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Working Papers in Input-Output Economics

WPIOX 09-012

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Vulnerability of a Developing Economy to Reduction in Overseas Remittances: A CGE Approach

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Archives: Impact analysis; CGE models and econometrics; (Inter-) Regional studies

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Date of submission: October 12, 2009

VULNERABILITY OF A DEVELOPING ECONOMY TO REDUCTION IN OVERSEAS REMITTANCES : A CGE APPROACH

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ABSTRACT

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Key words: *spatial impact, remittances, computable general equilibrium modeling*

JEL CLASSIFICATION : O50, R13, D58 , C68

I. INTRODUCTION

Remittance inflows to a number of emerging market economies have increased substantially as the stock of overseas workers has grown and shifted towards more skilled jobs. The subject has, therefore, received much recent attention.[1] In the Philippines in particular, second to exports of goods and services, remittances have become the largest foreign exchange source.[2]

Past studies of the impact of remittances on the economy have relied either on econometric estimation, which yield partial equilibrium estimates, or survey approaches. This paper uses an economy-wide (general equilibrium) approach that allows for interactions between all major sectors in economy, while ensuring consistency of results. A major feature of the paper is its inter-regional approach, which gives a spatial dimension to the analysis. The basis is of the approach is the social accounting matrix, a version of which, covering the year 1994, was especially constructed for several papers authored by C. Dakila.

The framework is of the applied general equilibrium (AGE) type. A general equilibrium is described, which consists of a set of 'economic agents' (such as consumers and producers), each of which demands and supplies goods or services, with each agent

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[1] One of the latest comprehensive studies is World Bank, Global Economic Prospects 2006: Economic Implications of Remittances and Migration (World Bank, 2006).

[2] Studies of the impact of OFW remittances include Chami, Fullenkamp and Jahjah (2005), Burgess and Haksar (2005), and Asian Development Bank (2004).

aiming to solve its own optimization problem. Agents are assumed to be price takers. Equilibrium is defined as a state of the economy in which the actions of all agents are mutually consistent and can be executed simultaneously.[3] In the model, adjustment to equilibrium is implemented by specifying that markets adjust to minimize the sum of excess supplies.[4] It can be noted that although several AGE models have been estimated for the Philippines, all previous models were national in scope. This is thus the first model to offer a spatial dimension to the analysis. It is also the first attempt to analyze the impact of remittances in the Philippines using an economy-wide approach.

A three-level production function is specified. At the bottom level, a Cobb-Douglas function combines labor and capital to produce value added; then, on top of this, a Leontief production function combines non-transport inputs and value added to produce output net of transport. Output net of transport is then combined with transport inputs to produce the final, delivered output, using a Cobb-Douglas production function. Capital and labor incomes accrue to households, who then allocate these to consumption and saving, with a constant marginal propensity to consume. Overseas remittances enter as transfer payments to households. Consumption is apportioned between different commodities using a Cobb-Douglas utility function. Final demand is then built up in a standard way.

Empirical results indicate that the main beneficiary (measured in peso terms) of remittance increases are the middle income classes across all regions. The second best

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[3] See Shoven and Whalley, 1992 or Ginsburgh and Keyzer, 1997 for more details on applied general equilibrium models.

[4] Quantities adjust in the model; prices follow to equate the notional and effective demands for labor.

beneficiaries are the low income household, again for all regions, with the notable exception of the National Capital Region, where the high income households are the second highest beneficiary of remittances. The paper highlights the data requirements for the modeling approach, which is instructive for emerging economies in similar situations.

