"A General Equilibrium Model of the Impact of Impedance Factor in Transport on Interregional Flows in the Philippines "

by Cristela Goce-Dakila & Shoshi Mizokami [1]

ABSTRACT

The paper estimates the impact of the impedance factor in transport on overall welfare, production levels, and interregional flows in the Philippines through the use of a spatial general equilibrium model.

A 3-level production function is specified. Capital and labor income accrue to households, which then goes to consumption and saving, with a constant marginal propensity to consume. Consumption is divided between different commodities using a Cobb-Douglas production function. Final demand is then built up in a standard way.

Impedance ratio is defined as the ratio of traffic volume to capacity. An exogenous shock in the form of higher capital input in land transport services sector in the National Capital Region , which enhances the sector's capacity, is introduced.

Empirical results indicate that the main beneficiary of such a policy is the middle income class on the consumption side . On the production side , the industrial sector in Southern Luzon, and other services sector in all of the five regions in the Philippines experienced positive spillover effects.

Key words : five-region SAM, impedance factor, traffic volume, capacity

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I. Introduction

Investment in transport infrastructure improves transport capacity and connects regions in an archipelago like the Philippines, It has significant welfare effects and impact on major macroeconomic variables. It leads to trade creation, increase in income and expenditures of interconnected regions and may lessen regional income disparity, within regions and across regions. It facilitates flow of goods and services from initial producer to final consumer. However, inadequate capacity to accommodate an increase in flow of commodities creates impedance or obstacles to free movement. This degree of obstruction is called impedance ratio.

. This paper hypothesizes that effective infrastructure planning is manifested by decreases in impedance in movement of goods from origin area to destination area. It utilizes the concept of the impedance factor in an applied general equilibrium model with a transport sector subdivided via different transport modes.. Impedance level, in this exercise , is defined as the ratio of traffic volume to the capacity of the sector where the trade volume originates. Traffic volume is represented by the monetary value of interregional and intraregional trade contained in the cell entries of input-output table portion of a five-region social accounting matrix (SAM); whereas capacity is represented by capital input measured in the value-added component of the production function of each sector. An exogenous shock is introduced which lessens the disparity between traffic volume and capacity

A spatial computable general equilibrium (SCGE) model is used measure the impact of an increase in transport capacity via higher capital input in land transport services sector of National Capital Region (NCR). A computable general equilibrium model is a microeconomic-based model. of the whole economy. It depicts interaction among different economic agents – households, firms, goods and factors distinguished from each other by their location. It takes account of structural relationships in an economy and measures numerically the economy-wide consequences of change in transport infrastructure policy via an endogenous-price system.

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II. Data Definition

2.1 Set Definition :

2.1.1 Regions : This paper subdivides the Philippines into 5 administrative regions – National Capital Region, Northern Luzon, Southern Luzon, Visayas & Mindanao.

2.1.2 Factors : The data set specifies two primary factors of production namely : capital and labor.

2.1.3 Sectors : There are seven production sectors delineated for each of the five regions – namely agriculture, industry, other services, water transport services, air transport services, land transport services and government services.

2.1.4 Institutions : There are 4 institutions included namely : household, firm, government and rest-of-the-world.

2.2 Assumptions : (1)All product and factor markets operate under perfectly competitive conditions. (2) Economic agents like households and firms maximize an objective function subject to constraints. Households maximize utility whereas firms maximize profit. (3) Equilibrium is defined as a state where the actions of all agents are mutually consistent and can be executed simultaneously. Quantities adjust in the model and prices follow to equate the notional and effective demand for labor. (4) In this model, adjustment to equilibrium is implemented by specifiying that markets adjust to minimize the sum of excess supplies. (5) Among the seven-production sectors; three belong to the transport sector, namely, water transport services sector, air transport services sector, land transport services sector. The demand for services of each type of transport mode is a derived demand associated with the demand of intermediate production goods. (5) Between the two factors of production , capital is immobile and labor is mobile among the five regions. (6) The economy has 36 markets . This is composed of thirty-five product markets of the aforementioned five regions with seven production sectors each, one capital market and one labor market.

2.3 System Level Data

The benchmark data are taken from a five-region social accounting matrix constructed by the authors for the Philippines, using 1994 Philippine interregional input-output data. (2005 : Mizokami & Dakila). The delineation of regions is based on the archipelagic geography of the Philippines. The disaggregation into seven sectors (with three transport sectors – water mode,air mode and land mode identified) is done to enable the researcher to look into the impact of a change in transport capacity of alternative transport modes on interregional economic activity. Households are divided into three income groups; namely low-income households, middle-income households and high-income households. Low income households are all those who earn below the regional poverty threshold as determined by the National Statistical Coordination Board. The high income households are those who earn 250,000 pesos and above annually. All the households earning income between the regional poverty threshold and the highest income bracket in the Family Income and Expenditure Survey (250,000 pesos and above) are classified as middle income households.

