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Growth, Trade Liberalization, and Poverty in the Philippines: An Integrated Sequential Dynamic CGE Microsimulation Analysis

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Growth, Trade Liberalization, and Poverty in the Philippines: An Integrated Sequential Dynamic CGE Microsimulation Analysis (A Research Proposal)

Erwin Corong

1. Introduction

The past three and a half decades bore witness to dramatic changes in Philippine trade policy landscape arising from both unilateral and multilateral agenda. In 1981, the country embarked on its Trade Reform Program (TRP) aimed at: (a) minimizing tariff dispersions between agriculture and industry; and (b) enhancing domestic producers' efficiency to make them globally competitive. By 1994, the country ratified the GATT thereby resulting to further phases of TRP implementations in line with the WTO commitments.

Past evidence shows that the combined impact of growth and trade liberalization reduced poverty in the Philippines (see for example Habito, 2000, Balisacan, 2003). Although trade liberalization may have contributed to enhanced productivity and growth in the Philippines, the impacts on poverty are still not fully apparent. This is so because the impacts of trade liberalization are often ambiguous and complex arising from resource reallocation effects that in turn bring about changes in factor income as well as consumer prices thereby resulting to variations in poverty dimensions and income distributional structure.

This proposed research seeks to assess the economic and poverty impacts of growth and trade liberalization in the Philippine economy. Given the complexity and the economy-wide nature of the subject, this study will employ an integrated sequential dynamic CGE microsimulation model that will be solved under a sequential dynamic path from 1994 to 2020, in order to simultaneously capture the economic and poverty effects of capital accumulation and trade liberalization.

The rationale behind this approach is twofold. Firstly, substantial poverty reduction in the country transpired during periods of significant economic growth (Balisacan, 2003). Secondly, it is widely believed that 'the only way to obtain large reductions in poverty is through economic growth' owing from trade-growth-poverty linkage (Hertel and Reimer, 2004; Winters, McCulloch, and Mckay, 2004). This proposed research attempts to answer: *What are the economic, sectoral, reallocation, poverty and income distributional effects of Growth and trade liberalization in the Philippines?*

2. Objective

The Primary objective of this proposal is to assess the economic and poverty impacts of growth and trade liberalization in the Philippines. The proposed methodology is to conduct policy simulations using a sequential dynamic CGE microsimulation model to analyze the macroeconomic and sectoral effects, as well as identify the household impacts by integrating household survey data (Family Income and Expenditure Survey-FIES) to generate the poverty and distribution effects.

Specifically, the goals of the study are:

(a) To assess whether the Philippines will benefit from freer trade in the medium run
(b) To account for the changes in poverty dimension and income distributional structure arising from growth and trade liberalization in the medium run
(c) To observe the transition path that the Philippine economy will take in light of the policy Shifts.

(d) To suggest complementary policies that must be undertaken in light of trade liberalization.

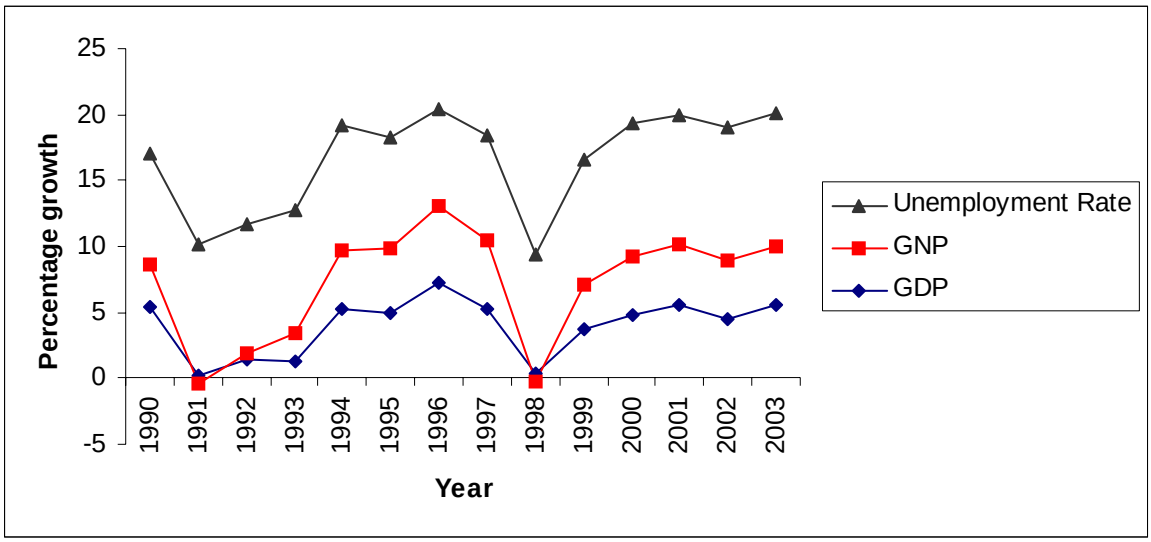
3. Preview of the Philippine Economy

3.1 Economic Performance

The performance of the Philippine economy has been characterized by a regular pattern of boom and bust growth cycle since the 1970s. To address this concern, the government has implemented various structural adjustment programs until the mid 1990s. To name a few, this included the fiscal and financial reforms, as well as trade reform to reduce import tariff, eliminate quantitative restrictions and to enhance export competitiveness among others. Nevertheless, these adjustment programs did not safeguard the Philippine economy from the impacts of national, natural, and international economic shocks during the last decade.

Figure 1 shows the Philippine economic performance over the last fourteen years. Clearly, it can be seen that the pattern of both real GNP and GDP growth reveals the boom-bust nature of the Philippine economy. During the last decade, the economy suffered two periods of considerable downturn that occurred in 1991 and 1998. The former was caused by political instability and power shortages while the latter was caused by the combined impact of Asian financial crisis and the El Nino Phenomenon.

Figure 1. Philippine Economic Performance



Source of Data: National Statistical Coordination Board (NSCB)

Surprisingly though, the mean living standard increased by nearly six percent between the period 1988 and 1991 in spite of the economic dip in the early 1991 owing to the strong economic performance in the year 1990. Furthermore, the mean living standard consequently increased by roughly 27% between the years 1994 and 1997 as a result of strong economic performance in 1996. Conversely, the slow economic recovery after the Asian financial crisis in 1997 and El

Nino phenomenon in 1998 resulted to mean per capita expenditure (or possibly mean living standard) that is almost equal to 1980 level by the turn of the century (Balisacan and Fuwa, 2004)[1].

Similarly, it can be observed from figure 1 that unemployment trends mimic the performance of the Philippine economy as it increased and decreased during periods of economic slumps and recovery respectively. The highest unemployment rate was registered in 1991, during the time when the economy experienced a negative GNP growth. While the high growth inclusive period of 1994 to early 1997 helped eased up the unemployment problems during the mid 1990's.

3.2 Trade Liberalization[2]

The Initial Trade Reform Program (TRP) in the Philippines started in the 1980's with: (a) 1981-1985 tariff reduction; (b) Import Liberalization program (ILP); and (c) the complimentary realignment of indirect taxes. The program however, was short-lived arising from balance of payment problems in the mid 80's. By 1986, the TRP was reinstated and this resulted to a decline in regulated items from 1802 in 1985 to 609 in 1988. In addition, export taxes on all products except logs were lifted.

In 1991, TRP-II or Executive Order (EO) 470 was passed in order to realign tariff rates within a five-year period. The realignment involved the narrowing of tariffs rates through a series of reduction of the number of commodity lines with high tariffs and an increase in the commodity lines with low tariffs. In 1992, EO 8 was implemented aimed at converting existing quantitative restrictions into their tariff equivalent rates.

By 1995, Memorandum Order (MO) 93 was passed to reverse the deregulation process by reinstating quantitative restrictions in lieu of tariff equivalent rates due to the Magna Carta for Small Farmers that was passed in 1991.

In 1994, TRP-III was implemented through a series of Executive orders that include: (a) EO 8 implemented in January 1, 1994 to reduce tariff rates in capital equipment and machinery; (b) EO 204 implemented in September 30, 1994 to reduce tariff rates on textiles, garments, and chemical inputs; (c) EO 264 in July 22, 1995 to reduce tariffs on 4,142 harmonized lines in the manufacturing sector; (d) EO 288 in January 1, 1996 to reduce "non-sensitive" components of the agricultural sector. Over all, TRP III was intended to reduce both the number of tariff rates and maximum tariff rates. Moreover, it was aimed at establishing four tier tariff schedule: (a) three percent for raw materials and capital equipment not available in the Philippines; (b) ten percent for raw materials and capital equipment available in the Philippines; (c) twenty percent for intermediate goods; (d) and thirty percent for finished goods.

By 1998, TRP IV was undertaken in order to recalibrate the tariff rate schedules implemented under the TRP. This was primarily due to the result of a tariff review process that evaluated the pace of tariff reduction in line with the competitiveness of the local industry. Initially, EO 465 was implemented on January 22, 1998 to adjust the tariff rate schedules of twenty-two industries that were identified as globally competitive (Tariff Commission, 2004). Subsequently, EO 486

[1] See Balisacan and Fuwa for an explanation(2004)
[2] Discussions stated herein mainly benefited from Cororaton and Cockburn (2003) and Philippine Tariff Commission (www.tariffcommission.gov.ph, 2004)

was passed on July 10, 1998 to amend the tariff schedule of residual items as well as reduce the number of tariff lines subject to quota from 170 under TRP III to 144 under TRP IV.

