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STRUCTURAL CHANGE IN PHILIPPINE AGRICULTURE: A GENERAL EQUILIBRIUM ANALYSIS*

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Analysis of changes in the industrial composition of economic activity (structural change) is important for informed policy making. Such analysis can best be undertaken using a computable general equilibrium (CGE) model. CGE models recognise links among industries arising from their roles as consumers of one another's products and from their competition for the economy's resources. In this paper, a detailed CGE model of the Philippines is employed to assess structural and technological change in Philippine agriculture during the period 1985 to 1992. The model estimates of technological change and other unobservable variables are used to explain structural change in Philippine agriculture and other sectors of the Philippine economy. The macroeconomic effects of this change are also discussed.

Keywords: computable general equilibrium, the Philippines, structural change

I. INTRODUCTION

This paper seeks to analyse the structural change in Philippine agriculture as well as the Philippine economy in general during the period 1985 to 1992. A detailed Computable General Equilibrium (CGE) model of the Philippine economy constructed by Buetre (1995) is employed to measure the changes in the unobservable variables such as technology, labour productivity, tastes and other structural variables which are sources of structural changes. The estimates of these variables together with the observable variables are used to explain the structural change in agriculture and the Philippine economy.

The paper is organized as follows. Background information on Philippine agriculture as well as the rest of the economy is provided in the next section. A general description of the model used in our analysis and the database as well as the methods and procedures used in constructing the historical data and the simulations conducted are discussed subsequently. The macroeconomic and sectoral results with emphasis on agriculture and the policy implications of the analysis are presented prior to concluding comments.

II. BACKGROUND

Together with fishery and forestry, agriculture contributes a large proportion to the gross domestic (GDP) of the Philippines. As such, it is the main source of employment. In recent

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years, however, employment in this sector has steadily declined. In 1985, for example, 51.2 percent of the workforce found employment in agriculture, fishery and forestry. In 1992, the sector's employment share was 45.3 percent. The non-agricultural sector, comprising mining, manufacturing, construction and services, has increased its share from 48.7 to 54.7 percent from 1985 to 1992.

These changes are reflected in sectoral outputs. In Table 1, we see that the sectoral shares in output of Agriculture, fishery, forestry and Industrial sectors were down from their 1980 and 1985 levels. These two major sectors supply 55 percent of the demand for domestically produced consumption goods. The share of Services sector increased from 35.98 percent in 1980 to 40.35 percent in 1985 and finally to 42.56 percent of GDP in 1992. Paradoxically, in spite of the industrialisation effort of the government, the share of the industrial sector declined from 40.52 percent in 1980 to 34.94 percent in 1992. These structural changes are reflective of the changes in policies, external shocks and other economic factors affecting production, consumption, investment and the foreign trade of the Philippines.

An analysis and understanding of structural change is important in the process of policy-making. Although policymakers may have the best of intentions, the set of prescribed policies may not be optimal. For example, a policy of increasing tariffs on imports of corn to protect local corn production benefits corn producers, but penalises corn users particularly the livestock raisers in terms of higher corn prices. With higher input prices, livestock products would also be more expensive thus raising costs to food processors. Whether the benefits gained by the protected sector from tariff protection outweigh the costs to other industries is an empirical question and obviously has to be analysed in a multi-sectoral way. Questions of this sort can be suitably analysed using a policy tool that can capture the linkages of variables in an economy-wide context. This can be handled by multi-sectoral computable general equilibrium model. CGE models are derived from microeconomic optimisation theory with considerable attention to individual behaviour. Detailed sectoral analysis can also be incorporated into a CGE model.

An alternative method is to use a macroeconomic model. Such models, however, are based on aggregate behaviour with reliance placed heavily on correlations found in time series of aggregated data. They rely on macroeconometric theory in choosing which variables to include in equations. Macroeconometric models broke down empirically in the 1970s, in part because they relied on data periods in which events such as supply shocks were relatively unimportant. These models perform poorly in the face of shocks that were not in their estimation period or when there are insufficient data observations. Moreover, if a proper understanding of structural change is desired, data at the sectoral level should be considered in

the model. These details cannot be incorporated into macroeconometric models masking the underlying sources of structural variations.

While there are existing Philippine CGE models, they are not capable of providing a detailed sectoral analysis of structural change. They are too small to be able to handle specific industry policy. Most are illustrative in nature. They are also designed for comparative static analysis.⁷ Moreover, Philippine CGE models are not capable of measuring changes in unobservable structural variables.