II. THEORETICAL FRAMEWORK

The model accounts for the interregional linkages of the Philippine economy. The model was originally developed to address the issue of the spatial impact of transportation; thus the transport component of the production sector of the model is relatively well-developed. Table 1 summarizes the sectoral structure of the model. The model distinguishes between seven main production sectors, which are further differentiated according to the five regions of origin. These five regions are an agglomeration of the current 17 administrative regions in the Philippines. Since the National Capital Region has an insignificant agricultural sector, there are therefore 34 production sectors. For each region, households are differentiated into three income classes. There are, therefore, a total of 15 household categories. To ensure consistency with official standards, low income households are defined as comprising all households that earn below the regional poverty thresholds as determined by the National Statistical Coordination Board. The high income households are those who earn ₱250,000 and above annually (in 1994 terms), which is the highest income bracket in the Family Income and Expenditure Survey (FIES). All the households with incomes between the regional poverty threshold and the highest income bracket in the FIES are classified as middle income households.[5]

Figure 1. Map of Five Region Delineation

Table 1 Sectoral Disaggregation of Five Region Model

PRODUCTION SECTORS	**REGIONS**	**HOUSEHOLDS**
Agriculture (Ag) Industry (Ind) Water transport (Wtr Tr) Land transport (Land Tr) Air transport (Air Tr) Other services (OthrSr) Government (Govt)	National Capital Region(NCR) Northern Luzon (NOL) Southern Luzon (SOL) Visayas (VIS) Mindanao (MIN)	Low income Middle income High income

A. HOUSEHOLD SECTOR

The model distinguishes between 15 representative households, with 3 household

[5] Mizokami, S. and Dakila, C. (2005) provide a detailed description of the database utilized in the model

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:

$$U_h = \prod_i C_{ih}^{\delta_{ih}} \quad (1)$$

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 constant; these then determine how labor incomes are 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:

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

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:

$$Yd_h = Y_h \left(1 - \tau_h\right) \quad (3)$$

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

$$\sum_i pd_i C_{ih} = c_h Yd_h \quad (4)$$

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:

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

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.

$$V_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i} \quad (6)$$

where for sector i and region r, V = value added, K = capital, L = labor, α = share of capital in value-added, and 1-α = share of labor in value-added. 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.

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

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

$$\Pi_j = pd_j X_j - \sum_i pd_j Mat_{i,j} - pva_j V_j \qquad (10)$$

subject to

$$X_j = B_j {X_j^{NT}}^{\beta_{1j}} W_j^{\beta_{2j}} A_j^{\beta_{3j}} La_j^{\beta_{4j}}$$

$$X_j^{NT} = \min\left[X_{1j}/a_{1j}, \dots X_{NTj}/a_{NTj}, V_j/a_{V,j} \right] \qquad (11)$$

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

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

$$pd_i * \frac{\partial X_i}{\partial {X^{NT}}_i} = p_{NT} \text{ or } pd_i \beta_{1i} \frac{X_i}{{X^{NT}}_i} = p_{NT} \qquad (12)$$

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

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

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

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

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

$$pva_i \left(1 - \alpha_i\right) \frac{V_i}{L_i} = w_i \qquad (13)$$

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:

$$Tar_i = tar_i \left(m_i \right) \tag{14}$$

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:

$$T_{Indirect,i} = tind_i \left(d_i + m_i \left(1 + tar_i \right) \right) \tag{15}$$

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

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

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:

$$S_G = \Sigma_i Tar_i + \Sigma_i T_{Indirect,i} + \Sigma_h T_{Direct,h} - \Sigma_i G_i - \Sigma_h Tr_{GOV,h} - Tr_{GOV,FOR} \tag{18}$$

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.

$$\text{pva}_i * \frac{\partial V_i}{\partial L_i} = w_i$$
$$\text{pva}_i \left(1-\alpha_i\right)\frac{V_i}{L_i} = w_i \qquad (11)$$

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:

$$\text{Mat}_{i,j} = a_{ij} X_j^{NT} \qquad (21)$$

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 IIA. 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 IID. 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:

$$Q_i = \sum_j Mat_{i,j} + \sum_h C_{h,i} + I_i + G_i + Exports_i \tag{22}$$

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:

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

The total product cost can then be built up from the components in a standard way.

