Infrastructure Development and Regional Growth: A Framework for Policy Research

Surya Raj ACHARYA* Shigeru MORICHI** and Tsuneaki YOSHIDA***

1. Introduction

Infrastructure investment is often presented as a policy instrument to serve the goal of regional balance. But the mechanism that how infrastructure investment actually affects the lung-run regional growth pattern is not very clearly understood even in theoretical setting, let alone in practical policy setting. This paper will make an attempt first to draw a rough sketch of the mechanism through which infrastructure investment influences the pattern of long-run regional growth, and then to set-up a framework for infrastructure investment policy analysis. For the purpose, the next section briefly discusses the theoretical foundation, which will be followed by a review of broad empirical patterns. Based on these, key policy implications are drawn out. Finally, a framework for further policy research is proposed.

2. Theoretical Foundation

There are several different theoretical approaches which aim at explaining the mechanism of regional growth and disparity, such as neo-classical theory (Bort 1960, Richardson 1969), export-base theory (Deane 1969), cumulative causation theory (Myrdal 1957, Kaldor 1970), unbalanced growth theory (Hirschman 1958) and disequilibrium dynamic adjustment theory (Clark et al. 1986). Among these, the neo-classical and cumulative models offer two mutually conflicting hypotheses, that have direct relevance to infrastructure investment policy. The standard neo-classical growth model is built on diminishing return to factors and constant return to scale. It predicts that the trade and factor flows tend to equalise factor price, and as a result the disparity between developed and lagging regions will diminishes over time. Hence, regional disparity is only a short-term phenomenon and is not worth of any sort of policy intervention.

The cumulative causation school places an emphasis on the process of agglomeration (localisation and urbanisation economy) and interprets the regional disparity as an outcome of difference in degree of agglomeration in different regions. The agglomeration phenomenon makes it possible for few leading regions to have increasing return to scale. Consequently, both capital and labour can flow in the same direction (rather than in opposite direction as predicted in neo-classical theory). Once the growth process is set in motion, it continuously reinforces the growth in core areas at the cost of peripheral areas. Recognition of the role of increasing return in the endogenous growth theory (Romer 1986, Krugman 1991) has given a fresh impetus to cumulative causation model.

Though conflicting in basic premises, these models however may provide a consistent theoretical underpinnings to set-up a framework for policy analysis. As the infrastructure policy for regional balance essentially calls for a dynamic setting, these two models might be relevant at two different phases. As noted by North (1994), neo-classical framework is not a suitable tool to analyse development-inducing policies. But neo-classical theory offers very elegant framework to analyse factor adjustment process in a competitive market. On the other hand, cumulative causation model might be more relevant when there is market imperfection and need for policy intervention.

3. Empirical Patterns

In the absence of a single integrative and well accepted theoretical framework, an investigation of empirical patterns would be an appropriate stage-setting step for formulating the policy research framework. What follows is a very broad-brush picture of ASEAN-4 countries (Indonesia, Malaysia, Philippines and Thailand) and Republic of Korea, and Japan on the trend of infrastructure investment and regional growth patterns.

3.1 Case of ASEAN-4 and Korea

The impressive economic growth in Korea and ASEAN-4 during post war period was mainly fuelled through high level of investment, but the domestic saving level was lower than the investment level (figure 1). The resource gap was filled up by inflow of foreign debt and direct foreign investment (the debt-service expenditure that ranged from 30 to 60 percent of the central government current revenue in

Key words: Regional Planning; Regional Disparity; Developing Countries

* Graduate student, Dept. of Civil Engineering, University of Tokyo.
** Member of JSCE, Dr. of Eng., Professor, Dept. of Civil Engineering, University of Tokyo, Bunkyo-ku, Hongo 7-3-1, Tokyo.
*** Member of JSCE, Dr. of Eng., Professor, Dept. of Civil Engineering, University of Tokyo, Bunkyo-ku, Hongo 7-3-1, Tokyo.

