Impact of Transport Margins on Economic Welfare in Metro Manila, Philippines: A Single Region SAM Approach

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ABSTRACT

This paper aims to construct a social accounting matrix for the National Capital Region, present a model of the role of transport sector in an applied general equilibrium framework, apply theoretical framework to an empirical study of the impact of additional transport infrastructure via lower transport margins on important regional macroeconomic variables, and suggest policies which would underscore the role of transport sector in enhancing regional economic benefit.

Initial results indicate that welfare losses nearly double the welfare gains if transport margin increases by 0.2 due to poor transport infrastructure planning in Metro Manila. However, welfare differentials are bigger for rich households than poor households. An interesting insight to this is that the adverse effect of inefficient transport infrastructure planning is felt more by the high income bracket than the low income bracket.

Key Words: transport planning, regional social accounting matrix, social welfare

1 INTRODUCTION

Very few studies in the Philippines have focused on the link between the transport sector and regional economic activity and structure. There has been no intraregional macroeconomic model that underscores this very important relationship.

It is a known fact that transport infrastructure investments reduce transport costs. This happens through (1) reductions in the cost of transporting commodities; (2) lower cost of business travel, (3) lower cost of travel to leisure and tourism destinations, and (4) lower costs of commuting which can lead to a widening of labor market catchment areas. The immediate benefit of the investment is the fall in the unit cost of each type of traffic multiplied by the volume of that traffic.

Transport can facilitate economic activity. It is this, which establishes the need to consider the impact on the economy of proposals to invest in infrastructure. Changes in transport costs affect relative product prices, which in turn affect the demand for different products. The latter then causes changes in income of factors used for output produced.

This paper therefore aims to do the following: (1) to produce a prototype regional social accounting matrix (SAM) for the National Capital Region (NCR) for the year 1994; (2) to present a model of the role of transport sector in an applied general equilibrium framework; (3) to apply theoretical framework to an empirical study of the impact of transport infrastructure on major regional macroeconomic variables; and (4) to suggest policies which would underscore the role of transport sector in enhancing regional economic benefits.

2 COMPUTABLE GENERAL EQUILIBRIUM MODELING IN THE PHILIPPINES

This section will present a survey of different computable general equilibrium (CGE) models created for the Philippines.

All CGE models that have been constructed were national in scope. The CGE models so far are the Agricultural Policy Experiment (APEX) model (1992); Bautista C. model (1987 & 1992); Bautista R. model (1986); Clarete (1984 & 1991); Cororaton (1989); (1988); Habito (1984 & 1989) and Jemio & Vos (1993).

The latest CGE model was the one constructed by Cororaton for the Philippine economy (PCGEM) in 2000. It is a neoclassical CGE model, with price clearing mechanisms and full employment equilibrium. It has 34 production sectors with 3 factor inputs as in labor, variable capital and fixed capital. The household sector is disaggregated into deciles and product differentiation is introduced in imports and exports. The model is closed with fixed current account balance, fixed exchange rate (the numeraire) and an endogenous price index, which is the weighted value added price deflator. The Armington specification is imposed in the imports function, while a constant elasticity of transformation (CET) specification is used in the export equations. The consumer utility function is of a Cobb-Douglas type. Savings go back into the system in the form of investment. The model is static and is calibrated using the 1990 SAM and the 1990 sectoral tariff revenue. In his paper presentation of the Philippine-wide CGE model, Cororaton simulated different scenarios brought about by changes in trade elasticities. The result showed that changes in trade elasticities are not very significant, but there are significant results for welfare indicators measured in terms of compensating variation and equivalent variation. Welfare indicators showed that poorer households respond favorably to high export elasticities and lower Armington elasticities (sensitivity of imports to relative price increases). The richer households are worse off under lower elasticities for both exports and imports. As areas of further research, the writer recommended the re-specification of the consumption function from Cobb-Douglas to LES linear expenditure system; re-specification of the value-added equations from simple Cobb-Douglas into a more general function like constant elasticity of substitution (CES); and the re-specification of household categories from the present decile groupings to socio-economic groupings which are not sensitive to income changes (Cororaton :2000).