Another inadequacy in studies pertaining to structural change is the failure to incorporate the effects of unobservable variables such as technological and taste change. Warr and Coxhead (1993), for example, estimated that over the period 1960 to 1984, 30 percent of growth in per capita output in the Philippines was due to technical progress in agriculture alone. Clearly, these variables have to be taken into consideration in the model especially for forecasting purposes.

III. AN OVERVIEW OF THE MODEL

The model was constructed by Buetre (1995). It is more disaggregated and more flexible or user friendly than other existing Philippine CGE models. It has forecasting capability and can produce an updated general equilibrium database. The core on which the Philippine CGE model was based is the ORANIF model of the Australian economy developed by Horridge et al. (1993). The core model was modified and other equations were added to permit the quantification of changes in unobservable structural variables.

There are 59 industries in the model producing 59 commodities. The formulation in the production side of the model allows the industries to produce more than one commodity. This feature reflects the production structure of most of the Philippine industries which are usually integrated (that is, a food manufacturer also produces livestock and crops). The transformation function permits the industries to change the output mix when relative output prices change. The composition of industry output is reflected in the make matrix.

Producers are assumed to be price takers both for their outputs and inputs. The multi-input, multi-output production system in which each industry can produce several commodities is kept manageable by the assumption of Input-Output separability. Producers are assumed to

⁷ There is a dynamic model constructed by Go (1991) for the Philippines. However, it can only forecast the values of aggregate variables.

choose their output mixes to maximise revenue subject to a CET transformation function. Producers are also assumed to minimise costs subject to a constant-returns-to-scale production function with a series of Leontief/CES nests. The nesting specification does not allow substitution between inputs of different commodity categories or between produced inputs, primary factors and "other costs". Substitution takes place between alternative sources (that is, domestically produced goods and imports) of produced inputs of a given commodity category; and between aggregate labour (a CES combination of labour of two types), capital and agricultural land. Hence, input demands are functions of activity variables and of the relative prices of substitutable inputs. For example, the demand for land in an industry is a function of the industry's activity level and of the prices of aggregate labour, capital and land.

There are also 59 investors which are themselves the industries. Each investor minimises the cost of imported or domestic investment good subject to the CES production function. An equation links industry investment to capital stock accumulation allowing for the dynamics of capital stock accumulation. The dynamic accumulation equations are used to give relationships between the growth rates of sector-specific capital and sector-specific investment. Households are assumed to choose the consumption of composites of domestically produced and imported commodities to maximise a Stone-Geary utility function subject to the aggregate-spending constraint. To maximise utility subject to the expenditure constraint, households minimise the cost of obtaining any given quantity of a composite commodity, subject to the CES functions which define the composites. Thus, household demands for source-specific commodities are functions of the demands for the relevant composites and of source-specific commodity prices. The composite commodities are CES combinations of source specific commodities the same way of aggregation as in intermediate input and investment demands. Hence, household demands for composite commodities are functions of the aggregate expenditure level and of the relative prices of the commodities.

The foreign sector is modelled in a way close to the small country assumption. For exports, a flexibility of export prices is given allowing downward sloping export demand curves for some commodities. This is done via the assignment of export elasticities of demand. For example, for some commodities, the export elasticities are relatively smaller while for most of the export commodities, the export elasticities are large making export demand curve virtually flat. This means that for most commodities, the quantity of Philippine exports has a very small effect on export price. The supply of imports is assumed to be perfectly elastic. Hence its prices are exogenous (that is, import requirements of the Philippines can be purchased at an unlimited quantity without any impact on import prices).

Basic-value prices are set via the competitive assumption that no pure profits can be earned from current production, investment, exporting or importing. With the assumption of constant returns to scale in the model's production functions for current production and capital formation, this implies that the basic-value prices of commodities and the supply prices of units of capital are functions just of the relevant input prices. The basic-value prices of imports are the domestic-currency equivalents of the foreign-currency value of imports inclusive of tariffs. Purchasers' prices for each of the five classes of purchasers (producers, investors, household, exporter, government) are the sums of basic values and sales taxes. Commodity taxes are treated as *ad valorem* on basic values. Setting these prices equal to the domestic-currency equivalent of the world price, imposes the assumption that no pure profits can be earned from exporting.