Thus, average cost per unit is

$$AC_i = \frac{\Sigma_j pd_j Mat_{j,i} + pva_i V_i}{X_i} \tag{24}$$

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

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

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.

III. Empirical Results: Regional Impact of Overseas Workers Remittances

A. Five-Region Model

With overseas remittances accounting for a significant portion of foreign exchange inflows, the sensitivity of economic activity to any disruption in such flows becomes a relevant policy question, especially in the wake of the recent international financial crisis. Remittances from overseas workers are the most important component of transfers from abroad, and it is thus the latter variable that we subject to a shock, in the magnitude of 5 percent. We apply this evenly across household types. The incidence of the shock depends upon household dependence on foreign income. This absolute incidence is summarized in Figure 2 (in million P, 1994 prices), and the relative incidence, in terms of the percentage fall in income, in Figure 3. In absolute terms, N. Luzon middle-income households are the most vulnerable, although a greater concentration of the impact of reduced transfers falls on NCR households, particularly the high and middle income classes. N. Luzon households generally bear the highest percentage reductions in incomes. The results generally validate the characterization of N. Luzon households as being most prone to migrate.

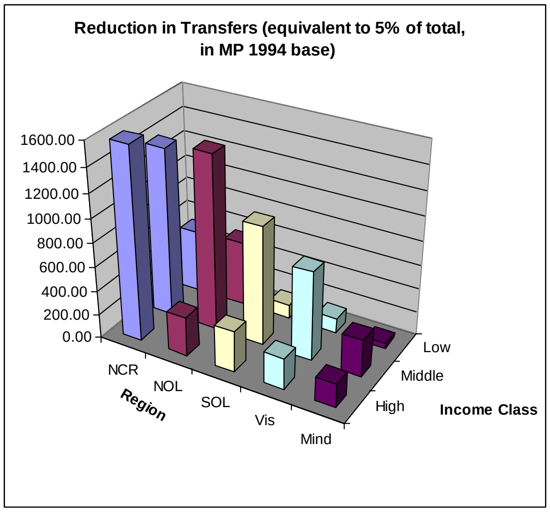

Figure 2

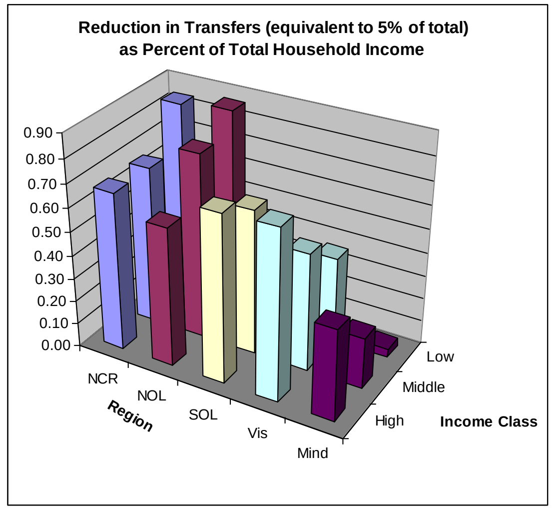

Figure 3

Lower income levels will induce reductions in consumption, and therefore on output, which then lead to second round impacts on the foregoing variables in a multiplier process. The final impacts will depend on the initial incidence of the income reductions across the different household groups, the consumptions patterns of such households, and the linkages between the different sectors of production (i.e., the transactions matrix, in an input-output analysis). Figures 4 and 5 show the final reductions in output, both in absolute and percentage terms. In peso terms, it can be seen that the impacts are largest for industry and services other than transport, for NCR and S. Luzon. Percentage-wise, however, agriculture and industry for S. Luzon take the greatest hit. Interestingly, there appears to be some relatively minor increase in output of other services for S. Luzon and N. Luzon; this may validate the observation that the services sector tends to serve as employer of last resort in case of slowdown in the economy.