To date there has been no work on CGE estimation at the regional level. However, there have been many CGE models constructed for the Philippine economy for various purposes. In a survey done by Cororaton in 1994; four CGE models were picked out to represent the range of constructed CGE models of the Philippine economy in terms of sectoral coverage. These models are the (1) APEX model; (2) Habito's second version of the PhilCGE model; (3) Cororaton's CGE model and (4) Bautista's first CGE model. The first three are based on the neoclassical general equilibrium paradigm while the last model is based on the structuralist framework. They represent two schools of thought in CGE modeling, which are the (1) neoclassical, Walrasian general equilibrium school of thought where the market-clearing variable is the price and (2) the non-Walrasian or structuralist school, where the market clearing variable is quantity. The largest one is the Agricultural Policy Experiments (APEX) model; two medium-sized CGE models (Phil CGE and Cororaton's) and the smallest constructed general equilbrium model (Bautista's). The Philippine CGE model developed by Cororaton (1998) shows that the impact of a change in implicit tariff on income distribution over the period 1990-2000 is generally progressive, except on the first decile, the lowest income group. The income share of the second to the seventh income groups increased, while the share of the eighth to the tenth declined during the period under consideration. The income share of the first decile declined. However, there are differences within sub-periods.

3 THEORETICAL FRAMEWORK

The assumption adopted by general equilibrium model is that if transport costs change, then there will be changes in relative product prices due to different transport cost intensities of different products. This will then lead to changes in the relative demand for different products, and then to changes in the incomes of the factors used to produce different products and so on. This is the approach adopted by computable general equilibrium model of the economy. In this type of mode, equilibrium is determined using computational algorithms to determine demand functions based on utility functions and production/cost functions. Transport investment lowers transport costs and the model computes the new equilibrium where everything in the economy (output levels, input levels, incomes etc.) is determined. In these models, the specification of utility and cost functions determine the outcomes. Transport is treated as a separate input and reductions in transport cost can feed through the system to predict the impact on output, employment and other variables. Standard benefit measurements can be evaluated using the usual expenditure function based measures compensating variation and equivalent variation.

3.1 MODEL SPECIFICATION

This single-region model is a take-off from Cororaton's Philippine General Equilibrium Model, which was formulated in 2000. The model has been adopted; with variations, to include a transport component The point in this initial modeling exercise is to investigate the initial impact of transport policy shock on essential regional economic variables. To achieve this, the paper employed a computable general equilibrium model in quantifying the impact of higher transport margins. The initial single- region model being considered is relatively simple. It has four production sectors—agriculture, industry, services and nontradeable services; two types of households—rich and poor in the rural and urban areas. The other institutions are the firm sector and the government sector. The model utilizes a CES value-added production function and a Cobb-Douglas utility function. The model distinguishes two factor inputs, labor and capital, which determine sectoral value added using a CES production function. Sectoral capital is fixed. Value added, together with sectoral intermediate input, which is determined using fixed coefficients, determine total output per sector. In both product and factor market, prices adjust to clear all markets. Consumer demand is based on Cobb-Douglas utility functions. Armington-CES function is assumed between local and imported goods, while CET is imposed between exports and local sales.

The model has seven major blocks, namely: (1) production, (2) factors of production, (3) trade, (4) demand, (5) income, (6) savings, and (7) the price bloc. The transport margin is added as a component of domestic price since this is usually passed on to the consumer in the form of higher domestic price to absorb transport cost.

The flexibility and robustness of the model was tested, by doing some simulation runs, using the GAMS program. This was undertaken by focusing on the price block portion of the model. That portion of selling price used to cover transport cost is known as the transport margin. Hence, a transport margin component was added, as part of the domestic price.

Output price affects both the export price and local prices. Indirect taxes and transport margin are added to local price to get the domestic price. The composite price or the price paid by the consumer, is arrived at, by adding the domestic price to the import price. Using this line of causality adopted by Cororaton model, sensitivity analysis is undertaken to determine what would be the general direction of change in welfare, if transport margins are varied upward and downward due to good or bad transport investment infrastructure planning. Transport margins increase if there is ineffective transport infrastructure investment planning and transport margins decrease is there is good transport infrastructure planning.