In line with TRP IV moreover, EO 334 was passed on January 1, 2001 providing for an amended tariff schedule on all product lines (except sensitive agricultural products) within the years 2001 to 2004. By and large, EO 334 provides for a tariff band of 0 to 5% starting the year 2004.

3.3 Pattern of Trade, Trade Reform Government Budget

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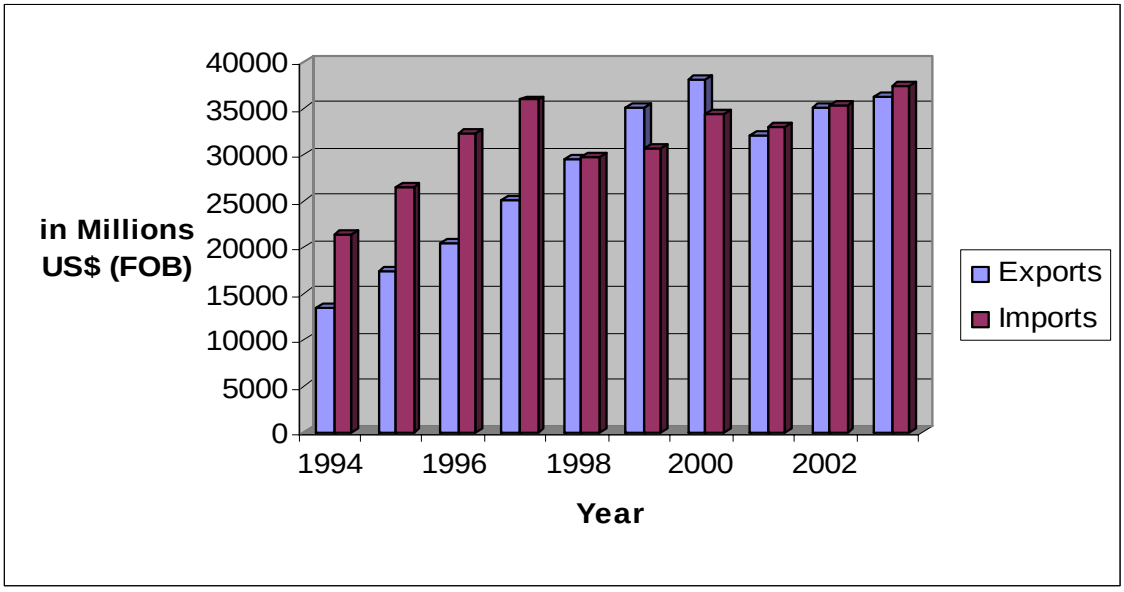
Figure 2 shows the pattern of Philippine trade from 1994 to 2003. In general, the imposition of TRP III in 1994 amplified the growth of exports in the mid 1990s until before the turn of the century. Similarly, the rapid relaxation of tariffs arising from the combined impacts of TRP III and the country's commitment to GATT-WTO resulted to a surge in imports that resulted to the highest trade deficit in 1997. Nonetheless, the massive depreciation of the peso in the late 1990s, both in nominal and real terms, as a result of the Asian financial crisis made Philippine exports such as garments and semi-conductors cheaper in the international market. As a result, the country realized two consecutive years of trade surplus' from 1999 to 2000. Though, this was short lived as exports tapered and imports intensified once again by 2001 due to increased cereal and electronic imports.

Moreover, the implementation of the various rounds of TRP and the commitments made to WTO resulted to declining tariff rate since 1994. From table 1, it can be seen that the over-all average nominal tariff rate has decreased by 82% between the period 1994 and 2002. In part, as a consequence of tariff reduction, the government fiscal position has continually worsened.

Figure 2 Pattern of Trade



Source: NSCB (2004)

Table. 1. Government Budget and Nominal Tariff

	Government Fiscal Position	Average Nominal Tariff Rate
1994	-1.3	33.0
1995	-1.0	26.8
1996	0.5	28.1
1997	0.1	25.7
1998	-1.8	22.1
1999	-3.6	20.3
2000	-3.8	19.5
2001	-3.8	7.7
2002	-5.0	6.0
2003	-4.3	-

Source: NSCB, 2005

3.3 Poverty and Inequality

Widespread poverty and the persistence of income inequality have been endemic since the post-war era (Balisacan, 1996). Although various government policies to address these concerns have been implemented, the extent of poverty reduction over the last three decades however have been gradual, that by the turn of the century, the Philippines recorded the highest incidence of absolute poverty when compared with other East Asian Economies (Balisacan, 2003).

Poverty is fundamentally a rural problem. As shown in table 2, half of the rural population lived below the poverty line in contrast to only a fifth in the urban areas during the year 1997. Although poverty decreased minimally, the trend however still remained the same by the year 2000.

Table 2. Poverty Incidence

	Year	
	1997	2000
Rural	50.7	48.8
Urban	21.6	18.6

Source: FIES (1997;2000)

Moreover, changes in poverty dimensions largely results from changes in expenditure and economic growth (Balisacan, 2003). Table 3 provides an overview of poverty dimensions and income distributional structure in the Philippines from 1985 to 2000. Generally, it can be observed that changes in FGT measures namely incidence, depth and severity were sensitive to changes in average expenditure, which in turn is dependent on the performance of the Philippine economy. Except for the periods 1988-1991 and 1991-1994 where the results are somewhat unclear[3], the largest decline in poverty transpired during the periods 1985-1988 and 1994-1997, during which significant growth rates of the Philippine Economy have been experienced. True enough using decomposition analysis, Balisacan (2003) confirmed that 70% of the observed

[3] Due to overlapping Cumulative Distribution (CD). See Balisacan (2003)

changes in poverty during these periods resulted from economic growth hence confirming that significant poverty reductions in the past transpired as a result of economic expansion.

Table 3. Average Welfare, Poverty, and Inequality 1985-2000(%).

	1985	1988	1991	1994	1997	2000
Average Per Capita Expenditure (in 1997 prices)[a]	17,197	18,926	20,049	19,600	23,694	22,865
Dimension of Poverty						
Incidence	40.9	34.4	34.3	32.1	25	27.5
Depth	13.2	10.1	10.6	8.7	6.4	7.2
Severity	5.8	4.2	4.5	3.4	2.3	2.7
Inequality						
Gini	0.41	0.40	0.43	0.40	0.43	0.45
Share of the richest 10%	26.2	24.2	26.9	24.9	28.4	28.2
Share of the poorest 20%	8.6	9.1	8.4	9.7	8.8	8.8

[a] Adjusted for provincial cost-of-living differences. The reference province is Metro Manila
Source: Balisacan (2003)

3.4 Spatial and sectoral dimensions

The spatial and sectoral dimensions of the Philippine economy arising from geographical conditions and urban-rural differences have been constantly blamed for widespread poverty and income inequality in the Philippines. By and large, it is commonly believed that Philippine development policy is inherently biased towards (a) Luzon where Metro Manila is located; and (b) urban against rural because of the large variation in access to infrastructure and proximity to social services.

Table 4. Sources of Change in aggregate poverty during the 1980s to 1990s

Source	Incidence	Depth	Severity
Regional Decomposition			
Intra-regional Effects	100.6	100.2	100.1
Population shifts	-0.7	-0.5	-0.4
Interaction Effects	0.1	0.3	0.3
Total	100.0	100.0	100.0
Sectoral Decomposition			
Intra-sectoral Effects	90.8	92.0	93.0
Population shifts	8.9	9.0	8.7
Interaction Effects	0.3	-1.0	-1.7
Total	100.0	100.0	100.0

Source: Balisacan (2003) based on Family Income and Expenditure Survey data

Once again, Balisacan (2003) exposed that geographical together with urban-rural biases did not contribute much to poverty and income inequality differences in the Philippines. Instead, his findings suggest that changes in poverty were mainly attributable to intra-regional (intra-sectoral) than inter-regional biases. Clearly from table 4, it can be seen that the results of sectoral decomposition were more robust than that of regional characteristics. This indicate that within

group contributions to inequality accounted for 82% compared to only 18% for between group contribution.

These results certainly imply that within region rather than between region inequality arising from differences in Physical possession and human assets explain the foremost reason of inequality in the Philippines. Thus, the divergence in welfare levels within sectors and not between sectors account for the variation in national household welfare.

4. Structure of the Philippine Economy

Table 5 presents the structure of the Philippine economy based in the 1994 SAM (Cororaton and Cockburn, 2003). On the trade side, it can be observed that the industrial sector in general accounts for more than half of the total trade in the country. In particular the non-food manufacturing sector, which is composed of the import dependent exportable goods such as semi-conductor, electrical equipment, and textile and garments dominate both the export and import share with 48 and 76 percent respectively. In spite of this dominance to trade however, the sector's export and import intensity of 34.7 and 45.3 percent is much lower compared to the mining sector's 43.1 and 66.3 percent respectively.