The model is general-purpose. It can be used to address a wide range of policy questions in addition to forecasting. Among these are tariff policy, employment and other labour related questions, technological and taste change, consumption, investment, and other industry and commodity-specific policy questions. The details of the structure of the model is represented by 20 blocks of equations the details of which are found in Buetre (1995). For purposes of this paper, only the relevant equations for assessing structural change are presented in Appendix I.

IV. DATA, METHODS AND PROCEDURES

Two sets of data are needed in conducting the simulation, the general equilibrium database and the historical data. The general equilibrium database is composed of data from the 1985 Input-Output table of the Philippines and parameters such as Armington elasticities, elasticities of substitution, elasticities of transformation, export elasticities of demand and investment parameter. The database construction is discussed in detail in Buetre (1995). This database was updated, post simulation, to 1992 using historical simulation techniques.

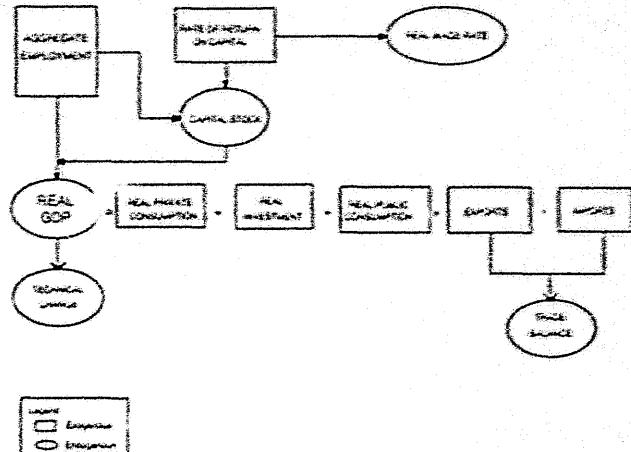
We need historical data to compute the percentage changes of certain variables in the model from the 1985 base period up to 1992, the year when we have the latest detailed information about the economy. These data are historical in the sense that their levels are already known but have not been incorporated into the 1985 CGE database. These data inputs could be macroeconomic or sectoral data. Macroeconomic data include expenditures in the national accounts such as aggregate consumption, aggregate investment, aggregate exports and imports, and government consumption, and data on their respective price indices (see Table 2). Data on national income including aggregate capital stock, compensation of labour and aggregate taxes are also among the macroeconomic variables which are usually published by statistical agencies. Sectoral data (see Table 3) include industry and commodity outputs,

international prices, imports and exports, and government and private consumption of goods and services, including tariffs. Most of these variables are usually endogenous or model-determined in simulations. That is, their changes are normally predicted. In historical simulation, we already know their levels and have to incorporate them into the database as shocks. The more information we can put into the model, the better. While it is desirable to gather as much information as we can, the availability of official statistics and the inconsistencies in statistical reports have impaired our ability to collect all of the changes in observable variables. Nevertheless, we presume that the data we were able to collect are sufficient to assess the structural and technological change and deduce the changes in other variables. Most of these data are not readily accessible and have to be processed. The construction of historical data is discussed in Bucci (1995).

In conducting historical simulations, the first step was to collect the percentage changes in the observable variables in the agricultural sector and the rest of the economy during the period 1955-1992. The changes in these observable variables characterize the structural change in the Philippine economy during the period in the context of this study. Structural change is referred to as the changes in the structural composition of macroeconomic and sectoral variables. By doing historical simulations, we are able to determine the changes in the non-observable variables that were associated with the structural change. Together with the observable sources of structural change, we use the estimates of the non-observable variables to assess the ability of the model to reproduce the pattern of structural change. This process is what we call structural simulation. Since we are mainly putting back the unobserved (endogenous) variables, the model replicates the changes in the known variables or the pattern of structural change during the period. This is the same approach employed by Purnama et al. (1988) and 1991 in analysing structural change in the Indonesian economy using the CRANI model. A related work that used a CGE model for the Spanish economy is reported in Richey, Pow and Benito (1991). Following the newly developed technique in analysing structural change by Dornbusch and McDougall (1993), we improve this type of analysis by quantifying the individual effects of the structural variables on macroeconomic and sectoral variables. This decomposited technique allows us to trace the contribution of each of the variables variables or identify the source of growth in the economy.

We highlighted a closure—the cognitive–cognitive space of the varieties of the subject, the historical and structural situations. The linguistic representation of the historical–cultural situation closure is in Figure 1 below.