3.2 ASSUMPTIONS

The following assumptions are adopted:

A.1.1 outputs/consumption of the two goods (X_1, X_2)
A.1.2 inputs of the two factors (K_1 L_1, K_2 L_2)
A.1.3 factor endowments (K^*, L^*)
A.1.4 relative factor prices (w/r)
A.1.5 relative goods prices (p_1/p_2)
A.1.6 factor intensity ratios (K_1/L_1, $K_2/$ L2)

A.2. We can deduce/derive –
A.2.1 one good/factor is the numéraire (Walras Law)
A.2.2 factors are fully employed
A.2.3 factor prices common across sectors
A.2.4 demand = supply for both goods
Given (A.2.1), we can obtain
A.2.5 values of outputs
A.2.6 values of factor payments

A.3. The logical conclusions emanating from assumptions A.1.1 to A.2.6 are :
A.3.1 zero profits in long run
A.3.2 household receives income from factors
A.3.3 household spends all income on consumption (no savings)
A.3.4 marginal products of factors are determined uniquely by *K/L* ratios
A.3.5 factor payments are determined by marginal products

B. The following relationships are specified:
B.1. Production functions –

$$X_1 = f(K_1, L_1), \; X_2 = g(K_2, L_2) \qquad (1)$$

B.2. Household preferences –

$$U = h(X_1, X_2) \qquad (2)$$

After these assumptions, the next section will discuss the theoretical underpinnings behind a general equilibrium model. It will tackle the firms' production function and the utility function of households.

3.3 FIRMS' PRODUCTION FUNCTION – CONSTANT ELASTICITY OF SUBSTITUTION

The standard 2-variable CES production function may be written as

$$Q = A\left\{\alpha K^{\mu} + (1-\alpha)L^{\mu}\right\}^{1/\mu} \qquad (3)$$

where *Q* is the output, and *K* and *L* are the two factors of production. *A* is a scale parameter, *a* (1-*a*) relates to the share of *K* (*L*) in factor payments, and m governs the curvature of the isoquants. The more usual measure of curvature is the elasticity of substitution, *s*. We may show that *s* = 1/(1-*m*), so an alternative representation of this CES function is

$$Q = A\left(\alpha K^{\frac{\sigma-1}{\sigma}} + (1-\alpha)L^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \qquad (4)$$

As noted earlier, the basic two-factor CES production function may be written in a variety of forms. The most convenient for basic algebra is

$$Q = A\left\{\alpha K^{\mu} + (1-\alpha)L^{\mu}\right\}^{1/\mu} \tag{5}$$

The marginal product of *K* is given by

$$MPK = A\left\{\alpha K^{\mu} + \left((1-\alpha)\ L^{\mu}\right\}^{(1-\mu)/\mu}\ \alpha K^{\mu-1} = \alpha A\left\{\alpha + \left((1-\alpha)\left(L/K\right)^{\mu}\right\}^{(1-\mu)/\mu} \tag{6}$$

so that, as must be the case for constant-returns-to-scale production functions, the marginal product of capital is a function of the *K/L* ratio, not the scale of output.

Note that, since from the preceding assumptions

$$\alpha K^{\mu} + (1-\alpha)L^{\mu} = \left(Q/A\right)^{\mu} \tag{7}$$

we may write this as

$$MPK = \alpha A^{\mu} Q^{1-\mu} K^{\mu-1} \tag{8}$$

Similarly,

$$MPL = (1-\alpha)A^{\mu} Q^{1-\mu} L^{\mu-1} \tag{9}$$

It follows that

$$\frac{MPK}{MPL} = \frac{\alpha}{1-\alpha}\left(\frac{K}{L}\right)^{\mu-1} \tag{10}$$

3.3.1.1 Factor demand functions

The standard cost-minimization problem for unit output is again

$$\text{Minimise } C = k.P_K + l.P_L \text{ subject to } A\left\{\alpha k^{\mu} + (1-\alpha)l^{\mu}\right\}^{1/\mu} = 1 \tag{11}$$

giving the standard semi-reduced form of the first-order-conditions as

$$\frac{MPK}{MPL} = \frac{\alpha}{1-\alpha}\left(\frac{k}{l}\right)^{\mu-1} = \frac{P_K}{P_L} \tag{12}$$