Table 5. Structure of the Philippine Economy

	Trade					Production		
	Exports (%)		Imports (%)			Value Added	Output	Capital
	Share	Intensity	Share	Intensity		Share	Share	Labor
Sectors	**(ei / e)**	**(ei/xi)**	**(mi/m)**	**(mi/qi)**	**vai/xi**	**(vai/va)**	**(xi/x)**	**Ratio**
Crops	3.1	7.5	0.7	1.7	77.7	10.3	6.8	0.98
Livestock	-	0.1	0.6	2.6	58.1	4.5	4	0.99
Fishing	3.3	20.8	-	0.2	71.7	3.7	2.7	1.79
Other Agriculture			0.1	2.6	82.3	1.4	0.9	1
Agriculture	**6.4**	**7.5**	**1.5**	**1.8**	**71.4**	**19.9**	**14.3**	
Mining	2.4	43.1	6.5	66.3	55	1	0.9	1.15
Food Manufacturing	9.0	10.2	5.4	6.3	30.8	8.8	14.7	1.74
Non-food Manufacturing	48.0	34.7	76.1	45.3	29.7	13.4	23	1.23
Construction	0.3	0.8	0.9	2.6	52.8	5.5	5.3	1.28
Electricity, gas, and Water	0.2	1.2			53	2.8	2.7	2.97
Industry	**59.9**	**21.3**	**88.8**	**28.4**	**34.5**	**31.6**	**46.7**	**8.4**
Wholesale and Retail Trade	14.2	20.9			64.1	14.2	11.3	1.95
Other Services	19.4	14.6	9.7	7.8	61.4	26.6	22.1	1.64
Government Services					69	7.7	5.7	
Services	**33.6**	**14.3**	**9.7**	**7.8**	**63.3**	**48.5**	**39.1**	
Total	**100**	**16.6**	**100**	**17.4**	**51.0**	**100**	**100**	

Source: Based on the 1994 SAM Cororaton and Cockburn (2003)
Where: e: exports, m: imports, q: composite good, va: value added, x: output

On the production side, the agriculture sector has the highest value added output ratio followed by services sectors. Moreover, it is worth noting that the non-food manufacturing has the lowest value added ratio among all sectors, though it is the third highest contributor to national value added at 13.4 percent and accounts for the largest output share in the total economy at 23 percent. In terms of capital labor ratio, it can be observed that electricity-gas-and -water is the most capital-intensive sector followed by wholesale and retail trade.

In summary, it can be concluded from table 5 that the non-food manufacturing sector will dominate the impacts of trade liberalization. More importantly, it is clear that any changes in the price paid to value added, as a result of trade liberalization will greatly affect the agricultural sector since it has the highest value added to output ratio.

Table 6. Sources of Household Income (in percentage share)

		All		NCR		Urban, no NCR		Rural	
	Sources of Household Income	**Poor**	**Non Poor**	**Poor**	**Non Poor**	**Poor**	**Non Poor**	**Poor**	**Non Poor**
Labor	Agriculture Skilled	2.9	1.5	0.4	0.2	2.6	2.2	3.4	2.7
	Agriculture Unskilled	28.6	4.3	2.3	-	22.1	3.5	34.9	13.6
	Production skilled	10.9	38.6	45	40.7	15	42.3	5.2	28.8
	Production Unskilled	10.4	7	20.4	4.6	12.7	8	8.1	9.9
Capital	Agriculture	17.9	4.5	0.3	0.2	11.7	3.4	23.3	14.3
	Industry	10.6	11.3	6.6	9.5	12.4	13.3	9.9	11.3
	Service (Wholesale and Retail Trade)	3.7	5.9	7.6	5.4	4.7	7.1	2.7	4.8
	Service (Others)	5.1	10.6	10.2	14.3	7.3	9.7	3.3	5.1
Others	Dividends	-	7.7	-	18.7	-	0.4	-	0.1
	Transfers	9.1	5.1	5.8	3.5	10.6	6.2	8.5	6.1
	Rest of the World	0.8	3.4	1.3	2.9	1	3.8	0.7	3.4
Total		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: 1994 Family Income and Expenditure Survey (FIES)

Table 6 shows the sources of household income in the Philippines during the year 1994. In general, one can readily observe the large disparity in the source of income between poor and non-poor. Poor households derive most of their income from agriculture, while the non-poor earn mostly from production. Similarly, this trend is likewise visible in the income share of poor and non-poor households between urban and rural sectors. Clearly, it is apparent that poverty is a rural phenomenon in the Philippines as majority of the poor are relying on the agricultural sector. Certainly, this is evident from table 6 as large part of the income generated by the poor stem from unskilled agriculture, in contrast to non-poor who's large proportion of income come from skilled production labor and returns to capital.

5. Brief Review of Literature in the Philippines

Trade Liberalization brings about resource reallocation effects that result to changes in poverty dimensions and income distributional structure. To capture the changes in poverty and income distribution arising from trade liberalization in the Philippines, Cororaton and Cockburn (2003) employed a CGE microsimulation model with 24,797 households to analyze the tariff reduction program (TRP) that were implemented between the year 1994 and 2000. In general, they found that trade liberalization reduces poverty but worsens income inequality. The magnitude of poverty reduction however is higher in Metro Manila where incidence is already the lowest relative to rural areas where incidence is the highest. The macroeconomic effects indicate that the impact of tariff reduction results to output contraction in the agricultural sector but an expansion in the non-food manufacturing sectors composed of textiles, garments, and semi-conductor industries. However, the reallocation from agriculture towards non-food manufacturing lead to increased inequality.

On the other hand, it has been widely argued that growth plays a significant role in reducing poverty. Balisacan (2003) analyzed the poverty and distributional impacts of economic growth in the Philippines using a partial equilibrium framework. His findings reveal that the largest decline in poverty transpired during periods of high economic growth. By decomposing the poverty effects moreover, he found that 70% of the observed changes in poverty during the high growth periods resulted from economic growth confirming that it largely contributed to observed poverty reductions in the past.

5.1 Research Gap

From the preceding discussion, it can be concluded that: (i) trade liberalization results to resource reallocation effects that result to significant changes in poverty and income distribution in the Philippines; (ii) significant reductions in poverty can be achieved through economic expansion arising from accumulation effects in the economy.

Although Cororaton and Cockburn employed a CGE microsimulation model allowing for analysis of individual household impacts, their model however was limited to a comparative static framework failing to capture the poverty effects of capital accumulation, and in turn growth in the economy. In the same vein, although Balisacan (2003) found that economic growth reduces poverty in the Philippines, his study however was conducted using a partial equilibrium framework hence, failing to account for the economic feedback arising from resource reallocation effects.

Thus to address these concerns, the use of a dynamic computable general equilibrium model that integrates individual household characteristic would be necessary in order to properly account for the economic and poverty effects of growth and trade liberalization in the Philippines.

6. Importance of Analyzing Trade-Growth-Poverty Linkage in the Philippines

The Philippines started its trade reform program in 1981. Since then however, the economic and poverty impacts of growth and trade liberalization have not been investigated. To address this, the proposed research seeks to employ a dynamic CGE microsimulation model that will be solved under a sequential dynamic path from 1994 to 2020. The rationale behind this approach is in order to simultaneously capture the economic and poverty effects of capital accumulation and

trade liberalization in the Philippine economy. This is important because as argued by Mcculloch, Winters, and Cirera (2001) "trade liberalization is an ally against poverty since it tends to increase average incomes, providing more resources to tackle poverty". Furthermore, "recent evidence suggests that greater openness enhances growth at least over the medium term, and that the growth benefits the poor" (Winters, 2003).

Perhaps, the relevant questions that must be addressed at this stage are: (a) Is trade liberalization an important policy vehicle to promote economic growth and at the same time reduce poverty in the Philippines? In particular, does the linkage really exist? If it does, is it really important to analyze the trade-growth-poverty linkage in the Philippines? (b) What will be the impact of trade liberalization and growth on employment and income of the poor, particularly those working in the import competing and export intensive sectors? (c) What will happen to laborers who will be displaced in contracting sectors, particularly agriculture? Will they be absorbed by the expanding sectors? (d) What will be the impact of Doha and further rounds of WTO negotiation on the Philippine economy? (e) What are the impacts of the full implementation of TRP IV in the Philippine economy, both at present and the medium term?

Of course, a concrete and quantifiable answer to these questions will only be determined by conducting the proposed research. Fundamentally, as Mcculloch, Winters, and Cirera (2001) suggests, the quantitative answers will depend on: (a) Price transmission; (b) Impacts on profits and wages; (c) Taxes and Government spending; (d) economic growth; (e) cost of adjustment; (f) risk and uncertainly; and (g) supply response.

In the mean time however, it turns out that the only way to indirectly address the questions posed above is by looking at recent Philippine evidence. Habito (2000) finds that the growth in exports as well as industrial activity coupled with decline in unemployment rate started right after the accession to WTO, which coincided with the implementation of TRP III in 1994. During this time, agricultural production increased particularly livestock, poultry, and fruits sectors. Furthermore, he concluded that the small drop in agriculture employment was offset by the new jobs created in the industrial sector. Indeed as discussed in part 3, the highest economic growth, and lowest unemployment rates were achieved right after 1994 which incidentally is the time, when upsurge in exports began.