FIGURE I
Diagrammatic Representation of Macroeconomic Closure



The way the measurement elements work is as follows:

- In the expenditure side, the aggregate consumption, investment, government exports and imports are fixed to their actual changes from 1985 to 1992. The gross domestic product should therefore be endogenous as it is implied by its components. Although we also know the gross domestic product, exogenising it will make the model over-determined and will not work. Fixing the aggregate final demands to the known changes does not mean that their commodity components will move in the same magnitude. The commodity components are allowed to vary subject to the exogenous aggregate demand.
 - With fixed exports and imports, the balance of trade must be endogenous.
 - On the income side, fixing the economy-wide rate of return π/cap_{t+1} allows the aggregate capital stock $1/cap_{t+1}$ to be endogenously determined. This determines the real wage rate via the factor price frontier. The aggregate employment, fixed at observed level, also helps to determine the capital stock via the production function. The industry changes in capital stocks are allowed to vary in accordance with the changes in their respective rates of return which are endogenous.
 - These known aggregate variables from the income side are enough to set the value of the gross domestic product. However, GDP is also implied in the expenditure side.

The complete documentation is reported in Chapter 19.

side. It is an accounting requirement that the GDP estimates from income and expenditure sides are equal. To reconcile the GDP from income and expenditure sides, a technical change variable (*talprigen*) has to act as a balancing factor or "absorber" of the difference between GDP from income and expenditure sides of the economy. The sign of this technological change variable indicates whether the country undergoes overall technological advancement or deterioration. A negative sign indicates that a given national output is produced with lesser national input, an indication of technological progress.

With a valid closure we put the known values of these macroeconomic variables into the model as shocks. The values of these shocks are shown in Table 2. This gives estimates for technological change and shifters on investment, government, exports and imports. Using their values we conducted macroeconomic structural simulations. This is done by reversing the closure. That is, the macroeconomic variables are now endogenous while the shifters are made exogenous and shocked with their model-determined values. In principle we should be able to replicate the historical values of macroeconomic variables. This process captures and explains the changes in the macroeconomic structure of the economy. Having incorporated these changes into the database, we are left with the question on whether the sectoral estimates generated by the model during macroeconomic historical simulations are consistent with the observed or known sectoral changes. Unfortunately, for some variables, there are wide differences among the model results and the observed sectoral changes. The main reason is that sectoral estimates are still based on the 1985 sectoral structure of the economy. This made us to do the task of putting the known changes in the sectoral variables (as in Table 2) into the model. These sectoral variables must add up to the known macroeconomic variables (for example, the aggregate of the known changes in commodity imports must be equal to the known aggregate imports). We followed the same methodology in that socio-economic historical structural simulations to measure the changes in unobservable sectoral variables and in explaining the sectoral structural changes during the period 1985 to 1992.

While we can directly proceed with sectoral historical simulations, we started with macroeconomic historical simulation to test the ability of the model to reproduce the known macroeconomic variables and detect any problem in the model before going into more detailed historical simulations. Experience indicates that it is easier to find the source of a problem when we are dealing with few changes in the model.¹

¹In a model with 76.415 equations and 98.986 variables looking for an error is extremely difficult.

V. RESULTS

The results (shown in Table 4) are mainly estimates of technology, taste and shift variables. These variables are considered to be sources of structural change.

A. Changes in Unobservable Structural Variables

The estimates of changes in unobservable variables are discussed below.

Change in Consumer Preferences

A crucial assumption made to estimate consumer preference or taste and input-saving technical change is uniformity across domestic commodity users. That is, to estimate the technological or taste change α_c , we made the assumption:

$$\alpha_c = \alpha_{cI_s} = \alpha_{cI_s} = \alpha_{cI} \quad (1)$$

where α_c is the uniform taste/input-saving technical change,

α_{cI_s} is the input-saving technical change for commodity c in industry I for current production,

α_{cI_s} is the input-saving technical change for commodity c in industry I for capital creation, and

α_{cI} is taste change for commodity c .

The above assumption means that for all industries, input-saving technical changes for production and capital creation are the same. This technical change is also equal to the household change in taste or preference. This means that when α_{cI} takes a value of say 10, then producer I needs 10 more units of commodity c to produce a unit of output and investor I would need similar units of inputs of c to create a unit of capital. Similarly, a household would have to consume 10 more units of c to satisfy a given utility. With positive α_{cI} , the technical change is input using for production and capital formation. For consumption, it means that households' taste is biased towards that commodity. This assumption was made necessary due to the lack of information on actual change in input utilisation by industries for current production and investment, and the absence of consumption data for 1992.