$$A\left(\alpha k^{\mu}+(1-\alpha)l^{\mu}\right)^{1/\mu}=1 \quad (13)$$

Thus *k/l* is homogeneous of degree zero in the factor prices, and

$$k^{\mu}=\left(\frac{1-\alpha}{\alpha}\right)^{\mu/(\mu-1)}\left(\frac{P_K}{P_L}\right)^{\mu/(\mu-1)}l^{\mu} \quad (14)$$

so that rearranging gives

$$\alpha\left(\frac{1-\alpha}{\alpha}\right)^{\mu/(\mu-1)}\left(\frac{P_K}{P_L}\right)^{\mu/(\mu-1)}l^{\mu}+(1-\alpha)l^{\mu}=A^{-\mu} \quad (15)$$

from which

$$k=\frac{\alpha^{1/(1-\mu)}P_K^{1/(\mu-1)}}{A\left(\alpha^{1/(1-\mu)}P_K^{\mu/(\mu-1)}+(1-\alpha)^{1/(1-\mu)}P_L^{\mu/(\mu-1)}\right)^{1/\mu}} \quad (16)$$

(*k* and *l* are of course the unit factor requirements).

Unit cost

The cost of producing one unit is then

$$C=k.P_K+l\,P_L \quad (17)$$

which gives

$$C=\frac{1}{A}\left(\alpha^{1/(1-\mu)}P_K^{\mu/(\mu-1)}+(1-\alpha)^{1/(1-\mu)}P_L^{\mu/(\mu-1)}\right)^{\frac{(\mu-1)}{\mu}} \quad (18)$$

which is homogenous of degree one in the factor prices.

Remember that unit production cost = price in the long-run perfectly competitive equilibrium. Note again the structural similarity of the unit price equation and the production function.

3.4 UTILITY FUNCTION OF HOUSEHOLDS – COBB DOUGLAS FORM

The two-good Cobb-Douglas utility function may be written as

$$U=X^{\theta}Y^{1-\theta}\quad \text{with}\quad 0<\theta<1 \quad (19)$$

The marginal utilities of goods *X* and *Y* are

$$MU_X=\partial U/\partial X=\theta\left(X/Y\right)^{\theta-1} \quad (20)$$

$$MU_Y = \partial U/\partial Y = (1-\theta)(X/Y)^{\theta} \quad (21)$$

Consumer demand functions

The standard consumer demand problem for income B and given prices P_X and P_Y is

Maximize $U = X^{\theta} Y^{1-\theta}$ subject to $B = X \cdot P_X + Y \cdot P_Y$ (22)

The semi-reduced form of the first-order-conditions is

$$\frac{MU_X}{MU_Y} = \frac{\theta}{1-\theta}\left(\frac{Y}{X}\right) = \frac{P_X}{P_Y} \quad (23)$$

$$B = X \cdot P_X + Y \cdot P_Y \quad (24)$$

From which we may obtain the demand functions

$$X = \frac{\theta \cdot B}{P_X} \quad (25)$$

$$Y = \frac{(1-\theta) \cdot B}{P_Y} \quad (26)$$

which are homogeneous of degree zero in income and prices.

Expenditure shares and demand elasticities

The expenditure shares are

$$\frac{X \cdot P_X}{B} = \theta \quad (27)$$

$$\frac{Y \cdot P_Y}{B} = 1-\theta \quad (28)$$

It should be apparent that the income elasticities and own-price elasticities of demand are all equal to 1, and that the cross-price elasticities = 0. (Parallel comments apply of course to the factor demand functions.)
Note that the higher is q, the higher the proportion of consumer income that is spent on good X, ceteris paribus

3.5 TRADE BLOCK

A convenient way of modeling the production possibilities frontier is as a CET function of the two outputs, X and Y. The CET function may be written as

$$A\left(\alpha X^{\rho} + (1-\alpha) Y^{\rho}\right)^{1/\rho} = \bar{N} \qquad \text{with } 1 < \rho < +\infty \quad (29)$$

where the elasticity of transformation, *s*, is given by $s = 1/(r - 1)$. The lower is s (the higher is *r*), the greater the curvature of the production possibilities frontier. The constant $\tilde{N}$ may be thought of as a measure of total output, and the scale parameter *A* is chosen in the calibration procedure to ensure that the aggregate value of the 2 components *X* and *Y* is equal to the value of total output.