In terms of poverty linkage, Balisacan (2003) supports this claim as he finds that the greatest reduction in poverty levels occurred during the high growth period of the mid 1990s. Similarly, Cororaton and Cockburn (2003) finds that although there is a displacement in the agricultural sectors as resources moves away from it and towards the industrial sectors, the much higher decline in consumer prices (as a result of tariff reduction) vis a vis decrease in income resulted to a reduction in poverty levels.

Thus, based on recent findings discussed above, it seems that the only way by which large reduction in poverty can be attained in the Philippines is by taking advantage of the trade liberalization, poverty and growth linkage. Indeed, if this is the case in the Philippines, then the country's liberalization tract will surely enhance and promote economic growth, consequently making the country more equipped to tackle its poverty reduction goals at least in the medium term.

On both policy and research grounds, this is important since analyzing these concerns will provide an over-all evaluation of the current and plausible future adjustments that the Philippine economy will take. With this, the resource reallocation effects together with the corresponding poverty and income distributional impacts can be captured. More importantly, undertaking this

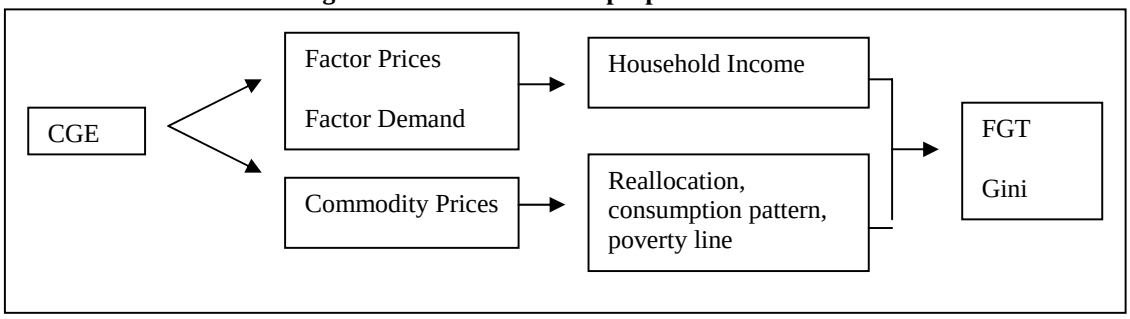
research will simultaneously fill in the current research gap and at the same time provide relevant information to appropriate government agencies such as the National Economic and Development Authority (NEDA) and the National Anti Poverty Commission (NAPC) which are tasked to implement poverty reduction measures in the country. Thus, both agencies can utilize the results of this research as a guide for better policy framing.

Finally, in terms of academic and civil society grounds, this research can provide a quantified assessment that will hopefully shed light on the contending viewpoints as to the real impact of growth and trade liberalization on poverty in the Philippines[4].

7. Research Methodology

The proposed study will employ a sequential dynamic CGE microsimulation analysis to assess the economic and poverty impacts of trade liberalization and growth in the Philippines. Figure 3 provides a stylized illustration of the proposed research. By following the arrows (flows), it can be seen that the CGE model will be used to analyze the economic, sectoral, volume and price effects of the intended policy simulation. Since the entire household survey will be integrated, the model will be fully capable of capturing the changes in individual household poverty characteristic and distribution structure through Foster-Greer-Thorbecke (FGT) measures and the Gini coefficient respectively.

Figure. 3 Illustration of the proposed research



7.1 Basic Structure of the Model

Figure 4 present the basic price and volume relationships within the model. On the supply side, Output (X) will be specified as a Constant Elasticity of Transformation (CET) between Export (E) and Domestic sales (D). The allocation between Exports and Domestic sales, will depend upon the export price (Pe), local price (Pl) and the elasticity of substitution. For instance, if the price of export increases relative to the local price, then the export supply will increase while the supply for domestic sales will decline. The magnitude of reallocation however, will depend upon the elasticity of substitution.

The demand side on the other hand, will be specified as a Constant Elasticity of Substitution (CES) function between imports (M) and domestic good (D). This is otherwise known as the Armington or small country assumption to account for product differentiation between imported and domestically produced goods. Similarly, the allocation between Imports

[4] It is widely believed that trade liberalization and growth does not result to poverty reduction because of the absence of trickle-down effect.

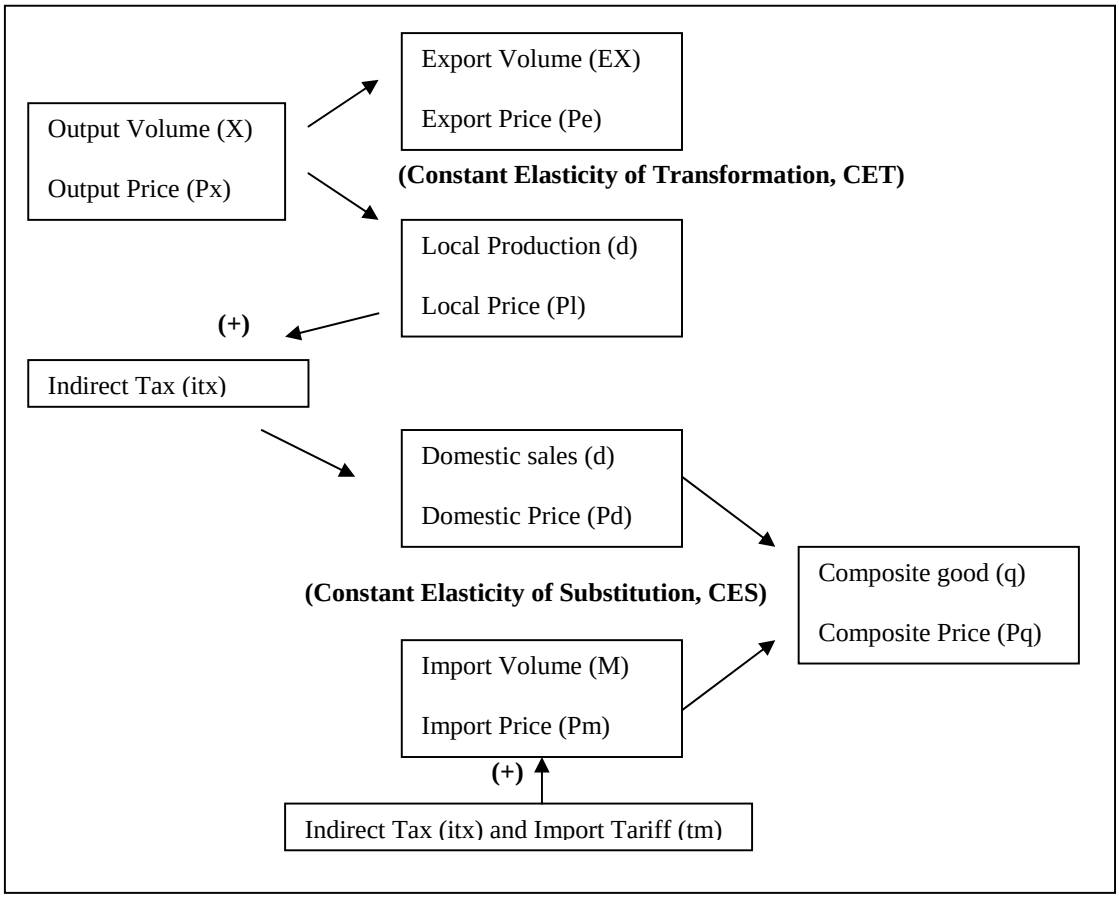
and Domestic goods will be dependent upon the import price (Pm), domestic price (Pd) and the elasticity of substitution. That is, if the price of import decreases relative to the domestic price, then the demand for imports will rise relative to the domestic good. Once again, the magnitude of reallocation will depend on the elasticity of substitution.

The supply side of the model assumes profit maximization, while the demand side assumes cost minimization. Thus, the first order conditions on the supply side will generate the necessary supply and input demand functions while the first order conditions on the demand side provides the necessary import and domestic demand functions.

With respect to prices, Output price (Px) will be determined as a composite price of exports (Pe) and local prices (Pl). Adding indirect taxes to local price will then determine the domestic prices (Pd), which when combined with import price (Pm) will result to the composite price (Pq).