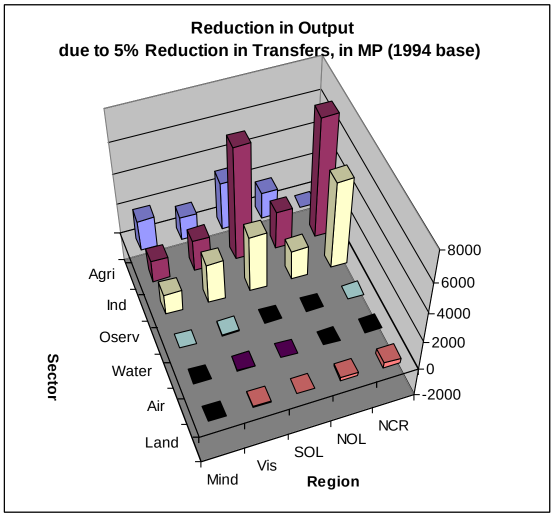

Figure 4

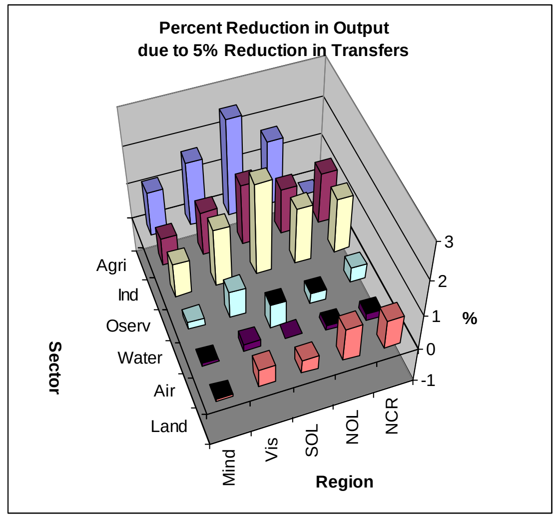

Figure 5

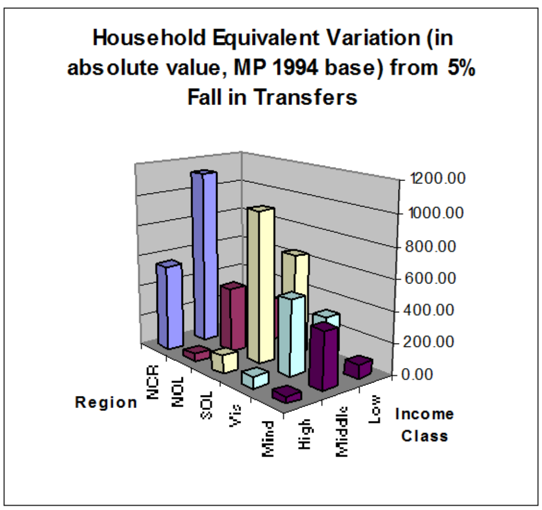

Figure 6

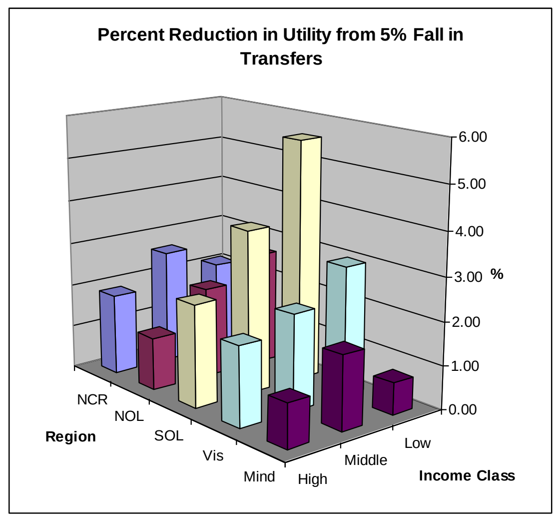

Figure 7

Although Figures 2 and 3 show the initial incidence of the fall in transfers, the final impact on utility can be quite different, and in general will be further influenced by the successive round effects on regional output, plus the successive impacts on incomes and consumption patterns. Figure 7 shows that the impact can be especially hard on low income classes across regions, except the NCR and Mindanao, where the impact is greatest on the middle income class. The latter result agrees with the finding shown in Figure 3 that foreign transfers are a comparatively insignificant source of support for the poorest families in Mindanao. Alternatively, one can look at the absolute welfare reduction across household categories. One measure of this is equivalent variation, defined as the amount of money a household would have to be compensated for in order to bring it to the original level of utility before the shock being considered. Using this measure, results (Figure 6) indicate that the main costs of remittance declines are the middle income classes across all regions. The second best highest costs are the low income households, again for all regions, with the notable exception of the National Capital Region.

B. Two-Region Model

To further examine the robustness of the five region model results, we specified a stripped-down two-region model. In the following model, the Philippines has been divided into the National Capital Region (NCR), the center of economic and social activity, and the Rest-of- the-Philippines (ROP) Region. This dichotomy takes off from the center-periphery theory of development. Since the data requirements for this model are less stringent, our validation enables us to work with a more detailed production sector breakdown, as shown in Table 2. Regional production activities are disaggregated into