A SYSTEM DYNAMICS STUDY OF THE COORDINATED DEVELOPMENT OF REGIONAL INFRASTRUCTURE

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ABSTRACT

Regional economic integration is a trend of modern economic development, and to realize such integration many supporting conditions, especially the coordinated development of regional infrastructure need be satisfied. The coordination of regional infrastructure, however, requires proper policies of the governments and cooperation among different areas as well.

INTRODUCTION

1. The Neglect of The Study of Regional Issues at Home In western countries, the issue of regional economy has long been under discussion since the second half of this century, and the study of and research on it have reached great depth. While in China, where economic plan and economic management were, and actually are, mainly based on economic sector rather than on economic regions, the issue of regional economy has been neglected. And the theoretical researches on these issues were neglected likewise. In recent years, many proposals have been put forward regarding the construction of economic regions That indicates much importance has been attached to regional issues. However, theoretical researches still center around the conventional theories of economic location and distribution of productivity, regional strategy and industrial policy, and regional investment, etc. The very issues concerning the coordination of development within an economic region, especially of infrastructure, unfortunately, remain untouched. This is very crucial to regional development and is the major matter we will deal with in this paper.

2. Regional Infrastructure and Its Nature Infrastructure, conventionally, refers to those facilities and institutions which provide common condition and public service to the direct production sectors and people's life, including transportation, telecommunications, power supply, environment protection, education and other cultural factors. But the definition we use here is a little different. We hold that infrastructure should include all the conditions that serve as the support to direct production and people's life. It covers all the public facilities of transportation, telecommunications, water supply and irrigation, etc.; natural resources like land, energy, raw materials, and water; and some of the sectors that belong to tertiary industries like financial and insurance service. Usually, they are, in the input-output tabular, at a high position. To summarize, it has the following features: (1) Shared use. (2) Non-exclusive use. (3) Scale effect. (4) Public ownership, high investment, long lifecycle, and low economic return.

REGIONAL DEVELOPMENT STRATEGIES AND THE ROLES OF INFRASTRUCTURE

1. The Delimitation of Economic Region There are various ways for delimiting economic regions, and two representatives are geographic method and administrative method. Each has its advantages and disadvantages. The method used here is something of a synthesis of these two. We delimit, for example, the Yangtze River Basin region as the administrative districts along the Yangtze River, including nine provinces and a metropolis.

2. The Regional Strategies Since 1949 and Their Outcomes The regional strategies regarding regional development since 1950s can be divided into two periods: (1) "Balanced Development Strategy" period, which can be divided again into two sub-periods. The first was

aimed to balance the coastal and inland areas, which is characterized by the style of "pointed development" and heavy industry orientation. Emphasis was placed on the middle part of the country then. This sub-period was followed by the so-called "Construction of The Great Third Line" period, in which, many heavy industries and military industries were set up in western China. This "balanced" disposition can also be seen in the construction of infrastructure. Take the railroad network as an example. The newly built railroads were almost all located in the inland areas. (2) "Non-balanced Development Strategy" period. During this period, the strategy was characterized by the pattern of "Gradient Push". It was aimed that by first developing the coastal areas, through "diffusion effect", the inland provinces can be "pulled" or "pushed" to co-prosperity. In such a situation, more investment went to light industries which have the advantages of small investment, quick payback and high profitability often than to infrastructures. This rendered unavoidable the supply shortage of energy, raw material and transportation, etc., which in turn limited further development of regional economy and became the "bottleneck" of the whole economy. (3) The trend of regional economic integration. Recently, researchers and some government officials suggested that the coordinated development of regional economy and the economic integration be the next step of regional strategy.

3. The Goal of Regional Economic Development and The Preconditions of Economic Integration The goal of the economic development of a region, we believe, should be a long-term, steady development of the region as a whole. It is an integral rather than a partial development. This is the coordination in space. It is also a goal of coordination in time, i.e., a dynamic optimum.

To realize this long-term coordinated development of a regional economy, it is essential to take account of: a)tech-economic structure; b)economic benefit structure to ensure fair distribution of benefit among different parts; c)regional infrastructure to avoid the limits from these things if they are neglected.

4. The Significance of The Coordinated Development of Infrastructure It clear that there are two major factors concerning the economic development of a region: (1) economic concentration; (2) transportation cost. To summarize: the development of regional economy is determined by the degree to which the infrastructure limits it, and the limitation of infrastructure is determined by its size, and more significantly, the coordination among its spatial parts.

5. The Results of Coordinated and Uncoordinated Development: The Model's suggestion (1) The present investment in infrastructure (here transportation) in the Yangtze River Basin is insufficient so that if this is to extrapolated into the future, the future output will be limited by the shortage of infrastructure; (2) Too much infrastructure investment is not favorable either since the investment in infrastructure has less return than ordinary industries; (3) And well planned investment increase in infrastructure is more favorable than others, it is preferred that great investment should be made in near future to remove the bottlenecks; (4) Coordinated development is better than uncoordinated, as can be seen from the comparison of assumption.