Import price is in domestic currency, which will be affected by the world price of imports (Pm), exchange rate (er), tariff rate (tm), indirect tax rate (idtx). The direct effect of tariff reduction for instance will result to a reduction in Pm, which if significant enough will lead to a decline in composite price (Pq)

Figure. 4 Basic Structure of the Model



7.2 Production Classification

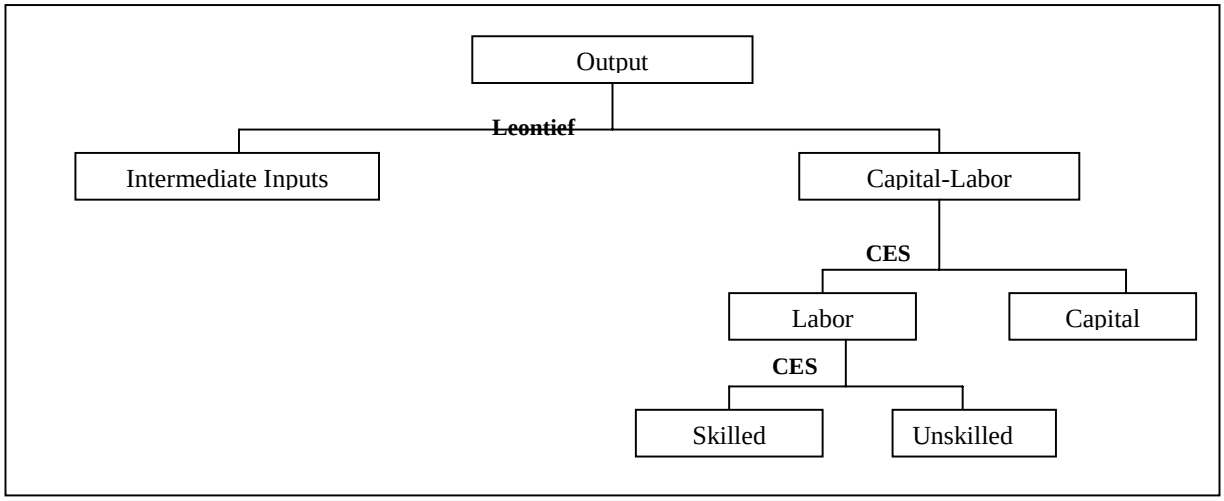
The model is a non-linear sequential dynamic CGE to be calibrated to the 1994 Philippine Social Accounting Matrix (SAM). It will be disaggregated into sectors composed of *Six agriculture* (Cereals, Fruits, Poultry, Livestock, Forestry, Other Agriculture), *Eight industrial* (Food Manufacturing, Rice and Corn Milling, Textile and Garments, Semi-conductors, Non-Food Manufacturing, Heavy Industry, Mining, and Other Industry), *five services* (Construction, Wholesale and Retail trade, Transportation, Other Services, Government Services) and *four energy* (Coal, Crude Oil, Refined Oil, Electricity) sub-sectors respectively. It will be assumed that all sectors produce tradable goods except the government which produces a non-tradable one.

7.3 Production Structure

The Nested Production structure of the model assuming constant returns to scale is depicted in figure 3. Under this structure, gross output will be determined through a three-stage process. The first stage involves the optimal determination of aggregated labor through a CES function of skilled and unskilled labor. In turn, the aggregated labor input will then be combined with capital to form a capital-labor composite through CES aggregation in the second stage. Finally, gross output will be produced through a Leontief function of intermediate inputs and the capital-labor bundle.

On the other hand, households will maximize utility based on a Linear Expenditure System (LES) that specifies a minimum consumption level.

Figure 3. Production Structure



7.4 Labor Type and Treatment of Labor Market

The model distinguishes four labor types: (a) agriculture and; (b) production. Consequently, agriculture and production labor are further classified into (a) skilled; and (b) unskilled labor. Skilled labor includes professionals, managers, and other related workers with at least a high school diploma while the rest belong to the unskilled category. Labor is fully mobile across sectors but is limited within specific skill category. This classification has been specified in order to easily capture the perceived mobility of agriculture labor into the industrial sector brought

about by output contraction and labor displacement in the agricultural sector arising from trade liberalization.

Hence, this allows for a more revealing labor mobility patterns based on the proposed simulations. Initially, a neoclassical labor closure will be assumed. However, owing to: (a) the dominant share of labor in the income of the poor, which are primarily in agriculture--as they are expected to be affected severely by trade liberalization in the Philippines (Cororaton and Cockburn, 2003); and the (b) the dynamic nature of the model, the proposed research will evaluate the labor market deeply and consequently analyze alternative labor market closures once the model becomes full proof.

7.5 Capital and Investment

Capital stock will be updated endogenously every period assuming that stocks and flows will be measured at the beginning and ending period respectively. On the other hand, investment will be distributed to different sectors of destination. The investment demand function that will be used in the study is similar to the one proposed by Bourguinon, Branson and De Melo (1989) as well as by Jung and Thorbecke (2003). In this case, the capital accumulation rate (ratio of investment to capital stock) is increasing with respect to the ratio of the rate of return to capital and its user cost[5].

7.6 Model Closure

Current Account Balance. The current account balance will be held fixed. This is analogous to the assumption of constant foreign savings. Sectoral exports and imports however, are not fixed, thus they respond to changes in the relative price ratio between Pe and Pl, which is the real exchange rate. The nominal exhange rate is fixed.

Government Account Balance. The government account balance will be retained in the model. With this, all simulations will use equal yield scenarios using various closure rules in the counterfactual policy simulation phase. Likewise, the government expenditure will be held fixed in all simulations.

Savings-Investment Balance. The savings-investment balance will be solved in the model. In this way, total investment will be determined through the accumulated savings within the economy.

Labor Market. The labor market will assumes a Neo-classical closure wherein Labor supply is equal to labor demand.

7.7 Welfare Measure

The study will use the Hicksian Equivalent Variation (EV) to assess the impact of growth and trade liberalization to changes in welfare. The Hicksian EV takes the old equilibrium income and prices and computes the change needed to achieve the new equilibrium (Shoven and Whalley, 1984) and is given by:

[5] The user cost is equal to the dual price of investment times the sum of depreciation rate and the exogenous interest rate.

$$EV = \left[(U^n - U^0) / U^0 \right] \cdot I^0 \qquad (1)$$

Where U^n represent the new utility state; U^o is the Old utility state; and I^o is the Old Income

7.8 Poverty and Distributional Measures

The effects of policy shifts on household poverty characteristic will be measured through Foster-Greer-Thorbecke (FGT) Pα class of additively decomposable measures (Foster, Greer and Thorbecke, 1984). In general, the FGT poverty measure is[6]

$$P_\alpha = \frac{1}{n} \sum_{i=1}^{q} \left(\frac{z - y_i}{z} \right)^\alpha \qquad (2)$$

Where α is the poverty aversion parameter; n is population size; q is the number of people below the poverty line, y_i is income and z is the poverty line/threshold[7]

The measure of poverty will be conducted before and after the policy shift. The FGT poverty measure will be dependent on the values that the parameter α will take. At α=0, the poverty headcount will be calculated by accounting for the proportion of the population that falls below the poverty threshold. At α=1, the poverty gap will be measured by indicating how far on the average, the poor are from the poverty threshold. Finally, at α=2, the poverty severity index will be measured. The Severity index is more sensitive to the distribution among the poor as more weight is given to the poorest below the poverty threshold. This is because the poverty severity index corresponds to the squared average distance of income of the poor from the poverty line hence, gives more weight to the poorest of the poor in the population

To capture the extent of poverty before and after the shock, the actual household income and poverty line from the 1994 FIES will be used to compute for the FGT indices, which will be used as the base data in the analysis. On the other hand, to capture the income distributional changes due to the policy shift, the Gini Coefficients before and after the policy changes will be computed. The Gini Coefficient is

$$\text{Gini Coefficient} = \left(\frac{1}{2xn^2} \right) x \left[\sum_i w_i \; x \; \sum_j w_j \; \left| y_i - y_j \right| \right] \qquad (3)$$

Where n is the over-all population; i and j are household indices; wi and wj are the number of people in household i and j, respectively (note that $\sum_i w_i = n$ and $\sum_j w_j = n$) and y_i and y_j are income of household i and j respectively.

Moreover, the spatial aspect of poverty and income distribution will be assessed by evaluating their changes before and after the policy shock. This will be accomplished by comparing the relative changes in poverty incidence and income distribution between the rural and urban population.

[6] See Ravallion (1992) for detailed discussion

[7] The poverty threshold would be equal to the food plus the non-food threshold, where threshold is defined as the cost of basic food and non-food requirements.

7.9 Business As Usual (BAU) Scenario

The model is a recursive CGE that will be solved under a sequential dynamic path from 1994 to 2020. Hence, the economy will be represented by a sequence of period related but intertemporally uncoordinated flow of equilibria, with agents assumed to be myopic basing their decisions on static expectations (Burniaux, et al, 1992).

The BAU scenario will provide the plausible future baseline path by taking into account all the anticipated changes in the Philippine economy through exogenous assumptions that will be based from the 2004 Philippine Medium Term Plan.

7.10 Counterfactual Policy Simulations

The policy shock will be executed through a two-tier tariff reduction. The first tariff reduction will be introduced into the model on the year 1999 in order to capture all the reforms that have been implemented in the Philippine economy under TRP III. The rationale for this is that although TRP III was passed and approved in 1994, the over-all tariff reduction process however was carried out between the years 1994 to 1998. Thus, the year 1999 provides for the completed phase of TRP III. In the same vein, the second tier tariff reduction will be introduced into the model by the year 2005 so as to capture the tariff reduction under TRP IV which were implemented between the years 2001 to 2004.

Table 4 summarizes the Policy Experiments that will be conducted in the proposed research. In all simulations, the government balance will be held fixed while any loss in government revenue from the implementation of policy reforms will be compensated either by changes in direct income or indirect output tax.

