore, the synergy effect of PPP is due to the complementary advantages of governments and private parties [4]. Local governments have macroscopic control and risk resistance ability and can implement powerful policy guidance; the added value of private parties, such as knowledge, skills, management experience, and innovation, becomes more productive with cooperation. PPP can also encourage professional institutions to participate in infrastructure construction, operation, and management, thus forming a "1 + 1 + 1 > 3" performance improvement mechanism of governments, private parties, and professional institutions [5]. Therefore, compared to the government-led single investment mode, PPP more reflects the win–win of economic and social benefits based on the synergistic effect.

2. Overall Economic Growth Effect of PPP

This paper analyzes the economic growth effect of PPP from the perspective of institutional innovation. According to the theory of institutional economics, effective institutional design is the key to ensuring and improving economic growth. Institutional innovation refers to reforming the existing system by key players in order to obtain specific benefits [6], which includes two forms, induced and mandatory. Induced institutional innovation achieves Pareto optimality through gradual accumulation of changes under the premise of compatible interests of various stakeholders. The effectiveness of institutional innovation is reflected in the coordination of interest distribution relationships among stakeholders, enhancing the interests of some stakeholders without harming others, so as to reach a consensus on reform, which can bring the bonus effect of institutional innovation to promote economic growth [7].

The essence of PPP is that it is an institutional design and innovation that gives full play to the respective endowment advantages of governments and private parties to carry out mutual long-term cooperation for the efficient supply of infrastructure and services. The understanding of PPP should be promoted to the level of institutional mechanisms, with the improvement of institutional efficiency as the core. The reform process of PPP in China is consistent with the logical process of institutional economics. With the transition of China's economy, the institutional arrangement of administrative monopolies in which local governments are the sole agents carrying out infrastructure investment, construction, and operation is difficult to sustain. Various drawbacks can be found, such as shortages of fiscal funds, insufficient supply capacity, and inefficient resource distribution. At this point, PPP, as an induced institutional innovation of "gradualism" initiated by the government, not only enables better realization of the government's public service functions, but also provides opportunities for private parties to gain economic benefits and fulfill social responsibilities, and bring more quality and inexpensive products and services to the public by giving full play to the endowment advantages of all parties through PPP's specialized cooperation

mechanism. Thus, the Pareto optimality of the "triple win" of governments, private parties, and people's livelihoods can be achieved [8]. Moreover, the cost of induced institutional innovation is relatively low, the social unrest is relatively small, and the intervention of local governments can make it progress more smoothly [9].

PPP gives adequate consideration to economic efficiency and social equity, which strongly conforms to the core connotation of institutional innovation. China's development experience has proven that PPP is key to deepening supply-side reform, introducing mixed ownership to SOEs, and innovating the mode of infrastructure investment. Therefore, it can be assumed that PPP, as an effective institutional innovation, has the overall economic benefit of promoting sustainable economic development. In addition to giving play to the "invisible hands" of the institution, PPP as an investment has a natural capital accumulation effect, thus can promote economic development. According to investment multiplier theory, PPP can drive the investment of the whole society, thus stimulating employment and consumption, and can improve the scale and quality of infrastructure provision to lay a solid foundation for industrial agglomeration.

3. Spatial Economic Spillover Effect and Industrial Heterogeneity of PPP

The mechanism of PPP that can exert a spatial spillover effect lies in the functional attributes of infrastructure and the spatial autocorrelation of economic development.

First, infrastructure is networked. As an important carrier of economic connections between regions, the connectivity of infrastructure can realize the spatial flow of production factors, break the market segmentation caused by the administrative division or spatial distance of regions, and connect different regions as a whole. In particular, transportation infrastructure creates an indispensable basis for guiding the distribution of productivity and the spatial distribution of the population, and also lays a solid foundation for improving the efficiency and competitiveness of regional economies. China attaches great importance to the networked economic advantages of transportation infrastructure, and has put forward the Belt and Road initiative and the strategy of building a country with a strong transportation network, which has become the "Chinese experience" that is valued worldwide.

Second, infrastructure has externalities, arising from the function of public goods. This means the social benefits of infrastructure often exceed its economic benefits, which means that infrastructure is not intended to make a profit, but to provide the necessary external conditions for the microeconomy and the necessary complementary goods for private capital, and to ensure the normal functioning of social and economic activities in a country or region. Marshall, in his book Principles of Economics, theorized about the extensive impact of infrastructure on other production units and summarized that the externalities of public goods have a spillover effect on economic growth. Pigou further distinguished and developed the theory of externality and spillover effects. The external benefit that infrastructure brings to other production units is called external economy or positive spillover, while the external effect that brings losses is called external diseconomy or negative spillover. In addition, the externalities of different types of infrastructure are heterogeneous. Transportation infrastructure not only has a direct impact on economic growth, but also has stronger externality, which has positive synergistic and spatial spillover effects [10][11]. Energy

infrastructure is better reflected as an external economy [12], while the new energy has a negative external economic impact in China's developing areas [13].

Third, the spatial dependence of economic development is one of the prerequisites for the spatial spillover effect [14]. Spatial dependence refers to the relationships among things or social phenomena, depending on and even restricting each other in the spatial dimension. The existence of spatial dependence indicates that the occurrence and development of things or social phenomena are always influenced by other units. Economic development obviously has such spatial dependence. The economic development of different regions is not only determined by their production capacity, but also affected by the development situation of other regions, which is related to the flow of production factors and the links of communication, distribution, and consumption. It is precisely because of the spatial dependence of economic development that improving the infrastructure in one region can promote the development of that region and also have an impact on the development of other regions [15].

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