III MODEL SPECIFICATION

The framework takes off from Mizokami model of two region economy in the Philippines with four production sectors including transport. (Mizokami, Itose, Dakila :2005). However, there are variations in specification of the production function. A three- nested production function is estimated. The transport sector intermediate input is isolated in the second level of production function. A more detailed disaggregation of transport sector is delineated – namely water transport services sector, air transposrt services sector and land transport services sector. Furthermore, another point of difference is that households in each region are decomposed into three income levels - low, middle and high. Finally, the rest-of-the-Philippines region is divided into four regions namely Northern Luzon, Southern Luzon, Visayas and Mindanao vis-à-vis National Capital Region.

This is the first spatial equilibrium model with a disaggregated transport sector in the Philippines. All CGE models devised in the past have been national in scope. This is also a first attempt in constructing a five-region social accounting matrix as database for SCGE model in the Philippines.

The model distinguishes between 15 representative households, with 3 household types (representing the low, middle, and high income classes) for each of the six regional groupings distinguished in this paper. The preferences of each household type are summarized by a corresponding Cobb-Douglas utility function:

$$U_h = \prod_i C_{ih}^{\delta_{ih}} \tag{1}$$

where δ_{ih} is the elasticity of the utility of the h^{th} household with respect to consumption of the i^{th} good. Each representative household maximizes its utility subject to its income constraint, which we describe below.

For each region, household labor income is assumed to be equal to the sum of the labor incomes that each household income group earns from supplying labor within the region. The endowments of labor of different income classes within a region are taken to be a constant; this then determines how labor income is distributed within each region.

Since capital is fixed, then each household income group is assumed to own a fixed share of total capital, and this ratio is maintained through the policy experiments. Household income is calculated as the sum of labor income ($w_i L_i$) plus that portion of capital income that accrues to the households ($\lambda_h \Sigma_i r_i K_i$), plus transfers from government and from the rest of the world. The latter two are exogenously determined. Thus, if we partition the indices h and i so that the r^{th} partition belongs to the rth region, then we obtain total income per household type as:

$$Y_{h,r} = \omega_{h,r} \sum_{i \in r} w_i L_i + \lambda_{h,r} \sum_i r_i K_i + Tr_{GOV,h,r} + Tr_{ROW,h,r} \tag{2}$$

where the ω's are the labor income distribution parameters, and, as indicated, the summation is for industries belonging to the rth region. Total disposable income is found by subtracting direct taxes imposed on the household from the foregoing quantity:

$$Yd_h = Y_h \left(1 - \tau_h\right) \tag{3}$$

where Y_d is disposable income and τ_h is the direct tax rate imposed on household h. Note that the summation now runs within each household type, so that we have dropped the subscript r referring to the partitioning across regions.

Each household type is assumed to consume a constant proportion of its disposable income. Thus, households maximize utility subject to the budget constraint

$$\sum_i pd_i C_{ih} = c_h Yd_h \tag{4}$$

where pd_i is the domestic price of the good and c_h is the average propensity to consume of household h. Given the Cobb-Douglas utility function, the first order conditions yield the following consumption demands for each commodity by each household type in each region:

$$C_{i,h,r} = \delta_i c_{h,r}\left[\omega_{h,r}\sum_{i\in r} w_i L_i + \lambda_{h,r}\sum_i r_i K_i + Tr_{GOV,h,r} + Tr_{ROW,h,r}\right]\left(1-\tau_{h,r}\right)/p_i \tag{5}$$

B. PRODUCTION SECTOR

Production is modeled assuming a three-stage production function. At the first stage, capital and labor are combined to produce value-added, using a Cobb-Douglas production technology.

$$V_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i} \tag{6}$$

where for sector i and region r, V = value added, K = capital, L = labor, α = share of capital in value-added, $1-\alpha$ = share of labor in value-added and A_i is scale parameter. This specification of the Cobb-Douglas function assumes constant returns to scale. Capital is assumed to be immobile across sectors while labor is mobile.

In stage 2 of the production process, value-added is combined with non-transport intermediate inputs under a Leontief technology, to produce a composite good, which is output net of transport (X_i^{NT}).

$$X_i^{NT} = \min\left[X_{1i}/a_{1i},\ X_{2i}/a_{2i},\ldots,\ X_{NTi}/a_{NTi},\ V_i/a_{V,i}\right] \qquad i=1,2\ldots\ldots34 \tag{7}$$

where Q_{ji} = non-transport intermediate input coming from sector j in origin to sector i in destination region, with corresponding Leontief coefficient a_{ji} in the second level production function; V_i represents value-added of output in destination region.