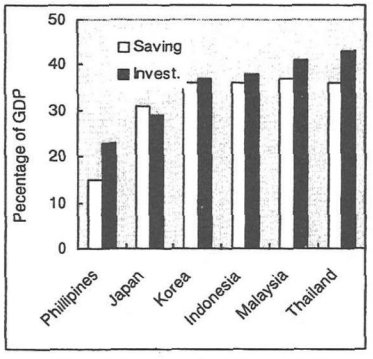

Figure 1: Gross domestic saving and investment, 1995

these countries during late 1980s indicates the degree of debt burden). These countries also aggressively promoted export (between 1970-1995, export rose by about 2 times in Philippines and by 3 times in

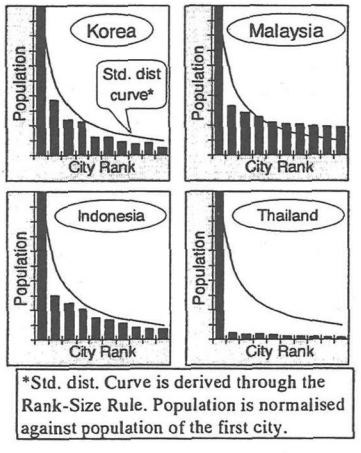

Figure 2: City-size distribution (1990)

Thailand by % of GDP). Manufacturing sector substantially increased it's share in export basket (Philippines accounts for 41 %, Korea 92.8 % and rest in between in 1992). Coupled with such a rising trend of manufacturing-based export is an increased emphasis on infrastructure to support export-oriented manufacturing sector. The foreign borrowing in these countries was mainly to finance capital intensive infrastructure projects. For instance, during 1979-85, Korea borrowed over 10 billion US$ from foreign public sources. Over 85 percent of this borrowing was for financing infrastructure projects (Government of Korea 1996). Yet, these countries face severe deficiency of infrastructure (World Bank 1995, 1997a). A few urban areas (mostly capital city) accounts for a major share of economic output and population (figure 2). The capital city, in particular, being a most competitive place for economic activities, still attracts high share of infrastructure investment.

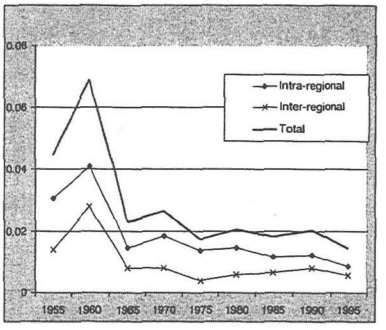

Figure 3: Income inequality index of Japan.

3.2 Japan's case

Infrastructure investment has remained one of the key elements in the process of regional growth in Japan. During post war recovery period (1945-60) and first phase of high economic growth period (1960-65), high emphasis was placed on the infrastructure development, first in central Japan comprising of Tokyo, Nagoya and Osaka metropolitan region and later along the pacific belt. This approach resulted in a heavy concentration of population and economic activities in the core region. To reverse the trend, various policy measures have been taken and infrastructure investment is one of them (OECD 1996).

Figure 3 shows the trend of regional income inequality measured as Theil's inequality index[1] (Theil 1967). It illustrates a continuously declining trend of total inequality index since 1960. However, during 1975-90, between the region inequality increased while within the region inequality continued to decline. This is probably because of strong dispersion effects within the region rather than between the region.

Japan has sustained a relatively high level of infrastructure investment (8.8 percent of GDP, in 1995, figure 4). However, the emphasis is now more on enhancing economic potentials of lagging region through increased infrastructure investment. For example in 1994, Hokkaido accounted for 512 thousand yen per capita (while Kanto received only

[1] Theil's inequality index:

Intra-regional inequality, $I_o = \sum_{i \in G_g} \lambda_i \log \frac{\lambda_i}{\mu_i}$

Inter-regional inequality, $I_g = \sum_{g=1}^{G} Y_g \log \frac{Y_g}{X_g}$

Total inequality, $I = I_o + \sum_{g=1}^{G} Y_g I_g$

y_i = share of i^{th} prefecture in total national income
x_i = share of i^{th} prefecture in national population
λ_i = share of i^{th} prefecture in the regional income
μ_i = share of i^{th} prefecture in the regional population
Y_g = share of g^{th} region in national income
X_g = share of g^{th} region in national population
G = number of regions
s_g = number of prefectures in g^{th} region

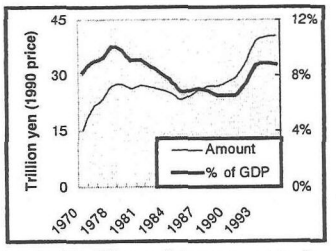

Figure 4: Trend of Public work investment in Japan

352 thousand yen per capita) as infrastructure investment.