3.6 WELFARE EFFECTS – NOTION OF EQUIVALENT VARIATION

To understand the welfare effects of various transport margins , this next section will discuss the concept of equivalent variation.

The diagrammatic analysis of equivalent variation, as indicated below, shows the measurement of the consumer welfare change associated with a change in prices .

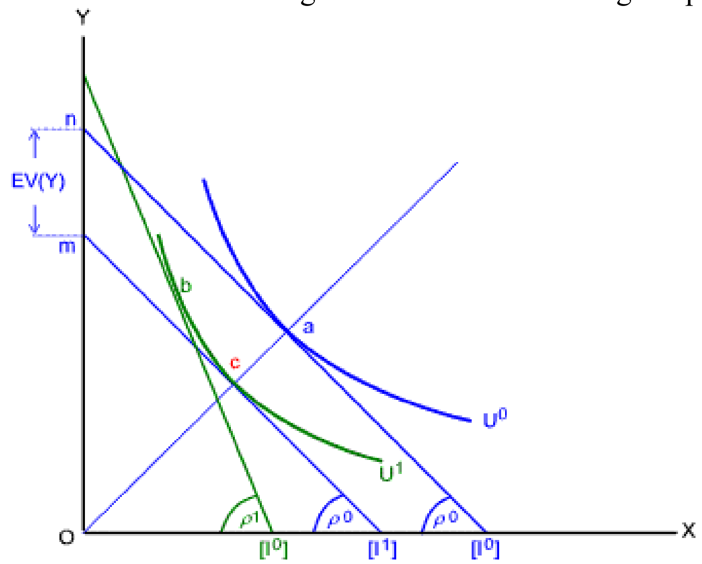

Figure 1. Diagram of Equivalent Variation

The initial equilibrium with money income I^0 and relative prices $r^0 = p_X^0/p_Y^0$ is at point a on indifference curve U^0. When relative prices change to $r^1 = p_X^1/p_Y^1$, but money income remains at I^0, the new equilibrium is at point b on indifference curve U^1. (In the case shown in the diagram, the price of X has risen – money income I^0 would, if spent entirely on X, purchase less of that good, and the price of Y has fallen – money income I^0 would, if spent entirely on Y, purchase more.)

The equivalent variation (EV) is that change in money income that would put the consumer on the new indifference curve at the old prices. That is, we must find the additional income that, at prices p_X^0, p_Y^0, would put the consumer at point c on indifference curve U^1. We may measure this in terms of the change in the amount that could be purchased of either *X* or *Y* from that additional income at the original price of the good concerned. On the diagram the EV in terms of *Y* is shown as EV(Y), or by distance mn. That is, if I^N is the money income needed to put the consumer at point *c* then $I^N = I^0 + EV(Y) * p_Y^0$

If the utility function is linearly homogenous, then calculation of the money value of mn, or of the proportionate change in money income, mn/On, is fairly straightforward.

The properties of similar triangles give mn/On = ca/Oa, and the properties of linearly homogeneous functions give U^1/U^0 = Oc/Oa. Hence mn/On = $(U^0 - U^1)/ U^0$. But we can obtain the numerical values of U^0 and U^1 from the output of the CGE model, and we know the original money income, I^0. If I^N is the money income needed to put the consumer at point *c* then we have

$$EV = I^N - I^O = \left(\frac{I^N - I^O}{I^O}\right) I^O = \frac{mn}{On} I^O = \left(\frac{U^N - U^O}{U^O}\right) I^O \qquad (30)$$

Zero long-run profits and 'product exhaustion'

The industry profits, *p*, are given by

$$\pi = P \cdot Q - \left(K \cdot P_K + L \cdot P_L\right) \qquad (31)$$

Substituting for the conditional factor demands gives

$$\frac{k}{l} = \frac{\alpha}{1-\alpha} \frac{P_L}{P_K} \qquad (32)$$

which is a linear function of output, *Q*. If we set the derivative of profit with respect to output to zero then we have an expression that does not contain *Q*, and so we cannot define an industry supply function. What we would obtain is

$$\frac{\partial \pi}{\partial Q} = P - \left(\frac{1}{A}\left(\frac{\alpha}{1-\alpha}\frac{P_L}{P_K}\right)^{1-\alpha} \cdot P_K + \frac{1}{A}\left(\frac{1-\alpha}{\alpha}\frac{P_K}{P_L}\right)^{\alpha} \cdot P_L \right) = P - \left(k \cdot P_K + l \cdot P_L\right) = 0 \qquad (33)$$

which implies that price = unit cost, so that there must be zero (long-run) profits.