Finally, stage 3 combines output net of transport with transport intermediate inputs under a Cobb-Douglas production function to yield total output gross of transport of commodity i ($X_{T,i}$).

$$X_{T,i} = B_i\left(X_i^{NT}\right)^{\beta_{1i}} W_i^{\beta_{2i}} A_i^{\beta_{3i}} La_i^{\beta_{4i}} \tag{8}$$

where W, A and La represent the different transport intermediate inputs that go into sector i, namely, water, air and land transport. This specification allows substitutability between the various transport modes. Total output of sector i (X_i) is found by summing together total output gross of transport of commodity i ($X_{T,i}$), indirect taxes on i ($T_{indirect,i}$), direct taxes imposed on firms in sector i ($T_{direct,i}$), imports of i (M_i), tariffs imposed on i (Tar_i), and net dividends from the foreign sector into sector i ($Div_{For,i}$).

$$X_i = X_{T,i} + T_{Indirect,i} + T_{Direct,i} + M_i + Tar_i + Div_{For,i} \tag{9}$$

The firm is assumed to maximize profits. Because of the nature of the production function, profit maximization can be described in three stages. The bottom stage entails choosing the optimum levels of capital and labor so as to maximize the contribution of value added to profits. At the second stage, as noted above, value-added is combined with other intermediate non-transport inputs in a fixed coefficients (Leontief) technology to produce output net of transport. Finally, the top stage determines the optimal combination of transport inputs to deliver output to the region of destination. Then for commodity j, the optimization problem is

Maximize

$$\Pi_j = \mathrm{pd}_j \mathrm{X}_j - \sum_i \mathrm{pd}_j \mathrm{Mat}_{i,j} - \mathrm{pva}_j \mathrm{V}_j \tag{10}$$

subject to

$$\mathrm{X_j} = \mathrm{B}_j {\mathrm{X}_j^{NT}}^{\beta_{1j}} \mathrm{W}_j^{\beta_{2j}} \mathrm{A}_j^{\beta_{3j}} \mathrm{La}_j^{\beta_{4j}}$$

$$\mathrm{X}_j^{NT} = \min\left[\mathrm{X_{1j}}/\mathrm{a_{1j}}, \ldots \mathrm{X_{NTj}}/\mathrm{a_{NTj}}, \mathrm{V_j}/\mathrm{a_{V,j}} \right] \tag{11}$$

$$\mathrm{V_j} = \mathrm{A_j} \mathrm{K_j}^{\alpha_j} \mathrm{L_j}^{1-\alpha_j}$$

where Π is total profits, Mat_{ij} is the matrix of intermediate inputs of each commodity into commodity j, V represents value added, and pva is its corresponding price.

At the top production level, the corresponding first order conditions (FOCs) for profit maximization are

$$\mathrm{pd_i} * \frac{\partial \mathrm{X_i}}{\partial {\mathrm{X}^{\mathrm{NT}}}_{\mathrm{i}}} = \mathrm{p_{NT}} \text{ or } \mathrm{pd_i}\beta_{1i} \frac{\mathrm{X_i}}{{\mathrm{X}^{\mathrm{NT}}}_{\mathrm{i}}} = \mathrm{p_{NT}} \tag{12}$$

$$\mathrm{pd_i} * \frac{\partial \mathrm{X_i}}{\partial \mathrm{W_i}} = \mathrm{p_w} \text{ or } \mathrm{pd_i}\beta_{2i} \frac{\mathrm{X_i}}{\mathrm{W_i}} = \mathrm{p_W}$$

$$\mathrm{pd_i} * \frac{\partial \mathrm{X_i}}{\partial \mathrm{A_i}} = \mathrm{p_A} \text{ or } \mathrm{pd_i}\beta_{3i} \frac{\mathrm{X_i}}{\mathrm{A_i}} = \mathrm{p_A}$$

$$\mathrm{pd_i} * \frac{\partial \mathrm{X_i}}{\partial \mathrm{La_i}} = \mathrm{p_L} \text{ or } \mathrm{pd_i}\beta_{4i} \frac{\mathrm{X_i}}{\mathrm{La_i}} = \mathrm{p_{La}}$$

There are no corresponding FOCs for the second level production stage, since this is characterized by fixed coefficients technology, and marginal conditions are not defined. However, once output net of transport is determined, the different non-transport inputs as well as total value added can be derived using the fixed coefficients technology in Eqn (7).

At the bottom level, profit maximization entails choosing the least cost combination of labor and capital to produce the required value-added. Since capital is immobile, of particular interest is the first-order condition for labor, which is

$$\text{pva}_i * \frac{\partial V_i}{\partial L_i} = w_i$$

$$\text{pva}_i \left(1-\alpha_i\right) \frac{V_i}{L_i} = w_i \tag{13}$$

C. GOVERNMENT AND THE EXTERNAL SECTOR

The model incorporates a national government sector, i.e., the behavior of local government units is not considered. Government enters the economy in several ways: it purchases output from each sector, imposes indirect taxes on production and tariffs on imported goods, and direct taxes on income of each household type. Government expenditures on each commodity are taken as exogenous in the model, while taxes are endogenous.

Tariff revenues per commodity equal the product of the tariff rates and import values:

$$\text{Tar}_i = \text{tar}_i \left(m_i\right) \tag{14}$$

where Tar_i and tar_i are total tariff collections from i and the tariff rate on commodity i, respectively. Indirect tax collections are given by the product of the indirect tax rate imposed on domestic production and the rate imposed on imports of the product:

$$T_{\text{Indirect},i} = \text{tind}_i \left(d_i + m_i \left(1+\text{tar}_i\right)\right) \tag{15}$$

Direct tax collections per household type in the model are computed as:

$$T_{\text{Direct},h} = Y_h - Yd_h \tag{16}$$

At this stage of model specification, imports and exports are taken as exogenous.