nine sectors, with a more detailed specification of industry (mining, manufacturing, electricity, gas & water and construction) and the financial sector separated from other services sector. The aim is to enable us to examine the impact on the formal banking sector and on specific industries of a decline in overseas Filipino workers remittances, brought about, say by a major external shock.

Table 2 Disaggregation of Two Region Model

Regions	Production Sectors	Households
National Capital Region (NCR) Rest-of-the-Philippines (ROP) (includes Northern Luzon, Southern Luzon, Visayas & Mindanao)	Agriculture (Ag) Mining & Quarrying (Min) Manufacturing (Mfg) Electricity,Gas&Water (EGW) Construction (Constn) Transportation (Trnsp) Trade (Trade) Finance & Insurance (Fin) Other Services (OthrSrv)	Low Income (Low Y) High Income (High Y)

This two-region model utilizes a simple one-level Leontief production function at the regional level. On the household side, we specify regional consumption functions for four types of households (as enumerated in Table 2) based on utility functions of the Cobb Douglas type. In a manner parallel to the simulation for the five-region model, the impact of a bigger decline in OFW remittances is estimated on critical regional macroeconomic variables such as output and welfare. The incidence on regional outputs of a ten percent decline in remittances is shown in Figure 8 and Figure 9 below. The figures show that the biggest reductions in terms of total regional output are for the manufacturing sector in the ROP and the NCR, and the ROP agricultural sector, in descending order, owing to lower consumption demand for both finished goods and raw material goods due to lower income of households. In terms of percentage values, most of the relative output losses were experienced by NCR production sectors namely its small agricultural sector, manufacturing, mining, and the utilities sector (EGW). For the ROP, the slack in final demand for its agricultural sector is the most severe impact of the exogenous shock.