Note that if (as under perfect competition) factors are paid the value of their marginal product then we must have

$$P_K = P \cdot MP_K = P \cdot \frac{\alpha Q}{K} \qquad (34)$$

$$P_L = P \cdot MP_L = P \cdot \frac{(1-\alpha)Q}{L} \qquad (35)$$

so that

$$K \cdot P_K + L \cdot P_L = K\left(P \cdot MP_K\right) + L\left(P \cdot MP_L\right) = K \cdot P \cdot \frac{\alpha Q}{K} + L \cdot P \cdot \frac{(1-\alpha)Q}{L} = P \cdot Q \qquad (36)$$

This is essentially the Product Exhaustion Theorem (a particular case of Euler's Theorem), which states that if factors are paid the value of their marginal product then the value of the output is exhausted by the payments to the factors (again we see that there are zero long-run profits).

Factor shares

Under perfect competition, total payments to factors as a proportion of the total industry revenue are

$$\frac{K \cdot P_K}{P \cdot Q} = \frac{K\left(P \cdot MP_K\right)}{P \cdot Q} = \alpha \qquad (37)$$

$$\frac{L \cdot P_L}{P \cdot Q} = \frac{L\left(P \cdot MP_L\right)}{P \cdot Q} = 1 - \alpha \qquad (38)$$

So with the Cobb-Douglas production function the factor shares are independent of the level of output and the market prices of the two factors.

Factor intensities

The capital-labor ratio is

$$\frac{k}{l} = \frac{\alpha}{1-\alpha}\frac{P_L}{P_K} \qquad (39)$$

so that, for given factor prices, the higher is *a* the more *K*-intensive is the industry.

4 ANALYSIS OF RESULTS

Two alternative scenarios are simulated below which indicate the varying effect of transport margin on overall welfare on two groups of the population in National Capital Region- rich households and poor households. Those households whose annual income falls below the poverty threshold, as indicated by NEDA ,then are considered poor households and those whose income fall above are considered rich households. No distinction is made between middle-income and high income groups because the demarcation line between the two is quite fluid.

4.1 SCENARIO OF HIGHER TRANSPORT MARGIN

The initial simulation results are presented below. The table below indicates the impact on welfare (measured in terms of equivalent variation) of various reductions in transport margin brought about by an increase in transport infrastructure investment in the Philippines. The 2 scenarios are: 1) a reduction in transport margin by 0.2% and 2) a reduction in transport margin by 20%.

Table 1. Scenario of Lower Transport Margin

Sector/ Activity	Reduction in Transport Margin by 0.2%	Reduction in Transport Margin by 20%
Rich Household	1.357	2.45
Poor Household	0.974	1.369
Equivalent Variation (Total)	2.331	3.82

Ballpark figures of 0.2% and 20% are adopted to measure the welfare gains.

The above result indicates the tremendous gains in welfare if, transport margins are lowered by the 0.2% and 20% respectively. However, it is apparent that the rich households in the Philippines benefit more in terms of higher welfare gains in both cases., than poor households.

4.2 SCENARIO OF HIGHER TRANSPORT MARGIN

Moving on to the other extreme, the same arbitrarily determined figures are adopted for the opposite scenario. This is when there is poor infrastructure planning and this causes (1) an increase in transport margin by 0.2% and (2) an increase in transport margin by 20%.

Table 2. Scenario of Higher Transport Margin

Sector/ Activity	Increase in Transport Margin by 0.2%	Increase in Transport Margin by 20%
Rich Household	-2.347	-18.736
Poor Household	-1.320	-10.745
Equivalent Variation (Total)	-3.667	-29.480

An interesting insight to this is that the reduction in welfare is greater for rich households as compared to poor households. So the adverse effect of inefficient transport infrastructure planning is felt more by the high income bracket than the low income bracket.

4.3 WELFARE ANALYSIS

Elaborating on the scenario of having inefficient transport infrastructure planning and consequently, higher transport margins, the following results can be deduced.