From the simulation results in Table 4, we can see that among the agricultural commodities, the change in preference for poultry is the highest, with percentage change of 39.42 percent followed by livestock, with percentage change of 33.12 percent. The change in preferences for

the Fish and fishery products decreased by 12.97 percent. It is perhaps that livestock particularly poultry have been substituted for fish. The food staple Palay has its preference improved marginally by 3.66 percent. The taste for Corn declined, indicating a shifting preference from corn towards Palay. The tastes for Banana and Coconut have declined by 46.56 and 35.08 percents, respectively. For other sectors the preference for Electrical machinery is the strongest with the value of taste variable equal to 103.59 percent. The strong household preference for this commodity may have been precipitated by two major reasons 1) rising incomes and 2) the power shortage that triggered big importation of electric generators. In the financial services it is notable that preferences have moved away from Non-banking services towards Banking where taste change grew by 36.63 percent while the former slumped by 44.06 percent. Strong preferences are also noticeable for Publishing and printing services, Basic metal products and Fabricated metal products.

The taste for Tobacco has declined by 21.24 percent*. Similarly consumer taste shifted away from beverages which include alcohols. This is an indication that the Filipino households consumed less of tobacco and alcoholic beverages, and perhaps are becoming health conscious. Another distinguishing consumer behaviour that is notable is the increase in taste for Wearing apparel and footwear in 1992 than in 1985 indicating that perhaps the Filipino households are becoming more fashion conscious.

Labour Productivity

The available employment data allowed us to measure labour productivity in only nine major industry groups. With these data we assume that labour productivities in each of the industries that belongs to a particular major industry are the same. Thus, for agricultural industries, the estimates of labour productivities are the same. Simulation estimates of labour productivities are in Table 4.

The estimate of labour productivity in all of the agricultural industries are 9.68 percent. To produce a unit more of output each of the industries in the agricultural sector needs 9.68 percent more of labour. The lowest productivity is in the mining sector -cows (11.7). Construction workers were also less productive with productivity loss of 11.26 percent. Transportation and communication services needed 15.14 percent more of labour to produce an output. Productivity gains are highest in the financial sector and real estate services with output being produced using 23.55 percent less of labour. Small gains of 0.28 percent have

*What was observed in some Western countries is true also in the Philippines. In Australia Dixon and McDonald (1993) found that the taste for tobacco declined during 1986/87 to 1991/92.

been experienced by other services sectors. The manufacturing sector experienced modest productivity gain of 7.97 percent.

Shifts in Foreign Demand

The traditional export crops like Coconut, Banana, Logs and other forest products, and Wood have negative estimated foreign demand shifts. The rest of the agricultural industries have positive shifts in export demands. The negative shift for Coconut may be due to the presence of substitutes in the international market may have affected the output of the coconut industry.

We estimated large shifts in foreign demand for exports particularly for Poultry, Water transport services, Miscellaneous manufactures, and Publishing and printing services (Table 4). These commodities are not the major export commodities in 1985. Hence a large shift on their demand would not affect their total share in exports much. Moreover, these are commodities where supply elasticities are small. Hence any large increase in their shifters would not be translated into a large increase in supply. We also noted very strong shifts for some export commodities like Textiles, Wearing apparel and footwear, Fabricated metal products, Machineries, Electrical machinery and Transport equipment.

Changes in Import/Domestic Preferences

The changes in import/domestic preferences are captured by the variable twist**. Estimates of twist variables from simulations showed large positive twists and almost 100 percent negative twists. Palay and Corn have largest negative twists of 99.93 and 99.89 percents, respectively (Table 4). This means that for Palay and Corn, the import-domestic ratios are smaller than what they should be on the basis of relative prices or there was a twist against imported Palay and Corn. There are also very strong twist of preference towards imported Livestock, Poultry, Fish and fishery products and Logs and other forest products. With positive value of twist like Electrical machinery which is the second most important import commodity after crude oil, the 50.80 percent value of twist means that the observed import/domestic ratio for Electrical machinery was greater than we would have expected on the basis of relative prices. Interpreted in another way, this means that there is a twist in favour of imported Electrical machinery.

**The twist variable (twist_src) is a source composition twister by commodity. It allows the model to cope with changes in imports which are not explained by import price changes. A theoretical exposition of this variable is in Buettre (1995).