D. INVESTMENT-SAVING BALANCE

Total household savings in the model are given by the aggregate difference between household disposable income and consumption expenditures:

$$S_h = \Sigma_h \left(Yd_h - C_h\right) \tag{17}$$

One complication is that some of the measured consumption expenditures are of the nature of investments, including pension premia, pre-need plans and stock investments. Thus, we introduce a balancing factor (ϕ) to account for any discrepancies between measured savings and investments.

Total government savings are the sum of the various revenue sources minus total government purchases of the outputs of the various sectors, total government transfers to households, and total net transfers of the government to the foreign sector:

$$S_G = \Sigma_i \text{Tar}_i + \Sigma_i T_{\text{Indirect},i} + \Sigma_h T_{\text{Direct},h} - \Sigma_i G_i - \Sigma_h \text{Tr}_{\text{GOV},h} - \text{Tr}_{\text{GOV,FOR}} \tag{18}$$

Total foreign savings, S_{FOR}, are given by the current account deficit minus net dividends to foreigners. Therefore, total savings are

$$S_{TOTAL} = S_h + S_{GOV} + S_{FOR} \tag{19}$$

Conceptually, total savings should equal total investment. As noted previously, our framework allows for statistical discrepancy by introducing a factor ϕ which transforms savings to investments. Investment distribution per sector is then modeled as constant proportion of total investment, with the distribution coefficients γ_i calibrated according to the sectoral distribution of investment in 1994:

$$I_i = \gamma_i \phi (S_{TOTAL}) \tag{20}$$

E. Demand

Total intermediate demand for commodities by the firm arises from its maximization of profits subject to the three-level production function. At the first level, the first order condition for profit maximization entails equating the marginal product to the marginal cost of labor.

$$pva_i * \frac{\partial V_i}{\partial L_i} = w_i$$

$$pva_i (1 - \alpha_i) \frac{V_i}{L_i} = w_i \tag{11}$$

where the marginal product of labor for each production sector is evaluated assuming that capital is immobile across sectors. For any given employment, equilibrium entails that the corresponding level of production equal the demand forthcoming at the employment level. Similar equations hold for the choice between output net of transport and the various transport inputs, at the third level of the production function. This equilibrium condition together with (11) determines pva. We turn to this in greater detail in the section on prices.

At the second level, each production sector combines value-added and every non-transport intermediate input according to a fixed proportions technology:

$$Mat_{i,j} = a_{ij} X_j^{NT} \tag{21}$$

where i runs through all the non-transport intermediate inputs and value added for each sector, j runs through all the production sectors in the economy, Mat_{ij} is the matrix of interindustry flows in the economy, a_{ij} represents the fixed coefficients technology, and, as before X_j^{NT} is output net of transport for the jth sector.

Final demand in the economy originates from households (consumption demand), firms (investment demand), government spending, and the foreign sector (export demand). Consumption demand by households originates from the maximization of the utility function, as described previously in section 4.1.2A. Although, for simplicity, firms' investment demand are not described explicitly in terms of optimization, the level of investment is determined by the transformation of savings into such, as described in section 4.1.2D. Government and export expenditures are taken to be exogenously determined.

The domestic demand for commodity i consists of the total intermediate demand, plus the total final demands for consumption, investment, and government purchases, while the total composite demand, represented by Q_i, is the sum of the domestic demand and exports:

$$Q_i = \sum_j \mathrm{Mat}_{i,j} + \sum_h C_{h,i} + I_i + G_i + \mathrm{Exports}_i \tag{22}$$

F. Prices and Equilibrium

For any given employment level, equilibrium entails that the corresponding level of production should equal the demand forthcoming at the employment level. This requirement, together with the first order conditions for profit maximization by the firms, determines the price levels in the economy, relative to the price of labor. The labor price is assumed to be the numeraire, and is thus taken to be fixed. Since capital is a fixed factor, we take returns to capital as a residual determined by the identity:

$$r_i = \frac{\left(\mathrm{pva}_i * V_i - w_i^0 L_i\right)}{k_i^0} \tag{23}$$

The total product cost can then be built up from the components in a standard way. Thus, average cost per unit is

$$AC_i = \frac{\Sigma_j \mathrm{pd}_j \mathrm{Mat}_{j,i} + \mathrm{pva}_i V_i}{X_i} \tag{24}$$

where pd_i is the domestic (tax-inclusive) price of i. In equilibrium, the average cost equals the composite price pq_i of the commodity (the composite price is the peso price of both domestically produced and imported commodities).

The excess supply for each commodity is given by:

$$ES_i = X_i - Q_i \tag{25}$$

The model treats all the foregoing relationships as constraints in a nonlinear programming problem. Markets are assumed to operate so as to minimize the value of sum of squared excess supplies for all commodities; i.e., the objective of the programming problem is to minimize the quantity

$$\Omega = \Sigma_i \left(\mathrm{pq}_i * ES_i^{\,2}\right) \tag{26}$$

In equilibrium, therefore, the unit cost is divisible into three parts: (1) $\frac{\sum_j pd_j q_{ji}}{X_i}$, where the j's are the non-transport inputs give the cost of non transport intermediate inputs per unit of X; (2) the same formula with the j's taken to be the transport inputs yields the transport margin; and $\frac{w_i L_i + r_i K_i}{X_i}$ is the cost of value added per unit of X.

