論文審査の要旨及び担当者

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（論文審査の要旨）

Mister Umid Abidhadjaev's thesis is entitled "Empirical Analysis of Economic Effects of Infrastructure".

The thesis comprises a series of studies focusing on the role and nature of the economic effects of infrastructure. Infrastructure is defined as public facilities that make possible economic activities such as communication, transportation and distribution networks. For instance, the provision of new infrastructure in the form of a railway connection is expected to create new opportunities for local firms and workers as they gain better access to distant markets with improved mobility.

Chapter 1 of the thesis employs the production function approach to explain the nature of infrastructure investment on economic activity. Mr Abidhadjaev augments the neoclassical growth model and provides a theoretical framework which explains how infrastructure investment can affect GDP under the steady-state condition. He then empirically estimates the direction and magnitude of the impact of infrastructure investment on the level of GDP per capita and growth rate of GDP per capita, controlling for variables of infrastructure and level of education in a cross-country growth regression. The data is for 44 developing countries and the period is 20 years. The main contribution of this first chapter is that it shows that infrastructure matters: it demonstrates that depending on the choice of proxy variables for human capital, the infrastructure investment to GDP ratio constitutes a significant determinant of economic growth rates.

Chapter 2 to Chapter 5 present empirical evidence obtained through the estimation of the impact of infrastructure provision on some outcome variables of interest, focusing on specific case studies.

Once infrastructure is provided, this should generate spillover effects by impacting the location of businesses, incomes of households, tax revenues of governments, and the general economic performance of the connected regions. Improving understanding of how investment in transportation infrastructure influences regional economic development is important. Central governments must learn from the assessment of past infrastructure projects to better select future projects. Budget constraints for infrastructure spending are particularly tight for developing countries with limited domestic capital markets. When turning to multilateral lenders and donor organizations for support, governments need to equip themselves with knowledge derived from careful studies such as those contained in this thesis.

While chapter 1 employs the production function approach and demonstrates statistically significant and positive impact of infrastructure on income per capita, this approach faces limitation in the absence of measurement of infrastructure in the form of time varying covariates such as monetary or physical units. Therefore the analysis presented in the four chapters that follow use the difference-in-difference approach, which focuses on the impact of the infrastructure project when information about the outcome variables of interest, geography (place) and time period of infrastructure project constitute sufficient condition to conduct an empirical study.

n Chapter 2 of the thesis Mr Abidhadjaev examines the nature and magnitude of the effects of infrastructure provision on regional economic performance, as observed by the regional GDP growth rate and its components. The empirical evidence obtained in the scope of this analysis is based on difference-in-difference estimation linking the changes in the growth rate

of regional-level economic outcomes in affected regions to the newly built railway connection in the southern part of Uzbekistan, conditioned on the regions' time-invariant individual effects, time-varying covariates and evolving economic characteristics. The main contribution of this chapter is the demonstration of the differential nature of infrastructure provision. Mr Abidhadjaev estimates the regional, spillover and connectivity effects of the railway connection, as well as the anticipation, launch and postponed effects of such a connection. The empirical evidence suggests that the railway provision made a positive and statistically significant impact, not only on the region itself but also extended to neighbouring and distant regions connected through the integrated system of railway connection. The main reason for examining such effects came from a literature survey of previous studies on infrastructure, which found positive results on the aggregate level but negative results on the regional level.

The chapter 3 focuses on the same infrastructure provision in Uzbekistan, using a different estimation strategy. The major differences from the one used for the previous chapter are as follows: time periods of the observed impact are determined in consequential order, and the control group is considered to be fixed irrespective of choice of treatment groups. The main contribution of this chapter is to reinforce the previously found results regarding spillover effects which took place not only across geographical points but also through timeline of project's construction and operation.

In Chapter 4 and Chapter 5 Mr Abidhadjaev analyse the impact of infrastructure investment on fiscal revenues of local government authorities.

Chapter 4 analyses the impact of Kyushu high speed rail line on tax revenues of the prefectures in Japan. The difference-in-difference coefficients were estimated focusing on time periods of construction and two operation phases. The analysis is carried out differentiating for geographical scope as well as disaggregated outcome variables in the form of personal income tax and corporate income tax. The main contribution of the chapter is the empirical evidence which allows differentiating the spillover effects by directly affected prefectures, neighbouring prefectures and prefectures of joint rail lines. The empirical evidence suggests that the prefectures where the Kyushu high speed rail line was located had statistically significant increase in tax revenues during the construction period, as well as the second phase of operation when Kyushu high speed rail line was connected to Sanyo high speed rail line. In contrast, during the autonomous operation phase this effect on tax revenues decreased.