Another striking feature is that a high share of expenditure burden is born by national government in lagging regions (62 % in Okinawa, 46 % in Hokkaido, and 39 % in Tohoku while only 30 % in Chubu and 33 % in Kanto). However, the infrastructure in lagging regions seem to be under-utilised while those in the developed regions are under pressure. For instance, the 1992 figure for ratio of gross regional

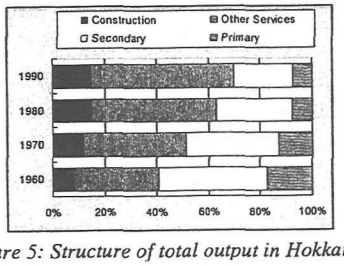

Figure 5: Structure of total output in Hokkaido

product to transport infrastructure stock (road, port, and airport) in Hokkaido remained as 1.7 while that in Kanto as 4.9.

In the process of economic development, the developed and lagging regions have followed two distinct patterns of structural change. The developed regions first witnessed rapid growth of manufacturing sector and in the later stage a shift to service sector. While lagging regions had a direct shift to service sector (with significantly high share of construction) from primary sector without passing through the phase of dominant manufacturing sector (figure 5).

Regions	1960	1970	1980	1990
Hokkaido	1.5	1.4	1.4	1.3
Tohoku	1.4	1.3	1.4	1.5
Kanto	3.8	3.7	3.7	3.9
Chubu	2.1	2.1	2.1	1.9
Kinki	3.1	2.7	2.5	2.4
Chugoku	1.6	1.7	1.8	1.5
Shikoku	1.4	1.2	1.3	1.2
Kyushu	2.0	1.5	1.7	1.6
Okinawa			1.2	1.2

Table 1: Inter-regional out-put inducement coefficient

Table 1 further illustrates the trend of relative economic strength of regions measured in terms of inter-regional inducement coefficient[2] (which basically reflects the relative competitiveness of regions in terms of inter-regional trade flow). Lagging regions (except Tohoku) show a declining trends while Kanto, despite having high coefficient value, shows rising trend.

4. Policy Implications:

The empirical patterns as observed in the above cases are too broad for any conclusive policy implication. They however provide a basis to trace out a generic role of infrastructure investment, particularly in determining the long-term spatial development. The broad policy implications (as relevant for infrastructure investment) from the case of ASEAN-4 and Korea, and Japan can be summarised as follow.

In ASEAN-4 and Korea, the investment-led growth process has created huge demand for infrastructure on one hand, and made the economy rely on foreign resources on the other. Countries have to aggressively promote export to maintain balance-of-payment stability and credit-worthiness and also enhance their competitiveness. The policy response to react such pressure is to concentrate economic activities (and investment for supporting infrastructure) in a few relatively well developed cities (mostly capital city) in order to exploit agglomeration economy and maintain competitiveness. Such a demand-driven approach has left no room for long-run objective of regional balance. Rather this has created a positive feedback mechanism in the growth of capital cities which are experiencing high concentration of economic activities and population.

Japan's case also shows similar trend of high concentration in few cities in core region, promoted basically through early investment in infrastructure. However, in the later stage, much emphasis was placed on increased infrastructure investment in the lagging regions with a hope to revive the economic potential of lagging regions. But, the concentration, particularly in Tokyo region, is still increasing. Overall, the regional income disparity index is declining. This alone, however, may not be a sufficient ground to infer that regions are converging in terms of economic potential and productivity as the trend followed by interregional out-put inducement coefficients indicates regional divergence.

A common thread in both of the above cases is the role of infrastructure investment in influencing productivity of a region through enhancing agglomeration. If a region receives an early

[2] Out-put multiplier in each region when final demand is increased by one unit in all regions.

investment in infrastructure, it might sustain it's initial advantage over other regions through reinforcing mechanism of agglomeration. This calls for a long-run perspective in designing infrastructure investment policy to ensure a balanced spatial development.