G . Equilibrium Condition :

$$Y = C + I + G + X - M \quad (29)$$

Where Y : aggregate supply
C: total consumption expenditures of the national economy
I: total investment expenditures of the national economy
G : total government expenditures of the national economy
X: total purchases of locally-made goods by foreign sector
M : total purchases of foreign-made goods by domestic residents of nation

Total consumption (C) can be represented by

$$C = \sum_h \sum_i \sum_r c_{h,r,i} \quad (29.1)$$

where h : household income class group
r : region
i : production sector

Total disposable income (Yd) is estimated by

$$Y_d = \sum_h \sum_i \sum_r Y_{d\ h,r} \quad (29.2)$$

Savings-Investment Balance is depicted by

$$I = a\ (Y_d - C) \quad (29.3)$$

where "a " is balancing parameter

Distribution of investment across sectors is embodied in the equation

$$I_{i,r} = w_{i,r}(I - \sum_h \sum Y_{nf}) \quad (29.4)$$

where Y_{nf} is income of informal sector and $I_{i,r}$ is formal investment

H. Impedance Ratio

Once equilibrium output is determined, the impedance ratio adjusts due to changes in the matrix of interindustry flows (Mat_{ij}). The change in impedance ratio is generated within the economic system via the change in Mat_{ij} divided by capacity of three transport mode -land, air and water, taken alternatively.

$$\text{IMPEDRatio} = Mat_{ij}/k_{trnsmode} \quad (30)$$

$$\Delta\ \text{IMPED Ratio} = \text{Imped Ratio}_{b4shck} - \text{Imped Ratio}_{aftrshck} \quad (31.1)$$

$$\Delta\ \text{IMPED Ratio} = Mat_{ijb4shck}/\ k_{trnsmode} - Mat_{ijaftrshck}/\ k_{trnsmode} \quad (31.2)$$

where Δ IMPED Ratio : change in impedance ratio

Imped Ratio_{b4shck} : impedance ratio before exogenous shock

Imped Ratio $_{aftrshck}$: impedance ratio after exogenous shock

$k_{trnsmode}$: transport capacity – either land, air or water

IV. OVERVIEW OF THE IMPEDANCE CONCEPT

The concept of impedance used in this paper , utilizes social accounting matrix (SAM) data. This is quite different from conventional concepts of travel impedance used in transport studies which are briefly discussed in this section.

Traditionally,according to Handy and Niemeier (1997), impedance is measured by distance or time. It is estimated by straight-line distance, network distance, network models simulating travel demand, field surveys of actual driving times or surveys of residents' perceived distance or travel time. The use of a generalised transport cost function, incorporating both time and monetary costs, is often an improvement over the use of time alone. Differences in travel time and cost by mode were addressed by calculating accessibility separately for different modes. This dimension of impedance was considered in this paper through the disaggregation of transport services sector into air, water and land transport services sector.

Forms of generalised transport impedance function containing travel cost and mostly travel time already exists (Otuzar & Williamsen : 1994) However, the following factors have to be considered in measuring impedance (1) the relation between travel time and costs (calculation of interaction travel time and travel cost); (2) different economic agents (firms and households); (3) different actor types and characteristics (high and low income groups);and (4) economic agents' perceptions of accessibility.The aforementioned generalized transport impedance measures are used to operationalize the concept of accessibility in transport planning studies. (Tillema T.& Van Wee Bert : 2002) .

V. EMPIRICAL RESULTS

After a thorough discussion of the five-region model used and the theoretical underpinnings of the impedance concept, the paper now proceeds to a discussion of the empirical validation of the model.

This section depicts the impact of higher capital input of NCR land transport services sector on major areas of macroeconomic policy; namely regional welfare, gross output , impedance ratio and consumption demand. This exogenous shock could be represented by an increase in land transport vehicles in NCR or building wider roads in NCR. The assumption adopted here is that funding of higher capital input of NCR land transport services comes from an equivalent amount of transfer payment from abroad.