B. Effects of Structural Variables

To assess the effects of *exogenous* and *observable* sources of structural change, we conduct structural simulations. In structural simulations, we reverse the changes used in technical simulations. The exogenous variables which we shocked with known changes in historical simulations become endogenous. The endogenous variables that is technology trade and shifts become exogenous and shocked with their respective estimated values in technical simulations. The results from the simulations are total effects of these shocks introduced simultaneously and identical with the observable variables. An area of interest is to know the individual effects of these structural variables. For example, a policy maker might be interested in knowing the effects of technological change in capital, consumption, power and so on. Following the pioneering work of Doms and McDonald (1991) we can decompose the total effect of the structural variables into their individual effects. In Table 5 we do this by capturing the changes in observable variables, in terms of individual effects of structural variables identified in columns 1 to 9. Column 10 is the total effect of variables 1 to 9, while 1 to 9 are macroeconomic variables listed in rows 1 to 11. For example, looking at row 1, GDP, the effect of total factor productivity is + 14 percent (row 1, column 1). This is interpreted as the change in the gross domestic product resulting from a 1% increase factor productivity. In other words, without labour productivity or wage setting technology change household growth, price change in imports, domestic export preference, shift in export demand, employment and other factors the GDP will increase by 1.14 percent when there is no economy-wide technological progress of 1.10 percent. Similarly, the effect of changes in labour productivity on GDP is at the bottom of row 1 and column 1. The effects of other variables on GDP are in columns 1 to 9 of row 1. The interesting feature of the decomposition is that the sum of the entries in the first column is the total effect in column 10. The addition is to 9 above these contributions to total change in each of the variables identified in the row. We discuss the effects of each of the variables in the columns in the next section.

The manner of the decomposition as is shown in Table 5 is dependent on the particular structural variable which is of interest.¹

C. Sources of Growth

In this section, we discuss the contributions of each of the structural variables (variables in the columns) to the total change (shown in Tables 1 and 3 and in Column 10 of Tables 5 and 6) in the macroeconomy as well as technical variables (variables in the rows). This means that instead of looking at the columns, we will analyse the changes along the rows of Tables 5 to 6. For the purpose of this paper our discussion is limited to the macroeconomic variables and economic outputs.²

Macroeconomic Structural Change

We provide some reasons for the structural changes by looking at the rows of Table 5. Since the entries in column 10 are just the same of the entries in the rows, each amounts for a certain percentage of the total change in column 10. In other words, we explain the change in the variables in column 10 in terms of columns 1 to 9. Starting from row 1, we see that the change in gdp during the period is 27.69 percent (column 10). Looking at the numbers in the GDP row, we see that the highest value is 20.51 percent. It comes from column 8 and interpreted as the contribution of employment or to growth of GDP. It accounts for 73.7 percent of the total change. The favourable shifts in foreign supplies and demands (column 7) appeared to be the next biggest contributor accounting for 29.16 percent.

The strong increase in imports (+40.88%) is mainly explained by the change in domestic export preference, the shift in foreign demand and supply and wage-setting technology change and employment. These four factors accounted for 79 percent of the total change in imports. The large importation effect of domestic export preferences did not affect the balance of trade much. The underlying reason is the nature of export demand by the affected industries and the improved domestic absorption. The gains in this situation as domesticated earlier are the industries with high export contents and are export oriented like electronics. The in and out flow of commodities holds in this case. For this reason, the export domestic preference have also been the major source of growth in exports. Employment growth and wage-setting technology change are the next sources of growth in exports. The main export reducing factors found in this study are the macroeconomic factors (column 9). The main reason for this is the need to divert the commodities from export to domestic market to reflect the increasing domestic absorption and to meet the actual trade balance deficit which is allowed to change as is observed (value only in Column 9). The trade

¹We can also express the change in terms of the variables in the rows. For example, the macroeconomic changes are explained in terms of technical changes. Such type of analysis is found in Baily (1993). Our concern here is to analyse the structural change in the Philippines particularly the agricultural sector. Hence this type of analysis is not discussed in this paper.

²Our results encompass various components of final demands as well as those of the supply side of the economy. However, to simplify our analysis, our focus is on the changes in macroeconomics and sectoral output.

deficit forced the real exchange rate to appreciate to allow exports to decline in a magnitude that will satisfy the actual deficit.