5. A Framework for Policy Research

Based on the insights gained from the above discussion, in this section, we propose a framework for policy research on infrastructure investment and regional disparity. The overall logic of the framework is based on a notion that the infrastructure investment help to build economic potential of a region in terms of its physical capacity to support a particular level of output, and it's ability to command a particular size of market area. The regional market condition in national context is largely determined on the basis of relative position of each region with respect to such

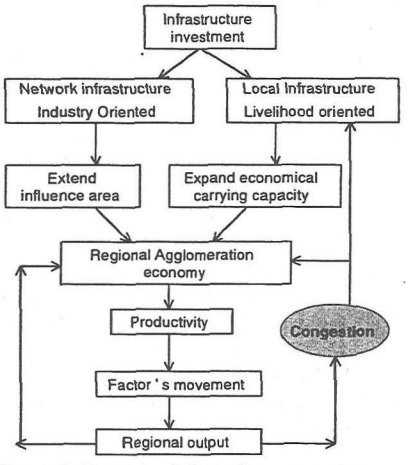

Figure 6: Framework for policy research on infrastructure investment and regional growth

economic potential. The long-run spatial pattern is then simply a result of interactions of economic agents guided through the regional market conditions. Hence, the framework has two distinct domains, first depicts how infrastructure investment induces development in regions influencing regional market conditions (cumulative causation framework) and, the next, how economic agents respond to market signals and allocate the factors among the regions (neo-classical framework).

Figure 6 shows the initial scaffolding of the framework. Infrastructure investment can be divided into two categories as network infrastructure (industrial production-oriented) and local infrastructure (livelihood oriented). These two categories of infrastructure investment influence the agglomeration potential of a region in two different way as illustrated in the figure. The agglomeration potential determines region's competitiveness through it's impact on productivity. Finally different region's relative attractiveness to factors of production determines the patterns of factor movement and ultimately regions' economic production. In addition to this unidirectional causal effects, there are several feedback mechanisms involved to drive the system endogenously. For instance, when a region experiences a growth in output due to improved productivity, the expansion in output feed-backs to productivity gain. Likewise, after achieving certain output level, a region may face a congestion which retards productivity. But congestion can be relieved through additional provision of local infrastructure.

6. Further work

Based on the above analytical framework and regional level data of Japan and Korea, a mathematical model (dynamic) will be formulated and validated. A policy simulation will be undertaken to investigate long-run effects of different policy options (in terms of investment allocation between sectors, namely industry-oriented and livelihood oriented and between advanced and lagging regions).

Note: The source of data on ASEAN-4 and Korea is World Bank (1997) and on Japan are Input-output Tables (1960-1990) and Statistical Hand Book 1998.

Refernces:

Borts, G.H. (1960). Equalisation of returns and regional economic growth, American Economic Review, vol. 50

Clark, G., M. Gertler and J. Whiteman (1986). Regional Dynamics, Boston: Allen and Unwin.

Deane P. (1969). The first industrial revolution. Cambridge University Press, Cambridge.

Government of Korea (1996) Country Report for the Republic of Korea, Presented to the Ministerial Conference on Infrastructure, 23-31 October 1996, New Delhi.

Hirschman A.O. (1958). The Strategy of Economic Development. Yale University Press, New Heaven.

Kaldor N. (1970). The case for Regional Policy. Scottish Journal of Political Economics, vol 17, pp 337-47

Krugman P. (1991). Increasing Return and Economic Geography. Journal of Political Economy, Vol 99(3)

Lucas R.E.Jr. (1988). On the Mechanics of Economic Development, Journal of Monetory Economics, Vol 22, 3-42

Myrdal, G. (1957). Economic Theory and Underdeveloped Regions. London: Duckworth

North, D. C. (1994). Economic Performance Through Time, American Economic Review, Vol 84(3), pp 359-368

OECD (1996). Regional Problems and Policies in Japan. OECD

Richardson H.W. (1969) Regional Economics, Weidenfeld and Nicolson, London.

Romer P.M. (1986). Increasing Return and Long-run Growth, Journal of Political Economy, Vol 94(5) pp 1002-1037

Theil, H. (1967). Economics and Information Theory. North-holland

World Bank (1994, 1997a). World Development Report 1994, 1997. Oxford University Press for the World Bank, Washington D.C.

World Bank (1995). Infrastructure Development in East Asia and Pacific, IBRD, Washington D.C.

World Bank (1997). World Development Indicators, 1997