Table 4. Counterfactual Policy Experiments

Experiment	Policy Change	Government Balance	Compensatory Measure
EXP_1	Two-Tier Tariff Reduction in 1999 and 2005	Fixed	Household income tax
EXP_2	Two-Tier Tariff Reduction in 1999 and 2005	Fixed	Indirect Output tax
EXP_3	Two-Tier Tariff Reduction in 1999 and 2005, and Zero Tariff by 2015	Fixed	Household income tax
EXP_4	Two-Tier Tariff Reduction in 1999 and 2005, and Zero Tariff by 2015	Fixed	Indirect Output tax

EXP_1 Trade liberalization will be executed in 1999 and 2005 respectively with household income tax as the compensatory adjustment to ensure revenue neutrality.

EXP_2 Same as EXP_1 except that indirect output tax will be used as compensatory adjustment to ensure revenue neutrality.

EXP_3 Similar to EXP_1 coupled with total tariff elimination by 2015, with household income tax as the compensatory adjustment to ensure revenue neutrality.

EXP_4 Same as EXP_3 except that indirect output tax will be used as compensatory adjustment to ensure revenue neutrality.

7.11 Data Sources

The main data source for the proposed research will be the 1994 Social Accounting Matrix (SAM) to be updated from the (a) 1994 Input-Output (I-O) table; (b) 1994 National Income Accounts (NIA); (c) 1994 Labor Force Survey (LFS); (d) 1994 Family Income and Expenditure Survey (FIES); (e) 1994 Philippine Statistical Yearbook; and (f) 2004 Philippine Development Plan. However, the proposed research will update the database to a 2000 SAM as soon as the 2000 IO table becomes available[8]. While the he CET and CES elasticity parameters will be based from APEX (Agricultural Policy Experiments: Clarete and Warr, 1992) model of the Philippine economy which were econometrically estimated.

7.12 Modeling Approach

Given the complexity and the aim to integrate a dynamic CGE microsimulation model, the proposed research will be executed in the following manner:

(1) Initially, use Cobb-Douglas production and utility functions, then switch to CES production and LES utility function once the model is running perfectly.
(2) Assume a representative household approach, then switch to microsimulation within a static framework
(3) Move to dynamic CGE with representative household approach.
(4) Switch to dynamic integrated CGE microsimulation afterwards.

8. Expected Results, Benefits and Dissemination

The proposed research expects to realize the following results and benefits:

- A quantified assessment of the possible economic, sectoral, poverty, and distributional impacts of growth and trade liberalization in the Philippines between the period 1994 and 2020.
- Shed light on the resource reallocation effects of trade liberalization, and its corresponding impact on the government's goal of enhanced economic growth and poverty reduction.
- Provide relevant information that the National Economic and Development Authority (NEDA) and the National Anti Poverty Commission (NAPC) can utilize for better policy framing

[8] The 2000 input-output table is expected to come out by third quarter of 2005, while the 2000 Family Income and Expenditure survey with (45,000 household) is available.

- Initiate an avenue for consultation and discussion with the government, academia, and civil society.

Thus, the research results can provide not only relevant information but also an opportunity for consultation and discussion with the country stakeholders. This is important in order to achieve a wholistic research approach that will hopefully bring about meaningful and significant policy impacts. To realize this, the research proposes to undertake the following Consultation and Dissemination (CD) strategies: (a) Direct Contact; (b) Specific Events; and (c) Publications and Media.

Direct Contact (DC). This activity will initially be carried out through a meeting cum consultation with identified DC partners that include: senior researchers from academia and industry, representatives from pro-poor non-governmental organizations (NGOs), and an official from NEDA and NAPC [9]. Within this meeting, the research activity and method will be presented to inform as well as gather comments and suggestions from DC partners in order to come up with a well-framed policy paper. After which, communication and consultations through e-mail will be executed to keep DC partners informed during the research process.

Specific Events (SE). The major SE activity will be accomplished by organizing a research symposium through the help of the Angelo King Institute of De La Salle University (AKI-DLSU). During this symposium, DC partners, other interest groups and media will be invited so as to ensure continuous consultation and at the same time maximize research results exposure. Moreover, an independent discussant apart from key DC partners will be invited to provide additional comments on the research. Similarly, participation in both national and international research conventions will also be undertaken with the aim of reaching a wider audience.

Publications and Media (PM). The strategy on PM dissemination activities constitutes both formal and informal mediums. The formal medium takes the form of publications through: (a) working papers (via the DLSU College of Business and Economics and PEP Working Papers); (b) submission to a refereed national journal (e.g. PIDS' Journal of Philippine Development; Philippine Journal of Business and Economics – DLSU; Philippine Review of Economics – University of the Philippines); (c) Submission to an international journal; and (d) Policy Briefs (Angelo King Institute). Specifically, the policy briefs and working papers will be distributed through e-mail and as a printed material.

On the other hand, the informal medium will be executed by writing a non-technical article for submission to the three top newspaper broadsheets in the Philippines (Philippine Daily Inquirer, Philippine Star, and Manila Bulletin). In particular, the article can be submitted for immediate publication to the once a week column of the College of Business and Economics of De La Salle University in Manila Bulletin

9. Institution and Researcher

Institution

De La Salle University-Manila is a non-stock, non-profit private organization. "It is a university that actively participates in both theoretical and applied research with the aim of improving the quality of life of the Philippine society"(www.dlsu.edu.ph).

[9] These representatives will be identified during the initial phase of the research

Researcher[10]

Erwin Corong
Lecturer,
De La Salle University (DLSU)

Modeling Experience[11]

The researcher is a novice CGE modeler who's first ever model was completed in December 2003 to assess the possible economic impacts of decreasing carbon dioxide emissions in the Philippines (Corong, 2003). Similarly, he has built a simple 4 sector Philippine static CGE model, which was coded in GAMS to serve as a blue print for future modeling extension (see appendix).

Given the limited experience of the researcher in the use of constructing SAM's and the use of CGE models for policy analysis, this research will surely generate an immense capacity building component.

Current Research Undertakings:

Cororaton C. and E. Corong. "Agriculture Sector Policies and Poverty in the Philippines: A CGE Analysis" (Research being carried out with the aid of a grant from the International Development Research Center (IDRC)-funded Poverty and Economic Policy (PEP) Research Network)

Cororaton C., J. Cockburn, E. Corong, and B. Decaluwe. "Doha Scenarios, Trade Reforms, and poverty in the Philippines". (Research being carried out with the aid of a grant from BNPP trust fund through the World Bank)

[10] I am still convincing a young, promising female graduate student and another male researcher from DLSU to join the research team. The list of researchers will be updated afterward.
[11] In terms of software, the researcher is familiar with GAMS and is currently learning Stata.

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APPENDIX

```
$Title Philippine Applied General Equilibrium Model
$OFFSYMXREF OFFSYMLIST

$ontext
Modeling Objective:
        (1) To construct a basic static four sector applied general equilibrium model of the Philippines.
        (2) To serve as a blue print for future model extensions

Erwin L. Corong (De La Salle University)

MODEL DESCRIPTION:
-A small open Economy model of the Philippines with 4 goods and 2 factors
-4 sector-1994 Social Accounting Matrix
-Cobb-Douglas Production and Utility Function
-Factors of Production - Capital and Labor
-One household and Labor type
-CET Export and Domestic sales
-CES Armington relation
$offtext

*============================= CALIBRATION FILE ========================

Set i Sectors    / AGRI  Agriculture
           INDU  Industry
           SERV  Services
           NTRS  Non-Tradable Services /

td(i) Tradable Sectors / AGRI  Agriculture
             INDU  Industry
             SERV  Services /

ntd(i) Non-tradable sector / NTRS  Non-Tradable Services /

td_0serv(td) Goods / AGRI  Agriculture
            INDU  Industry /

h household / h household /

alias (i,j), (td,td1), (h,h1);

*============================= PARAMETER DEFINITION ======================
PARAMETERS
*PRODUCTION
A(i)          Cobb-Douglas scale parameter for sector i
alpha(i)      Cobb-Douglas share parameter for sector i
int_coef(i)   Leontief fixed intermdiate coefficient
va_coef(i)    Capital labor value added coefficient of sector i
aij(td,i)     Input-Output coefficient

*TRADE
cet_sp(td)    CET scale parameter of td
rho_cet(td)   CET substitution parameter (export and domestic good)
ex_sh(td)     Share of exports in CET
sig_ex(td)    Sigma parameter in exports
```

arming_sp(td) Armington scale parameter of td
rho_im(td) Armington substitution parameter (export and domestic good)
im_sh(td) Share of import in Armington
sig_im(td) Sigma parameter in imports

*DEMAND
ch_pa(td,h) Household consumption parameter
inv_pa(td) Investment parameter

*INCOME AND SAVINGS
hh_dply(h) Household distribution parameter in labor income
hh_dpky(h) Household distribution parameter in capital income
hh_dpdiv(h) Household distribution parameter in dividend income
lambda Capital income share to households
lambda_for Capital income share to foreigners
aps(h) Average propensity to save of households

*VARIABLES TO HOLD INITIAL VALUES
*PRICES

w0 Wage rate
r0(td) Price of capital in td
pwim0(td) World price of imports
pwex0(td) World price of exports
er0 Exchange rate
pva0(i) Price of value added of i

px0(i) Output price of i
pl0(td) Domestic price of td excluding tax
pd0(td) Domestic price of td with tax
pq0(td) Composite price of td
pex0(td) Domestic price of exports of td
pim0(td) Import price of td