Sectoral Structural Change

In Table 6, the changes in sectoral outputs are presented in Column 10. The changes in structural variables that contribute to the total change in sectoral output are in Columns (1-9). Except for Coconut and Banana, the outputs of the agricultural industry have generally expanded. The decline in coconut output is mainly attributable to the taste/input using technical change while the unfavourable shifts in foreign demand and supply accounted mainly for the decline in banana output. A large proportion of banana is exported so it is sensitive to foreign demand changes. For coconut, only a small proportion of its output are exported in its form. Most of its output goes to the domestic industries as inputs particularly to Food manufacturing which absorbs 90 percent of its intermediate input supply. Input saving technical change unfortunately has exerted an output-reducing effect on food manufacturing. These changes in the two industries are related.

Simulation results show that the most important source of structural change in agriculture is employment and taste/input saving technical change (Table 6). The agricultural sectors which benefitted most from employment are Rice, Corn, Sugarcane, Banana and Other crops. The source of growth for Livestock and Poultry is taste/input saving technical change. Changes in labour productivity, domestic/import preferences and other macroeconomic factors having negative values tend to reduce the output in agricultural industries.

It is worth noting that the expansion in the crops sector is less than the gross national expenditure. This is what is expected for sectors producing commodities with low expenditure elasticities. This reasoning is also true for Food manufactures whose expansion is only 4.10 percent (row 18, Table 6) inspite of the high increase in domestic absorption. Within the agricultural sector, what appeared to break above the domestic absorption growth is the livestock and poultry sectors. Livestock expanded by 61.73 percent while Poultry output increased by 80.16 percent (rows 6 and 7, Table 6). These two industries both benefited greatly from taste/input-saving technical change and growth in employment. In addition their products have higher expenditure elasticities than other agricultural products, and compared with the crops sector these two industries are not constrained by the fixity of land which is utilised in crops.

The sector that experienced the most rapid growth in output is Transport equipment followed by Wearing apparel and footwear and Electrical machinery. Transport equipment output expanded by 109.53 percent during the period 1985 to 1992 (row 36, column 10). This sector

benefited mainly from shifts in domestic/import preferences, taste/input-saving technical change and employment.

The expansion in Wearing apparel and footwear, the second fastest growing industry, is attributable to the shift in export demand which accounted for 47.5 percent of the total change in output. Employment, domestic preferences and taste are the other major sources of growth in the output of this industry.

The production of Electrical machinery is the third fastest growing activity and the shifts in foreign demand and supply dominate the expansion of this sector. The increase in employment has also a large effect on its output but it is only a quarter of the effect of foreign demands and supplies. Input saving technical change appeared to be an output-reducing factor for Electrical machinery. The overall increase in output of Electrical machinery is due to increased utilisation of its own output and being an export-oriented industry.

The worst performers during the period 1985 to 1992 are the mining and forestry sectors. The contraction in output is most severe in Chromium ores whose output declined by 59.71 percent (row 13, Table 6). This is an export oriented industry, having 71 percent of its output going overseas. As such, it is very vulnerable to change in the export demand. Of all the mining sectors, it is Gold which has the lowest decline in output. The main reason is the positive contribution of taste/input-saving technical change (column 3).

Taste/input-saving technical change is also the major factor for the 38.53 percent decline in output of Logs and other forest products. Seventy percent of the output of this sector is consumed as intermediate input and about 27 percent goes to final demand. For this reason, the devaluation in column 3 is not enough to manifest a positive growth. Apparently, the main users of Logs and other forest products are the mining sectors and construction, both of which have contracted in column 3 in response to the depressed domestic absorption.

Generally, all the services sectors performed well between 1985 and 1992. Leading them is the financial services sectors notably Banking and Non-bank services. Banking services has the highest expansion in output of 84.03 percent. This phenomenal growth is attributable to the growth in employment which contributed 32.13 percent, while labour productivity, and input saving technical change have their contributions of 22.63 and 18.90 percent, respectively (row 47, Table 6).

VI. POLICY IMPLICATIONS

We observed that there was a deterioration of labour productivity in the agricultural and mining sectors during the period 1985 to 1992 indicating a surplus of labour or that the employment of labour in the two sectors is not optimal. This further means that the relatively larger expansion in the manufacturing and services sector was not sufficient to draw the surplus labour from agriculture and the mining sectors. On the other side of the coin, it might be that a factor inhibits movement or even attract labour towards these two sectors. For the agricultural sector, one sociological factor that may have prevented the farmers from moving out of agriculture is their attachment to farming as a way of life. One other factor is the lack of necessary skills of the farmers that would allow them to compete outside of agriculture. The Comprehensive Agrarian Reform Program which allowed the small farmers/tenants to own lands is another probable factor that contributes to the stickiness of farm labour in agriculture.