Table 3. Scenario of inefficient transport infrastructure planning and consequently, higher transport margin

	Equiv Variation	EV/Disp Income	Gross Disp Inc	Growth Nom Inc
Rich Household	-2.347	-4.322	-3.037	1.407
Poor Household	-1.320	-3.889	-3.032	1.407
Total	-3.667	-4.155	-3.035	1.407

The detrimental welfare effects on the regional economy are manifested by the negative values of equivalent variation (EV) and EV/ Disposable Income. As earlier mentioned, the decline in welfare of rich households is greater than that of poorer households, if higher transport margins occur. The lower gross disposable income is due to more personal income taxes paid by households. This is based on the fact that nominal income, which is the basis of personal income tax, grew by 1.407 units.

Table 4. Equivalent Variation for Household h

Type of Household	Equivalent Variation of HH
Rich Household	-2.347
Poor Household	-1.320
Whole Economy	-3.667

Table 4 quantifies the overall impact on the whole economy and that is that utility level of the whole society declines by 3.667. If we add together the welfare levels of rich and poor households, the utility level of the whole society would be 3.667. However, around two-third of the overall decline in welfare can be attributed to the decline in welfare of rich households.

Table 5. Percentage Growth of Various Incomes

Type of income	Percentage change of Various Types of Income
Labor Income	-3.888
Capital Income	-3.572
Firm Income	-3.572
Government Income	-3.572
Tariff Revenue	0.002
Indirect Tax Revenue	-0.671
Direct Tax Revenue	-3.116

It is significant that all types of factor income and institutional income went down. Relative to other factors of production, the biggest impact was on labor income. Reallocation of factor payment by producers moves away from labor and capital; and gears toward payment of higher transport cost. The income of firms and government decline due to lower levels of economic activity of these institutions.

Tariff revenue went up because imports went up. Both indirect and direct tax collection decreased due to contraction of domestic economic activity.

Table 6. Percentage Growth of Household Income

Type of Income	Rich household	Poor Househld
Total income	-3.037	-3.032

The decline in total income and disposable income of rich and poor households further reinforces the results of lower welfare levels of both types of households as measured by equivalent variation.

Table 7. Weighted Percentage Growth of Various Aggregates

Macroeconomic Aggregates	Weighted Percentage Growth of Volume	Weighted Percentage Growth of Price
Output	-0.311	-0.105
Composite demand for TD	-0.195	1.407
Domestic Sales	-0.285	1.438
Local Production	-0.285	-0.230
Value-Added	-0.033	-3.760
Labor	0.001	-3.888
Capital	Near 0	-3.572
Exports	-0.294	Near 0
Imports	0.046	Near 0

The results above indicate that additional transport cost translate into lower volumes for all major macroeconomic aggregates except labor and imports which went up. The reason here could be that if domestic transport costs rise then, then consumers shift to imports whose international transport cost is not affected. The slight increase in labor may be due to shift from capital intensive to labor intensive techniques, whose transport costs are lower.

In the case of growth of prices, the increase in growth rate price of domestic sales is due to the fact that transport cost margin is part of domestic price and therefore pulls upward domestic price of sales. This trend is carried over to the composite demand price of tradeables since it is composed of domestic price and import price; the former pulled upward by higher transport margin

Table 8. Percentage growth of volumes

Sectors	Growth In volume of Output	Growth in volume of Domestic Demand	Growth in Volume of Investment Demand	Growth in volume of Intermediate Demand	Growth in Volume of ValueAdded
Agriculture	-2.505	-2.748	-4.802	-1.585	-2.505
Industry	-2.000	-2.214	-5.218	-0.874	-2.000
Services	3.177	3.388	-6.863	0.654	3.177
Tradeable Services	-0.471		-	-0.471	

The result apparent from the table above indicates that it is only the services sector which experienced substantial rise in volume of output, domestic demand, intermediate demand and value-added. This is because transport services which is part of services sector, may be considered a vital and therefore intermediate input to production to different types of demand.

Table 9. Growth in Labor, Exports and Imports

Sectors	Growth of Labor	Growth of Exports	Growth of Imports
Agric	-4.590	-0.694	-1.600
Industry	-5.290	-1.020	-1.525
Services	7.358	1.559	4.315
Non-Tradeable Services	-0.471		

The growth in volume of labor in services may be the reason why total nominal income increase. This has spurred upward the import level of services sector and also exports of services sector.