*PRODUCTION
x0(i) Output of i
va0(i) Value added of i

*FACTORS
k0(td) Capital in td
l0(i) Labor in i
ls0 Labor supply

*DEMAND
ch0(td,h) Household consumption
inv0(td) Investment demand
tinv0 Total Investment
d0(td) Domestic demand for td
q0(td) Composite demand for td
g0 Government consumption
intp0(i) Intermediate consumption of i from sector j
intdem0(td) Interdmediate demand for td

*FOREIGN SECTOR
ex0(td) Export of td

```
im0(td)         Import of td
cab0            Current account balance
div_for0        Foreign deividends
for_gvpay0      Government debt service payments
for_grant0      Foreign grant received by the government
yfor0(h)        Foreign income of household

*Income
ylabor0         Labor income
ycap0           Capital income
yhh0(h)         Household income
ydhh0(h)        Disposable income of household
yfirm0          Firms' income
ygov0           Government income
div0            Dividend income
gtrans0(h)      Government transfers to households
dtxrev0         Direct tax revenue of government
timrev0         tariff revenue of government
itxrev0         Indirect tax revenue of government
timrv0          Government import tariff revenue on td
dtxrvf0         Government direct income tax revenue from firms
dtxrvh0         Government direct income tax revenue from households
itxrv0          Government indirect income tax revenue

*SAVINGS
savhh0(h)       Household savings
savfirm0        Firms' savings
savgov0         Government savings

*TAXES
dtxrf0          Direct income tax rate on firms
dtxrh0(h)       Direct income tax rate on households
itxr0(td)       Indirect income tax rate
tim0(td)        Import tariff rate

rescale         Rescaling factor    /10000/
;

*============================= BENCHMARK DATA ============================
$Include Phil_CGE_data.gms

*====================ASSIGINING DATA TO INITIAL VARIABLES ================

x0(i)         = data("x0",i);
va0(i)        = data("va0",i);
k0(td)        = data("k0",td);
l0(i)         = data("l0",i);
inv0(td)      = data("inv0",td);
ex0(td)       = data("ex0",td);
d0(td)        = data("d0",td);
im0(td)       = data("im0",td);
q0(td)        = data("q0",td);
itxrv0(td)    = data("itxrv0",td);
timrv0(td)    = data("timrv0",td);
px0(i)        = data("px0",i);
pl0(td)       = data("pl0",td);
```

```
pwim0(td)     = data("pwim0",td);
pwex0(td)     = data("pwex0",td);
r0(td)        = data("r0",td);
sig_ex(td)    = data("sig_ex",td);
sig_im(td)    = data("sig_im",td);

hh_dply(h)    = hy0("hh_dply",h);
hh_dpky(h)    = hy0("hh_dpky",h);
hh_dpdiv(h)   = hy0("hh_dpdiv",h);
yfor0(h)      = hy0("yfor0",h);
gtrans0(h)    = hy0("gtrans0",h);
yhh0(h)       = hy0("yhh0",h);
ydhh0(h)      = hy0("ydhh0",h);
savhh0(h)     = hy0("savhh0",h);

dtxrvh0(h)    = others("dtxrv0", h);
dtxrvf0       = others("dtxrv0", "inst1");

*============== CALIBRATION OF INITIAL VALUES OF SOME VARIABLES ==========
*TAXES
dtxrh0(h)       = dtxrvh0(h)/yhh0(h);
dtxrf0          = dtxrvf0/yfirm0;
tim0(td)        = timrv0(td)/im0(td);
itxr0(td)       = itxrv0(td)/(pl0(td)*d0(td)+im0(td)*pwim0(td)
                *er0*(1+tim0(td)));

timrev0         = sum(td, timrv0(td));
dtxrev0         = sum(h, dtxrvh0(h))+ dtxrvf0;
itxrev0         = sum(td, itxrv0(td));
yfirm0          = yfirm0*(1-dtxrf0);

*PRICES
pex0(td)        = pwex0(td)*er0;
pd0(td)         = pl0(td)*(1+itxr0(td));
pim0(td)        = pwim0(td)*er0*(1+tim0(td))*(1+itxr0(td));
pq0(td)         = (pd0(td)*d0(td)+ pim0(td)*im0(td))/q0(td);

mat0(td,i)      = mat0(td,i)/pq0(td);
pva0(i)         = (px0(i)*x0(i)- sum(td, mat0(td,i)*pq0(td)))/va0(i);
r0(td)          = (pva0(td)*va0(td)-l0(td)*w0)/k0(td);

*DEMAND
ch0(td,h)       = ch0(td,h)/pq0(td);
inv0(td)        = inv0(td)/pq0(td);
tinv0           = sum(h,savhh0(h))+savfirm0+savgov0+cab0;
intdem0(td)     = sum(i, mat0(td,i));
intp0(i)        = sum(td, mat0(td,i));

*========================= CALIBRATION OF PARAMTERS ====================

*PRODUCTION

va_coef(i)      = x0(i)/va0(i);

int_coef(i)     = intp0(i)/x0(i);
```

```
alpha(i)        = (w0*l0(i))/(pva0(i)*va0(i));

A(td)           = va0(td)/(l0(td)**alpha(td)*k0(td)**(1-alpha(td)));

A(ntd)          = va0(ntd)/(l0(ntd)**alpha(ntd));

aij(td,i)       = mat0(td,i)/intp0(i);


*TRADE
rho_cet(td)     = (1+sig_ex(td))/sig_ex(td);
ex_sh(td)       = 1/(1+(pl0(td))/pex0(td)*(ex0(td)/d0(td))**(rho_cet(td)-1));
cet_sp(td)      = x0(td)/(ex_sh(td)*ex0(td)**rho_cet(td) +
              (1-ex_sh(td))*d0(td)**rho_cet(td))**(1/rho_cet(td));

rho_im(td)      = (1-sig_im(td))/sig_im(td);
im_sh(td)       = (pim0(td)/pd0(td))*(im0(td)/d0(td))**(1/sig_im(td));
im_sh(td)       = im_sh(td)/(1+im_sh(td));

arming_sp(td)   = q0(td)/(im_sh(td)*im0(td)**(-rho_im(td)) +
              (1-im_sh(td))*d0(td)**(-rho_im(td)))**(-1/rho_im(td));

*DEMAND
ch_pa(td,h)     = ch0(td,h)*pq0(td)/ydhh0(h);
inv_pa(td)      = inv0(td)*pq0(td)/tinv0;

*INCOME AND SAVINGS
lambda          = lambda/ycap0;
lambda_for      = lambda_for/ycap0;
aps(h)          = savhh0(h)/ydhh0(h);
hh_dply(h)      = hh_dply(h)/ylabor0;

hh_dpky(h)      = hh_dpky(h)/(lambda*ycap0);
hh_dpdiv(h)     = hh_dpdiv(h)/div0;

*================================ MODEL ================================

VARIABLES
*PRICES
w               Wage rate
r(td)           Price of capital in td
pwim(td)        World price of imports
pwex(td)        World price of exports
er              Exchange rate
pva(i)          Price of value added of i

px(i)           Output price of i
pl(td)          Domestic price of td excluding tax
pd(td)          Domestic price of td with tax
pq(td)          Composite price of td
pex(td)         Domestic price of exports of td
pim(td)         Import price of td

*PRODUCTION
x(i)            Output of i
va(i)           Value added of i
```

mat(td,i) Inter-industry matrix

*FACTORS
k(td) Capital in td
l(i) Labor in i
ls Labor supply

*DEMAND
ch(td,h) Household consumption
inv(td) Investment demand
tinv Total Investment
d(td) Domestic demand for td
q(td) Composite demand for td
g Government consumption
intp(i) Intermediate consumption of i from sector j
intdem(td) Interdmediate demand for td

*FOREIGN SECTOR
ex(td) Export of td
im(td) Import of td
cab Current account balance
div_for Foreign deividends
for_gvpay Government debt service payments
for_grant Foreign grant received by the government
yfor(h) Foreign income of household

*Income
ylabor Labor income
ycap Capital income
yhh(h) Household income
ydhh(h) Disposable income of household
yfirm Firms' income
ygov Government income
div Dividend income
gtrans(h) Government transfers to households
dtxrev Direct tax revenue of government
timrev tariff revenue of government
itxrev Indirect tax revenue of government

*SAVINGS
savhh(h) Household savings
savfirm Firms' savings
savgov Government savings

*TAX RATES
dtxrf Direct income tax rate on firms
dtxrh(h) Direct income tax rate on households
itxr(td) Indirect income tax rate
tim(td) Import tariff rate

*OTHERS
leon
ntaxr
;

*========== EQUATION DEFINITION ==========

EQUATIONS
*PRODUCTION
xeq(i) Output of i
vaeq1(td) Value added of td
vaeq2(ntd) Value added of ntd
intpeq(i) Intermediate consumption
mateq(td,i) Inter-industry matrix

*FACTORS
leq1(td) Labor in td
leq2(ntd) Labor in ntd

*TRADE
ceteq(td) CET relation between export and domestic sale
exeq(td) Export supply of td
compeq(td) Armington specification
imeq(td) Import demand in td

*DEMAND
cheq(td,h) Household consumption
inveq(td) Investment demand
intdemeq(td) Intermediate demand for td
geq Government consumption