ANALYSIS OF THE PARADOXES IN THE DEVELOPMENT OF INFRASTRUCTURE

1. The Ability of Infrastructure Self-balance and The Expansion of The Region Because of the lack of natural resources or of some specific conditions a particular region may have no way to balance the demand and supply of its infrastructure. For example, the following table lists the demand for coal and the required freight of Shanghai in the next 20 years (forecasted by the model). The conclusion is that, as a separate region, it is impossible for Shanghai to

meet its demand infrastructure without falling back on other areas, to say nothing of coordinated development. So, in order to realize the coordinated development, the territory of the region must be expanded to such an extent as to be able to balance its demand and supply for infrastructure.

Table 1. Some of the future demands of Shanghai (Extrapolated)

Year	1992	1997	2002	2007	2012
Coal(10,000 ton)	2877	5659	9252	14680	23050
Electricity (100 M kw.h)	397	925	1926	3770	7015
HighwayTran.(10,000 ton)	9329	11850	13110	13520	13820

2. The Inefficiency of Initial Allocation and Its Stickiness The initial allocation of an infrastructure here refers to the initial construction or the accumulation before a certain time point. Today's difference in economy between coastal, middle and western China is at least partly attributed to the fact that there are good traffic conditions in north-south direction, and poor in west-east direction. One indication of this kind of inefficiency is the co-existence of idle and crowded infrastructures in different areas. What's more, the inefficiency of infrastructure is sticky, because of the fixed nature of it. So, the only feasible way is to reallocate them in the form of incremental investment. But reallocation, as will be discussed below, has its own paradoxes.

3. The Inefficiency of Reallocation----Quantity and Structure

(1) Non-return or low-return of infrastructure Some public facilities' benefit is included in the consumers' surplus of the users. For some others, though some fees are charged, the prices are below the normal price either because of economic policy or because of the inherent price difference between primary and finished goods.

(2) The result of the local interest maximization --- inefficiency in quantity Infrastructure has the nature of "quasi-collective goods" and shared-use, it makes the local government have such an intention as to expect other districts and/or central government to invest first. (But the financial power of the central government is weakening.) So the current pattern of investment in infrastructure has the characteristic of insufficiency in quantity.

(3) The result of localism---Inefficiency in structure Another implication of local interest maximization is that they only invest in those infrastructures that are urgent and have manifest internal or external effects (mainly for this area). As a result, the capacity of the whole is reduced dramatically. infrastructure also tends to be inefficient in spatial distribution.

4. The "Alienation" Phenomenon in The Development of Infrastructure

Under the principle of "comparative advantage", the provinces rich in resources are usually

Table 2. The relative weight of gross output of coal mining industry & relative GDP per capita (1993).

Province	relative weight	Order	Relative GDP p.c.	Order
Anhui	1.85	1	0.47	6
Sichuan	1.68	2	0.51	5
Jiangxi	1.37	3	0.54	4
Hunan	1.18	4	0.56	3
Jiangsu	0.33	5	1.08	1
Hubei	0.17	6	0.68	2
Zhejiang	0.09	7	1.08	1

Note: 1) relative weight = (weight of output of coal-mining industry of the province) /(that of the country)
2) relative GDP per capita = (GDP per capita of the province)/(that of the country)

encouraged and urged to concentrate on producing their "advantageous" products (service), say,coal, but because these products usually have a subnormal price they don't bring much wealth to their producers. So, the resources turn against their masters. This is a problem that the market system can not solve, and our former planned system tended to aggravate this unfairness. The resource-rich areas then are discouraged in their production, which reduces the total supply of these infrastructures.

THE POLICIES IN THE COORDINATED DEVELOPMENT OF REGIONAL INFRASTRUCTURE

1. First of all, ideologically, the cognizance of shared utility of infrastructure, shared benefit among the sub-regions, and long-term and integral development of the whole region must be established.

2. Market System and The Distribution of Benefit

the paper suggests, the subsidy policy of government should be adopted so that the discrepancy between the equilibrium and the actual price can be compensated. After that, with the adjustment of prices, when the two prices converge, the subsidy should be cut off accordingly.

3. Government Investment Infrastructure belongs to those types of industries which profit little, so, even in the market setting, great government funds are still needed to be invested in infrastructure rather than in processing industries.

4. Regional Ad hoc Committee Coordination

At the regional level, there should be a pan-regional authority, for example, "Coordination Committee of Regional Infrastructure", consisting of the representatives from the member provinces and areas and from the central government. This committee must aim at the long-term economic development of the whole region and its decision should be made on the basis of scientific investigation and careful analysis. It has the right and obligation to coordinate between the difference member parts. It is to set up integral programming, settle disputes, and supervise. This committee must be democratic, efficient, incorruptible and non-bureaucratic.

5. Regulating The Infrastructure

The law makers should enact specific regulation on who to use it and how to use it, who to maintain it and how to maintain it, who to control it and how to control it, etc. Since the construction and the maintenance of infrastructure have regulations to go by, the infrastructure can be made beneficial to the whole economy and society.

6. Methodology of Research

Methodologically, more advanced approaches should be adopted. The synthesis of qualitative and quantitative methods, dynamic rolling analysis (such as SD), model set and other advanced approaches are all useful tools for supporting the decision making of the development of regional infrastructure.

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