Percentage growth of prices

The highlight of the model presented is the price block. An interesting feature of the price block is the result with regards to services sectors. Among the four major sectors, the service sector is the only one with positive growth in prices. This is because transport is a major tradeable service sector with higher mark-ups in transport margin. This result is replicated in the case of growth of local price since domestic service sector includes the transport sector.

Table 10. Growth in Price levels

	Growth in Price of Output	Growth in Composite Price	Growth in Domestic Price	Growth in Local Price	Growth in Price of Value Added	Growth in Price of Capital
Agriculture	-1.219	0.455	0.589	-1.384	-6.451	-9.371
Industry	-0.661	0.895	1.178	-0.806	-5.515	-6.465
Services	1.059	2.676	3.187	1.164	-0.653	1.970
NonTradeable Services	0.474	-		-3.888		

However, for all sectors, there was a positive growth in composite price. This is due to higher domestic prices attributed to additional .02 transport cost by increase in growth Domestic price, together with import price, accounts for positive growth of composite price.

The decline in growth of price of capital in all sectors except services may indicate the scarcity effect of capital input in the services sector as compared to labor input.

Table 11. Growth in Prices of Exports and Imports

	Growth of Prices of Exports	Growth of Prices of Imports
Agriculture	Near 0	Near 0
Industry	Near 0	Near 0

Services	Near 0	Near 0

The table above shows that there are no significant changes in prices of exports and imports. This is due to the small country assumption in the model. This means that the region in this study is a price-taker of tradeables and not a price-maker. Prices of tradeables are dictated by world market prices.

Table 12. Savings

	Household Savings	Firms' Savings	Government	Current Account
Base	13.00	5.00	-1.00	23.000
Simulated	12.605	4.464	-1.817	23.000
Difference	-0.395	-0.536	- 0.817	Near 0

The simulated level of savings has a very low margin of error (based on Table 12) considering that there is very little difference between values of base variables and simulated variables of different types of savings. This implies that the benchmark data for savings of household, firms, government sector and foreign sector, are closely approximated by the single-region CGE model.

Tables IV.2 and IV.3 reinforce the results of Table IV.1 as evidenced by the decline in utility of rich households and poor households from base value to simulation value. Again the prevailing theme of the results is that welfare losses for rich households are greater than those of poor households.

Growth of consumption demand

Higher transport margins lower growth of consumption of all households in all major sectors due to lower disposable income across sectors.

Table 13. Growth of consumption demand

	Growth of Consumption Demand of Rich Households	Growth of Consumption Demand of Poor Households
Agriculture	-3.476	-3.471
Industry	-3.897	-3.893
Services	-5.565	-5.560

5 CONCLUSION

The foregoing discussion underscores the importance of efficient transport infrastructure planning due to its impact on micro agents; in this case the household and the firm.

With regards to welfare, the reduction in welfare is greater in terms of magnitude of utility levels of rich households as compared to poor households. The adverse effect of inefficient transport infrastructure planning is felt more by the high income bracket households than the low income bracket households. But this does not negate the fact that all households are adversely affected by such flaw in macroeconomic planning.

Important policy recommendations are in place. The first is a further investigation into the income distributional effects of transport infrastructure investment. If higher income groups are more affected, this is because their stock of wealth of which disposable income is a component is much bigger than low income groups. The second policy direction is further examination of the spatial impact of transport infrastructure investment. The locational distribution of infrastructure investment may affect welfare findings if they are situated near target groups as in the lower income brackets. There has to be adequate planning as far as location of infrastructure investments are concerned. The third concerns the impact of transport margin on total domestic price of goods and services. While government regulation plays a role in determining transport fares, the oligolistic character of some subsectors of transport industry in the Philippines needs to be looked into. Maybe the entry of new players and the lifting of artificial barriers to competition may lower transport margins. Lastly, the role of the private sector in assisting the government, as far as offering producers and consumers, more affordable transport prices cannot be discounted. More room for public-private sector collaboration is in place, specially, in financing.

In the end, interesting extensions may be made by making the model an interregional model and the dimension of space in transport planning can be fully explored.

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