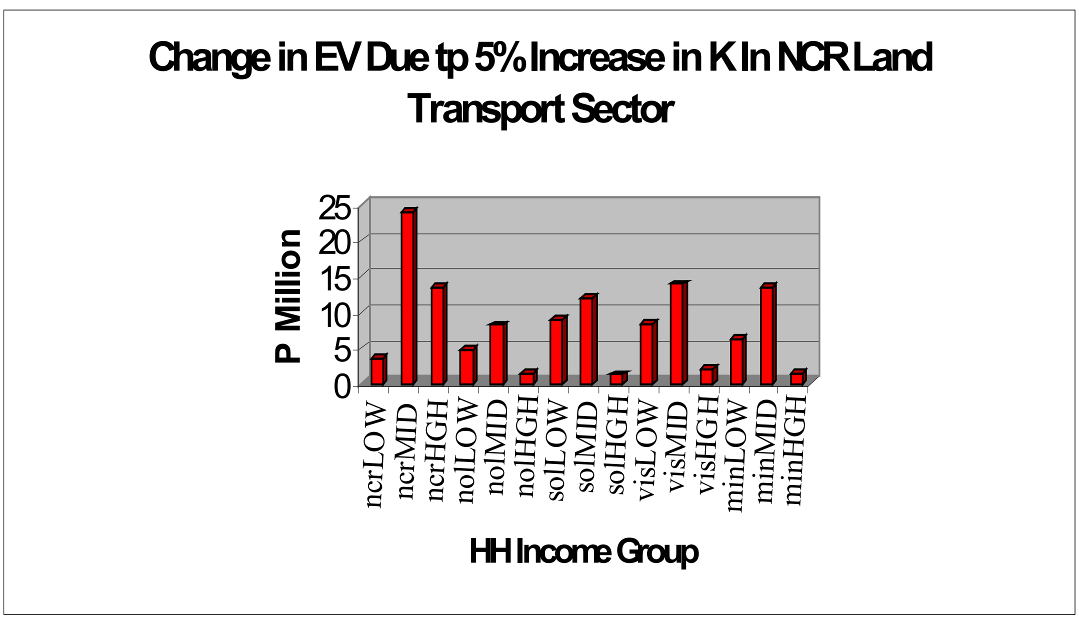
5.1 IMPACT ON WELFARE

There was an increase in overall social welfare. This was manifested by an upsurge in equivalent variation. However, the distribution of this welfare gain was centered primarily in NCR and Southern Luzon. The region with the lowest welfare gain was Northern Luzon. This was ten times lower than that of NCR. Visayas and Mindanao in Southern Philippines registered only around one-sixth the value of increase in welfare in the National Capital Region.

The main beneficiary of the exogenous event in terms of welfare gains is the middle income class in all the five delineated region of the Philippines. This augurs well for the rise of a middle income group in the Philippines.

However, even more significant is the fact that it is the low income group which had the second highest welfare gain ; much higher than that of the high-income group.

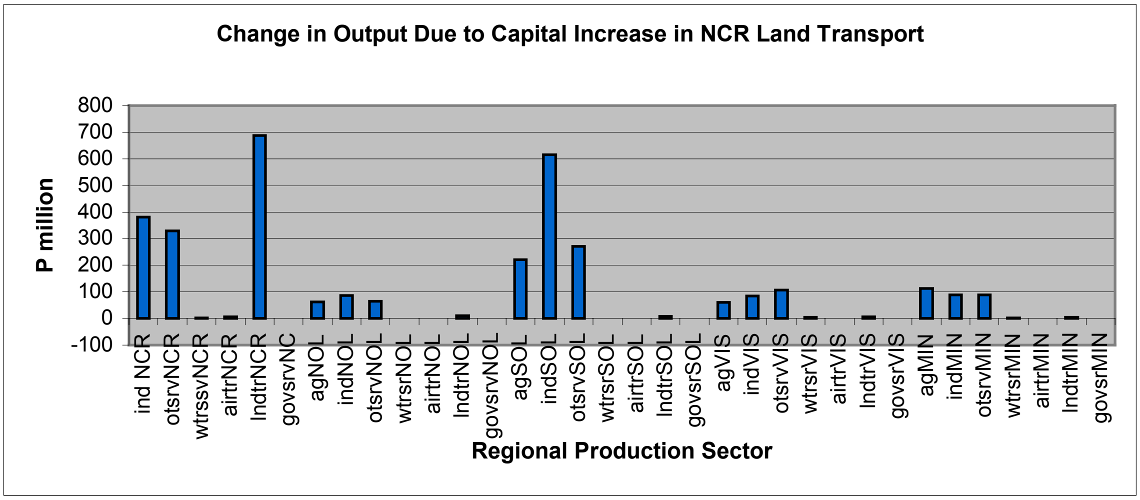
Figure 1



5.2 IMPACT ON OUTPUT

The sectors which benefited the most from an increase in capital in NCR land transport services sector are the industrial sectors of Southern Luzon and NCR. This means that improvement in capacity of the land transport services sector has significant spillover effects on the adjacent region Southern Luzon as compared on the other adjacent region which is Northern Luzon. The industrial sectors in the three other regions namely Visayas , Mindanao and Northern Luzon registered positive increments..Consistent among the five regions was the beneficial impact on output on industry,agriculture and other services sector.