Chapter 5 contains analysis of the effects of the construction and operation of Southern Tagalog Arterial Road in the Philippines, on the county-level government revenues in affected counties in Batangas province of the Philippines, conditioned on the counties' time invariant entity effects. The main contribution of this chapter is the estimation of direct effects of the highway on the outcome variables of the counties of its location, as well spillover effects on corresponding variables of neighbouring counties, gradually testing the impact by dividing total observations into 5 groups. Similarly in terms of timeline, the chapter examines the impact starting with the pre-construction period, construction period and operation period of the highway. The results suggest that the Southern Tagalog Arterial Road in the Philippines induced a positive and statistically significant impact on local government fiscal revenues in counties of location during construction and operation periods, while spillover effects across neighbouring counties appeared to be positive but of diminishing nature with respect to distance from the highway. In contrast to the case of Kyushu high speed rail line, outcome variables in the form of user fees and regulators fees are chosen. This allows comparison between magnitudes of variation of non-tax revenues and total fiscal revenues of the counties.

To summarize, the thesis demonstrates evidence of significant statistical association of infrastructure with economic growth. In terms of the nature of infrastructure's impact on regional economic activity and fiscal revenue performance, the thesis presents case studies with empirical evidence suggesting the possibility of spillover effects across geography and time, meaning that the impact of infrastructure might take place not only during the operation period and on the region of location, but also prior to the operation period and in neighbouring and distant regions of the country connected through the railway system.

These findings contribute to the discussion on infrastructure financing options and compensatory measures with regards to induced changes in regional economic activity.

論 文 審 査 の 要 旨

【評価】 The chapters contained in this thesis carefully analyse the impact of infrastructure investment on economies by econometric methods that are suitable for each of the cases. In particular, the author's findings of effects of higher levels of economic activities in areas far away from railroad constructions in Chapters 2-4 are new in the literature, and are useful for understanding conflicting results at the aggregate and regional levels in the literature.

The economic effect of infrastructure investment is very difficult to measure. This thesis contributes to the literature by showing that tax revenues along the railway and highway can effectively measure this effect, by comparing tax revenues along the new railway or highway with the regions far from the railway or highway. The difference in difference method is used to test whether two groups of the region show statistically significant differences. In the case of a highway, all regions along the highway benefited after three or four years of construction. In the case of a railway, terminal stations benefitted the most and the connectivity of the railway with the market and port etc. turned out to be important to enhance the economic effect of the infrastructure. The highway case in Manila, the railway case in Uzbekistan and the Bullet train case of Kyushu (Japan) demonstrates that the method can be applicable to various kinds of infrastructures.

The thesis also shows that there are some time lags between the time of construction and the time when we see the full effect of the infrastructure. After private companies are built along the highway, training of employees and management adjustment seem to take two to three years, which explains why tax revenues increase significantly after two or three years of operation. The control group can have an endogeneity problem. However, the thesis tests many regions along the highway and railway. It can identify the kilometres for which the infrastructure had a positive impact on tax revenues.

These results have important policy implications for a country conducting a country-level cost-benefit analysis of infrastructure investment.

During the discussion on the results of the analyses contained in the thesis, questions were raised regarding: (1) the insight from the augmented neoclassical model beyond the result that infrastructure investment can increase the growth rate of GDP, (2) how the particular cases were chosen for the dissertation research, and (3) a few puzzling empirical results with statistically significant but unexpected signs. However, these points do not at all detract from the overall value of this thesis, only provide avenues for further research in this area.

All of the five chapters are based on papers co-authored with Doctor Naoyuki Yoshino, Professor Emeritus of Keio University and currently Dean of the Asian Development Bank Institute, who had been the applicant's thesis advisor until Doctor Yoshino left Keio University. Mr Umid Abidhadjaev has fully demonstrated his ability as an independent researcher by presenting some of these papers at conferences as well as university seminars, including at Harvard University and University of Oxford.

A part of Chapter 1 was published in the *American Journal of Economics,* a part of Chapter 2 was published in a book entitled *Effective Use of Social Economic Potential and Attraction of New Sources of Economic Growth* published by Tashkent Institute of Forecasting and Macroeconomic Research, and a part of Chapter 3 was accepted and is forthcoming for publication in the *Journal of Asian Economics.*

For these reasons, all five examiners unanimously agree that Mr Umid Abidhadjaev should be awarded the Doctoral Degree in Economics from Keio University.