別紙様式 10

研　究　主　論　文　抄　録

論文題目

Impact of Transport Infrastructure Investment on Interregional Economic Activity & Regional Welfare: SAM-Based General Equilibrium Approach

地域間経済や地域社会厚生に与える交通基盤投資のインパクト：多地域 SAM の作成と応用一般均衡モデルによる分析

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主論文要旨

This thesis investigates the impact of transport infrastructure investments across space in terms of economic benefits produced as in higher regional welfare, enhanced interregional equity, higher levels of output, factor incomes, interregional flows and final demand. On the other side, the negative effect in terms of higher impedance in movement, pollution, and inefficiencies related to price distortions due to inability to capture external costs of transport intensity will be presented.

The study starts with the simplest representation of regional economy -a single region model of National Capital Region (NCR). This section provides a discussion of methodological concerns & empirical issues of the construction of a regional social accounting matrix. It presents a single region model which has four production sectors- agriculture, industry, services and non-tradeables services, two types of households and two other institutions – the firm and government sector, seven major blocks – production, factors of production, trade, demand, income savings and price block. It takes off from the Cororaton model of general equilibrium model of the national economy with a major variation.　Within the price block, the transport margin is added as a component of domestic price.　It utilizes a CES production function and a Cobb-Douglas utility function. Two alternative scenarios (higher and lower transport margin) are simulated which measure the impact of transport margin on overall welfare on two household groups – high income and low income groups.　Results indicate that welfare losses nearly double the welfare gains if transport margin increases.

The next chapter focuses on a two-region model with the Philippines subdivided into National Capital Region (NCR) and Rest-of-the-Philippine (ROP) economies. The first part is an extensive discussion of construction of bi-region social accounting matrix (SAM). Then a spatial general equilibrium model, which uses a bi-regional SAM with two household types (high income vs. low-income) as database, is presented.　Each region has four production sectors - agriculture, industry, services and transport, two factors inputs – labor and capital and one government sector. Both production function and utility function are of Cobb-Douglas type. The highlight of this Mizokami-inspired model is the introduction of an impedance function which affects transport margin based on the relationship between traffic volume and transport capacity. Results indicate that transport infrastructure investment which improves transport capacity between ROP and NCR leads to higher welfare gains to households in ROP than in NCR. These infrastructure improvements which connect ROP to NCR leads to narrowing of the income gap between rich region like NCR and other poor regions which belong to the rest-of-the-Philippines.

The highlight of the thesis is the spatial general equilibrium model (SCGE) model with five-region SAM as the database. The first subsection discusses the methodology and related issues involved in creating the five-region SAM. It will relate interregional input-output freight flow data to origin-destination commodity flow data so that a robust SCGE database is created. The next part is the presentation of the five-region model which will be used to measure the impact of transport infrastructure investment. The model takes off from the Mizokami two-region model with variations on the production and consumption side. A three level production function of Cobb-Douglas-Leontief form is estimated for each regional production sector. The transport intermediate input is isolated in the second level. The transport sector is subdivided into water, air and land transport services sector. There are seven production sectors- agriculture, industry, other services sector, government services sector and the three transport sectors. Households are disaggregated into low, middle and high income level groups. Utility function is of Cobb-Douglas type. The rest-of-the Philippines is subdivided into Northern Luzon (NOL), Southern Luzon (SOL), Visayas (VIS) and Mindanao (MIN). This is the first SCGE model with a disaggregated transport sector and the first attempt in constructing a five-region SAM database in the Philippines. Exogenous variables include capital input, exports, imports, government expenditures, indirect and direct tax rate. The closure rule adopted is that saving should equal investment. To attain equilibrium, quantities adjust and prices follow to equate the notional and effective demand for labor. The model treats all income = expenditure relationships as constraints in a nonlinear programming problem. Markets adjust so as to minimize the value of the sum of squared excess supplies for all commodities.

This five-region model is used to measure the impact of alternative types of exogenous shocks which affect impedance levels of traffic flow and output elasticity with respect to transport inputs. The first scenario discusses the impact of a 5% increase in capital input in land transport services sector in the National Capital Region. Empirical results indicate that the middle income group had the highest welfare gain across all regions. On the production side, the industrial sector in all five regions had biggest output increment with those located in NCR, SOL and MIN as highest in rank. In terms of impedance (V/C -trade volume to capacity ratio), the biggest decline was registered by those traffic flows with SOL transport sectors as destination. Air transport services in all destination regions had the biggest decline in V/C ratio. Agriculture and industry sectors in non-NCR destinations had positive changes in impedance ratio.

The next scenario discusses the impact of a technological improvement of transport infrastructure which results to higher output elasticity with respect to transport input. One case delineated is the impact of a 5% increase in output elasticity with respect to NCR land transport input brought about by better constructed road network within NCR. The impact on impedance was that traffic flow with NCR land transport sector as origin and destination registered huge increase in impedance ratio. Increase in impedance was highly correlated with sectors which had big increases in output. Decrease in impedance was registered for water and air transport services in other regions (NOL, SOL and MIN). Substitution in favor of land transport mode was prominent in NCR and VIS regions. In terms of relative welfare gains the low income households in SOL and VIS had highest percentage change in utility.

The next scenario discusses the impact on welfare of alternative 5% increase in capital input of transport services sector in Mindanao region -the region with the poorest provinces in the Philippines - MIN water, air and land transport services sectors. Empirical results indicate that capital infusion in MIN land transport sector had the highest welfare effect in the region. Whereas the same action in MIN water transport sector had negligible effect on welfare. On the other hand, across all five regions, the middle income group had the biggest welfare gain followed by the low income group.

In the last simulation, the case of 5% increase in output elasticity to transport input in water transport mode in all five regions taken one at a time is presented. In terms of output and relative welfare gains, the highest impact was registered by technological improvements in VIS water transport mode, followed by MIN water transport sector and then by NCR water transport sector.

In terms of consumption level, households declined their absolute consumption of the specific water transport sector which had higher output elasticity. This means less water pollution due to the declined level of consumption of water transport services by households across all regions.

In conclusion, an integrative transport-economy policy package will be suggested with specific emphasis on land transport infrastructure investment. Policy directions on how to uplift low income groups to middle income groups via optimal location of transport infrastructure investment will also be formulated. The trade-off between higher output growth coupled with transport intensity and lower impedance in movement and environmental degradation costs will also be discussed.