Figure 2

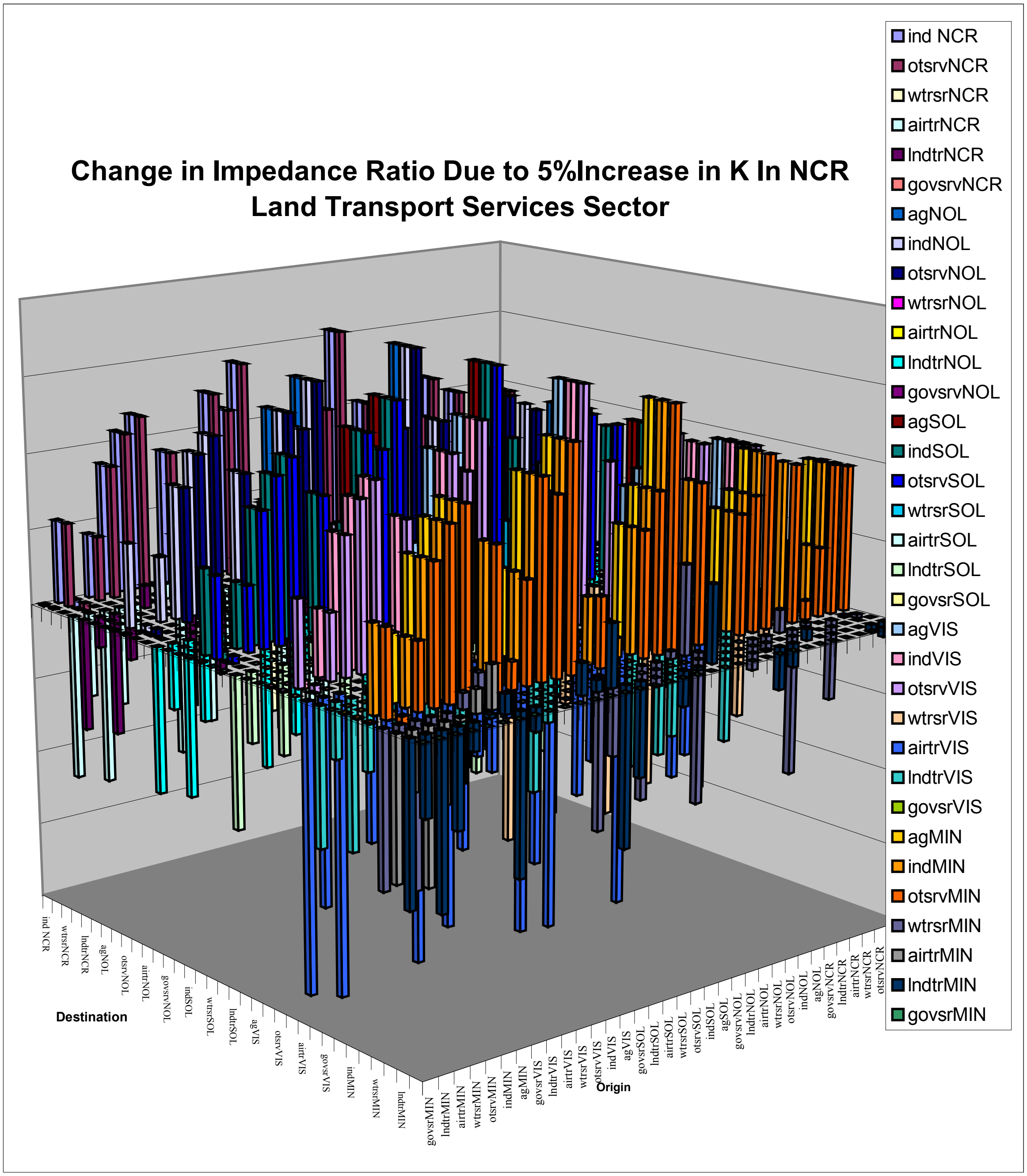


5.3 IMPACT ON IMPEDANCE

In a previous section, impedance has been defined as the resistance to movement of goods and persons between two points in space . In a frictionless economy, there is no resistance to movement of goods and people across space. Hence, there is no impedance.

Since this study utilizes data from a multi-regional social accounting matrix (MRSAM), it does not consider the elements of travel time and distance used in conventional measurements of impedance. Impedance in this simulation exercise, is defined as the ratio of traffic volume to capacity (as represented by capital input of sector in MRSAM . Hence impedance is minimized if capacity is adequate enough to accommodate full traffic flow. Using MRSAM data , this adequacy is measured by an impedance ratio where the numerator is traffic flow and the denominator is the monetary value of capital input used by sector in origin area.

Figure 3



An exogenous shock of 5% increase in capital input of NCR land transport services sector is introduced. This represents an increase in capacity of aforementioned sector. Then, the deviation in the value of the impedance ratio is measured.

The change in impedance ratio after the exogenous shock, can be interpreted as a sensitivity variable. It is the sensitivity of volume to capacity (V/C) ratio of origin-destination trade flows with respect to a change in capacity of land transport services sector in National Capital Region. If the sensitivity variable is positive, this means that trade flow between the respective sectors of the two regions is extremely responsive to changes in capacity of NCR land transport sector .The increase in capacity of land transport services in NCR can take the form of a wider and longer road network Higher resistance to movement across space occurred and this resulted to higher impedance. On the other hand, if the sensitivity variable is negative, this means that there was lesser impedance due to the decline in volume-capacity ratio brought about by higher capacity in NCR land transport sector..