*Income
ylaboreq Labor income
ycapeq Capital income
yhheq(h) Income of households
ydhheq(h) Disposable income of households
yfirmeq Firms' income
ygoveq Government income
timreveq Tariff revenue of government
dtxreveq Direct tax revenue of government
itxreveq Indirect tax revenue of government

*SAVINGS
savhheq(h) Savings of households
savfirmeq Firms' savings
savgoveq Government savings

*Prices
pimeq(td) Import price of td
pexeq(td) Export price of td
pcompeq(td) Composite price of td
pdeq(td) Domestic price of td with tax
pxeq(i) Output price of i
pvaeq(i) Price of value added
req(td) Price of capital

*EQUILIBRIUM
eqdomeq(td_0serv) Domestic absorption
eqlabeq Labor market equilibrium
eqinveq Savings investment equilibrium
eqcabeq Current account balance

*OTHERS

```
WALRAS          Walras' verification law
;

*============================ EQUATION SPECIFICATION ======================

*PRODUCTION
xeq(i)..        x(i) =e= va_coef(i)*va(i);

vaeq1(td)..     va(td) =e= a(td)*(l(td)**alpha(td)*k(td)**(1-alpha(td)));

vaeq2(ntd)..    va(ntd) =e= l(ntd);

intpeq(i)..     intp(i) =e= x(i)*int_coef(i);

mateq(td,i)..   mat(td,i) =e= aij(td,i)* intp(i);

*FACTORS
leq1(td)..      l(td)   =e= (alpha(td)*pva(td)*va(td))/w;

leq2(ntd)..     l(ntd)  =e= (px(ntd)*x(ntd)-sum(td, mat(td,ntd)*pq(td)))/w;

*TRADE
ceteq(td)..     x(td) =e= cet_sp(td)*(ex_sh(td)*ex(td)**rho_cet(td) +
                (1-ex_sh(td))*d(td)**rho_cet(td))**(1/rho_cet(td));

exeq(td)..      ex(td) =e= d(td)*((pex(td)/pl(td))*
                ((1-ex_sh(td))/ex_sh(td)))**sig_ex(td);

compeq(td)..    q(td) =e= arming_sp(td)*(im_sh(td)*im(td)**(-rho_im(td))
                +(1-im_sh(td))*d(td)**(-rho_im(td)))**(-1/rho_im(td));

imeq(td)..      im(td) =e= d(td)*((pd(td)/pim(td))*
                (im_sh(td)/(1-im_sh(td))))**sig_im(td);

*DEMAND

cheq(td,h)..    ch(td,h) =e= ch_pa(td,h)*ydhh(h)/pq(td);

inveq(td)..     inv(td) =e= inv_pa(td)*tinv/pq(td);

intdemeq(td)..  intdem(td) =e= sum(i, mat(td,i));

geq..           g =e= px("ntrs")*x("ntrs");

*Income

ylaboreq..      ylabor =e= w*sum(i, l(i));

ycapeq..        ycap =e= sum(td, r(td)*k(td));

yhheq(h)..      yhh(h) =e= ylabor + lambda*ycap +
                div + gtrans(h) + yfor(h) ;

ydhheq(h)..     ydhh(h) =e= (1-dtxrh(h)*(1-ntaxr))*yhh(h);

yfirmeq..       yfirm =e= ((1-lambda-lambda_for)*ycap)*(1-dtxrf);
```

```
ygoveq..        ygov =e= dtxrev + timrev + itxrev + for_grant;

timreveq..      timrev =e= sum(td, tim(td)*im(td));

dtxreveq..      dtxrev =e= sum(h, dtxrh(h)*yhh(h)*(1-ntaxr))+
                ((1-lambda-lambda_for)*ycap*dtxrf);

itxreveq..      itxrev =e= sum(td, itxr(td)*d(td)*pl(td))+
                sum(td, im(td)*itxr(td)*pwim(td)*er*(1+tim(td)));

*SAVINGS
savhheq(h)..    savhh(h) =e= aps(h)*ydhh(h);

savfirmeq..     savfirm =e= yfirm - div - div_for;

savgoveq..      savgov =e= ygov - g - sum(h, gtrans(h)) - for_gvpay;

*Prices
pimeq(td)..     pim(td) =e= (1+tim(td))*pwim(td)*er*(1+itxr(td));

pexeq(td)..     pex(td) =e= pwex(td)*er;

pcompeq(td)..   pq(td)*q(td) =e= (pd(td)*d(td)+pim(td)*im(td));

pdeq(td)..      pd(td) =e= pl(td)*(1+itxr(td));

pxeq(td)..      px(td)*x(td) =e= (pl(td)*d(td)+pex(td)*ex(td));

pvaeq(i)..      pva(i)*va(i) =e= (px(i)*x(i)- sum(td, mat(td,i)*pq(td)));

req(td)..       r(td)*k(td) =e= (pva(td)*va(td)-l(td)*w);

*EQUILIBRIUM
eqdomeq(td_0serv).. q(td_0serv) =e= sum(h, ch(td_0serv,h))+ inv(td_0serv)
                    + intdem(td_0serv);

eqlabeq..           sum(i,l(i)) =e= ls;

eqinveq..           tinv =e= sum(h, savhh(h))+ savfirm + savgov + cab;

eqcabeq..           cab =e= sum(td,pwim(td)*im(td)*er)+lambda_for*ycap
                + div_for + for_gvpay - sum(td, pwex(td)*ex(td)*er)
                - sum(h, yfor(h))- for_grant;

*OTHERS
WALRAS..            leon =e= q("serv")- sum(h,ch("serv",h)) -
                    intdem("serv") - inv("serv");

*==================== INITIALIZATION OF VARIABLES ==========================
**---------------------- ENDOGENOUS VARIABLES ----------------------------

*PRICES
w.l          =  w0;
r.l(td)      =  r0(td);
pva.l(i)     =  pva0(i);
```

```
px.l(i)       =  px0(i);
pl.l(td)      =  pl0(td);
pd.l(td)      =  pd0(td);
pq.l(td)      =  pq0(td);
pex.l(td)     =  pex0(td);
pim.l(td)     =  pim0(td);

*PRODUCTION
x.l(i)        =  x0(i)/rescale;
va.l(i)       =  va0(i)/rescale;
mat.l(td,i)   =  mat0(td,i)/rescale;

*FACTORS
l.l(i)        =  l0(i)/rescale;

*DEMAND
ch.l(td,h)    =  ch0(td,h)/rescale;
inv.l(td)     =  inv0(td)/rescale;
tinv.l        =  tinv0/rescale;
d.l(td)       =  d0(td)/rescale;
q.l(td)       =  q0(td)/rescale;

intp.l(i)     =  intp0(i)/rescale;
intdem.l(td)  =  intdem0(td)/rescale;

*FOREIGN SECTOR
ex.l(td)      =  ex0(td)/rescale;
im.l(td)      =  im0(td)/rescale;

*Income
ylabor.l      =  ylabor0/rescale;
ycap.l        =  ycap0/rescale;
yhh.l(h)      =  yhh0(h)/rescale;
ydhh.l(h)     =  ydhh0(h)/rescale;
yfirm.l       =  yfirm0/rescale;
g.l           =  g0/rescale;

dtxrev.l      =  dtxrev0/rescale;
timrev.l      =  timrev0/rescale;
itxrev.l      =  itxrev0/rescale;

*SAVINGS
savhh.l(h)    =  savhh0(h)/rescale;
savfirm.l     =  savfirm0/rescale;

ntaxr.l       = 0;
*--------------------------- EXOGENOUS VARIABLES ------------------------
*EXGENOUS VARIABLES
*TAX RATES
dtxrf.fx      =  dtxrf0;
dtxrh.fx(h)   =  dtxrh0(h);
itxr.fx(td)   =  itxr0(td);
tim.fx(td)    =  tim0(td);

*INCOME
div_for.fx    =  div_for0/rescale;
```

```
div.fx        =  div0/rescale;
for_gvpay.fx  =  for_gvpay0/rescale;
for_grant.fx  =  for_grant0/rescale;
yfor.fx(h)    =  (yfor0(h)/rescale);
gtrans.fx(h)  =  gtrans0(h)/rescale;

pwim.fx(td)   =  pwim0(td);
pwex.fx(td)   =  pwex0(td);
er.fx         =  er0;
k.fx(td)      =  k0(td)/rescale;
ls.fx         =  ls0/rescale;
ygov.fx       =  ygov0/rescale;
cab.fx        =  cab0/rescale;
savgov.fx     =  savgov0/rescale;

*model dlsupagem /all/;
*dlsupagem.holdfixed=1;
*dlsupagem.iterlim=0;
*solve dlsupagem using mcp;

*====================== SIMULATIONS -- POLICY SHOCKS ====================

*dtxrf.fx      =  dtxrf0;
*dtxrh.fx(h)   =  dtxrh0(h);
*itxr.fx(td)   =  itxr0(td)*0;
*tim.fx(td)    =  tim0(td)*0;
*ls.fx         =  (ls0/rescale)*.0;

model dlsupagem /all/;
dlsupagem.holdfixed=1;
dlsupagem.iterlim=2000;
solve dlsupagem using mcp;
```