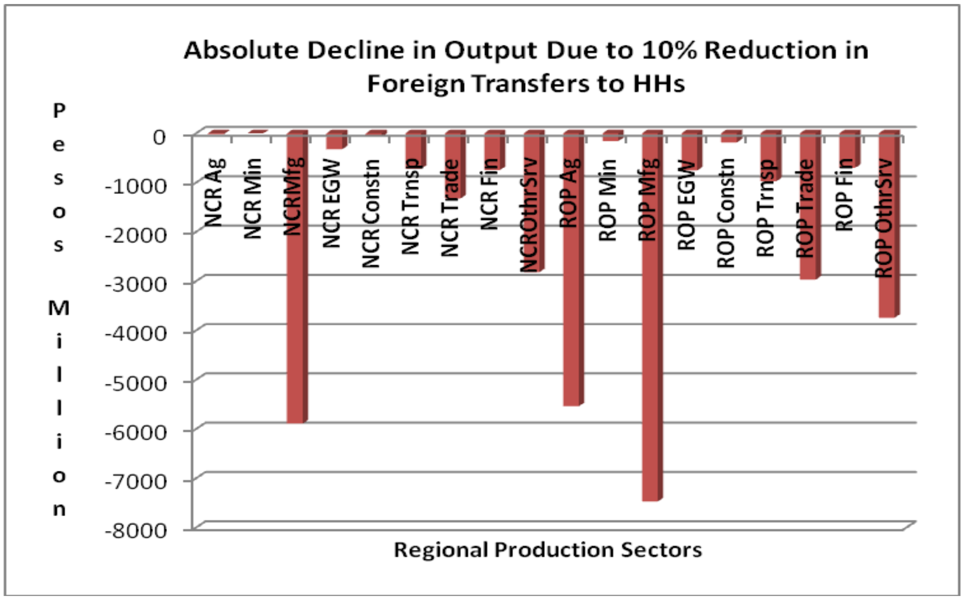

Figure 8

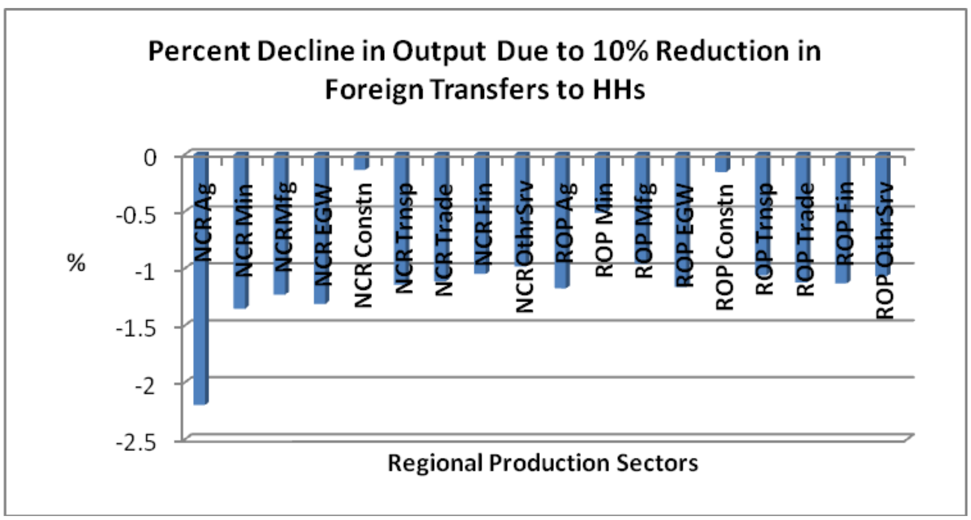

Figure 9

Our inclusion of utility functions into the model specification enables us to say something about the welfare effects of a shock in remittances. The biggest absolute decline in welfare is experienced by high income households in the ROP region, followed by high income households in the NCR (Figure 10). However, in terms of relative decline in welfare, NCR low income households experience the biggest decline, followed by the high income households in the rest-of-the-Philippines (Figure 11). This demonstrates the inequitable impact of lower OFW remittances brought about by the current global recession.