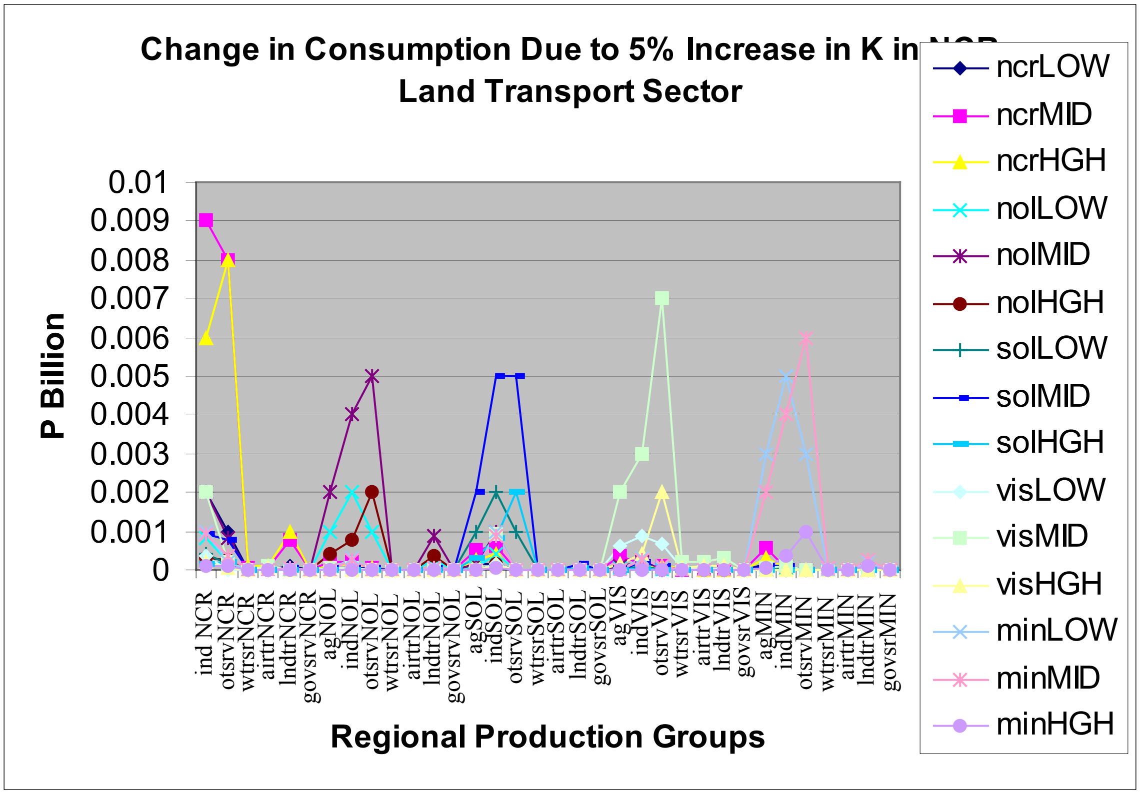
A significant impact of the exogenous shock is that all trade flows coming from NCR land transport sector to the other sectors in all other regions in the Philippines experienced the biggest decline in impedance. Also, most of the traffic flow emanating from land transport sector in Southern Luzon , water transport services sector in Visayas and Mindanao experienced lower impedance ratio. This implies that there is a positive spatial impact of enhanced capacity of NCR land transport sector in terms of less friction in movement of goods and persons from Visayas & Mindanao;both regions located in Southern Philippines.There are strong interregional linkages in transport sector.

On the other hand, all trade flows with NCR land transport services sector as destination sector had positive change in impedance ratio. This can be attributed to ncrease in magnitude of interregional of trade flows from all other sectors in National Capital Region (NCR), Northern Luzon (NOL), Southern Luzon (SOL), Visayas (VIS) and Mindanao (MIN) moving into NCR land transport services sector. The increase in trade flows is due to enhancement of output created by higher capacity in NCR land transport services sector.

5.4 IMPACT ON CONSUMPTION DEMAND

The exogenous shock caused significant increases in consumption demand across all regions. The figure below shows that it is the middle income class in all five regions which experienced the biggest increase in consumption expenditures. The next group which had higher consumption expenditures was the low income class. This reinforces the finding on impact on equivalent variation. It highlights the finding that middle class income group, consuming output of NCR land transport services sector, was the main beneficiary of lowering of impedance ratio. There was a big jump in consumption expenditures in Southern Luzon industrial sector. This means that this adjacent region experienced a positive spillover effect due to enhancement of land transport capacity of National Capital Region.

Figure 4



VI . CONCLUSION

The above discussion highlights the importance of the impedance factor in affecting overall social welfare, production levels, and consumption levels across regions and production sectors in the Philippines.

Less friction in movement of commodities and persons across space, in terms of negative change in impedance ratio, enhances overall utility. The middle income class group benefits the most relative to the other income classes in all five regions. However, it is the National Capital Region, relative to other regions, which experienced the biggest increment in welfare. Land transport capacity improvements in NCR can lead to the rise of a strong middle class in the Philippines.

An improvement in NCR land transport services via higher capital input in this sector also has spillover and feedback effects on gross output and inputs of production sectors across the Philippines. While the main beneficiary is the NCR land transport services sector itself, production levels and interindustry linkages in other sectors specifically the industrial sector and other services sector in non-NCR regions are also enhanced by infusion of more capital in NCR land transport services sector.

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