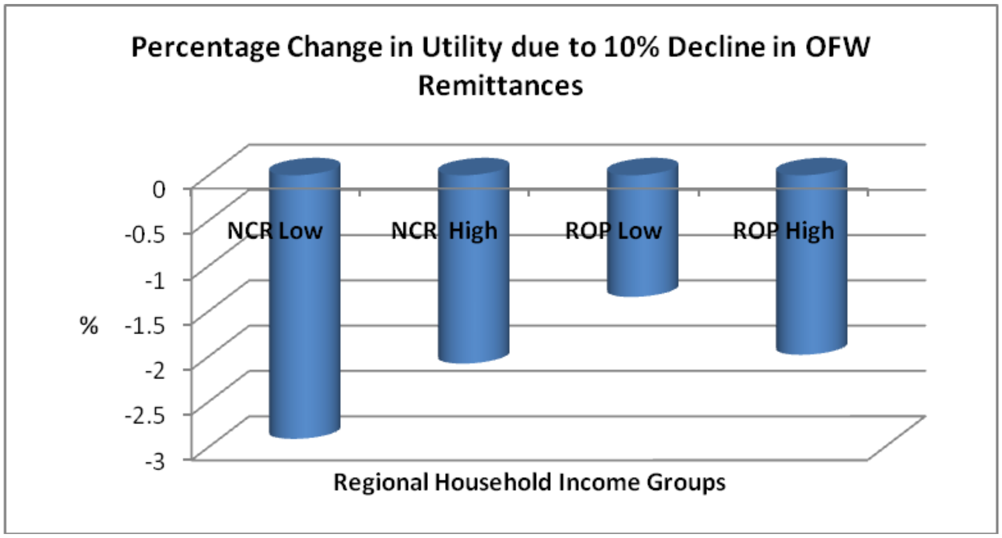

Figure 10

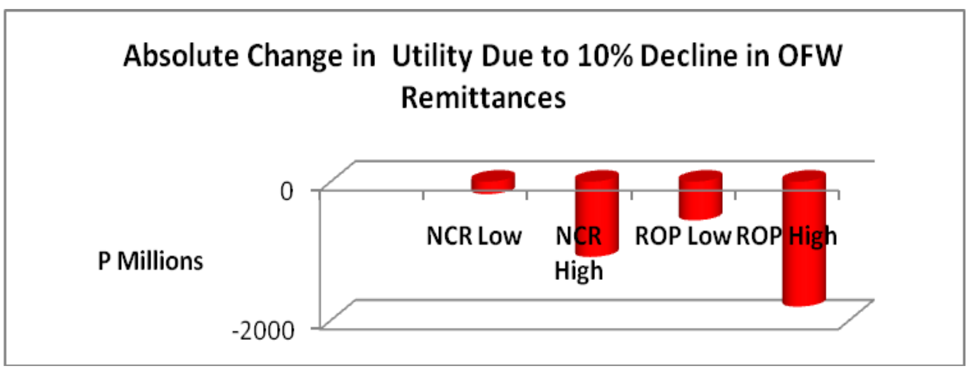

Figure 11

IV. CONCLUSION

Assessing household vulnerability to shocks is an important aspect of policy design. An applied general equilibrium framework can be an important tool is quantifying the spatial dimension of such shocks. In view of the increasing importance of remittances as a source of foreign exchange, this work can be seen as a first attempt to fill a void in our knowledge of the impact of instability in such flows on the various sectors of the economy.

This paper presented the results of two models with different levels of sectoral and regional production and household disaggregation. Aside from this, different functional forms were used for each type of model. The five region model utilized a three-level production function (Cobb-Douglas--Leontief--Cobb Douglas), whereas the two region model utilized a Leontief single level production function. The comparative results showed while the functional specification of the production function and the level of disaggregation of the regional production sector exert a significant influence on the empirical results, the simulated incidence of a decline in overseas Filipino workers' remittances on delineated production sectors and household income groups across the Philippines are broadly consistent across the model specifications that were considered.

The quantitative results presented in this paper can be subject to further refinement. In this regard, timely and detailed information on resource flows in the economy are essential, especially an updated transactions matrix, survey of family income and expenditures, and flow of funds in the Philippines. On the other hand, this paper hopes to contribute to the as yet limited stock of empirical work on the spatial dimension of economic activity in the Philippines, which in this case is focused on the spatial impact of a decline in foreign transfers to Philippine households.

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