Although technical/taste change benefitted much of the agricultural industries, there is a deterioration in the case of banana, corn and coconut. Does this mean that these three sectors are neglected in terms of research and development? Since banana and coconut are major export crops, would increased research expenditure help the economy? Or would a policy on export promotion be more effective? As for banana, a policy that will increase export demand will likely improve output as indicated by the large negative effect of export demand shift.

Our study reveals that in most of the sectors, there is a strong twist in favour of imported products, except for Poultry and Corn in the agricultural sector. Is this entirely due to changes in preference or has the Philippines allowed the flood gates open for imported products through import liberalisation? The strong preferences for imported products will have implications for the balance of trade.

VII. CONCLUDING COMMENTS

In this paper, we estimated, using a detailed CGE model, the values of unobservable variables like changes in technology, consumer preferences, import domestic preferences and shifts in export demands in the Philippines. We used the estimates of these variables and other observable structural variables to explain the macroeconomic as well as sectoral structural changes. This enabled us to quantify the contributions of structural variables or the sources of growth in sectoral outputs and the economy.

Our estimates of unobservable structural variables show that there is a deterioration in labour productivities in agriculture, mining and other services sectors. Expansion in productivities are estimated for manufacturing and most services sectors. Most of the technical/taste change in agriculture is favourable with high gains for Livestock and Poultry. Simulation results show that the most important source of structural change in agriculture is employment and taste/input saving technical change. Labour productivity, changes in domestic/import preferences and other macroeconomic factors tend to reduce the outputs in the agricultural sector. For export crops particularly coconut and banana, the shifts in export demands have large influence on their outputs.

Outputs in Philippine agriculture can be improved by giving attention to factors contributing negative effects to outputs. From our results, this is in terms of improving labour productivity, macroeconomic factors (policies on prices and exchange rate) and shifting preferences towards domestically produced goods.

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TABLE I
Sectoral Shares on Gross Domestic Product, 1980 to 1992

Sector	Year		
	1980	1985	1992
AGRIC., FISHERY and FORESTRY	23.50	24.58	22.51
INDUSTRIAL SECTOR	40.52	35.07	34.94
Mining	1.50	2.08	1.62
Manufacturing	27.60	25.15	25.35
Construction	9.39	5.08	5.10
Electricity, gas and water	2.03	2.76	2.87
SERVICES SECTOR	35.98	40.35	42.56
Transportation, Communication and Storage	4.78	5.54	5.91
Trade	13.01	14.48	14.70
Finance	3.94	2.99	4.11
Ownership of dwellings and real estate	5.19	5.62	5.71
Private services	4.90	6.84	6.97
Government services	4.16	4.88	5.15
GROSS DOMESTIC PRODUCT	100	100	100

Source: Computed from 1993 Philippine Statistical Yearbook

TABLE 2

Macroeconomic Data for Historical Simulations*

Variable	1985	1992	Change %
Personal Consumption Expenditure	416,961	561,319	34.62
Government Consumption	40,490	54,968	35.76
Capital Formation	93,290	139,930	37.43
Exports	136,010	237,218	74.41
Imports	124,206	298,485	140.31
Gross Domestic Product	563,545	714,950	27.09
Gross National Expenditure	550,741	776,217	40.94
Employment (1000 persons)	19,801	23,917	20.79
Population (1000 persons)	54,668	64,258	17.54
CPI			81.40
Import Price Index			51.08
Export Price Index			61.80
GDP price deflator			88.40

Source: 1993 Philippine Statistical Yearbook for 1992

Expenditures are in Million Pesos, constant 1985 prices

Formula for % change: $(1992 - 1985) / 1985 \times 100$ TABLE 3
Sectoral Data (%), 1985-199

Sector	Domestic	Exports	Imports	Employ- ment ^a	Price of Exports
	Output				
1 Palay	8.26	0.00	-99.88	12.07	
2 Corn	8.11	0.00	-99.78	12.07	
3 Coconut/copra in farms	-39.33	31.60	0.00	12.07	
4 Sugarcane	13.56		0.00	12.07	
5 Banana	-21.21	8.05	0.00	12.07	
6 Other crops incl. agric. services	23.73	34.44	162.18	12.07	
7 Livestock	56.75	-100.00	657.61	12.07	
8 Poultry	106.20	0.00	50.00	12.07	
9 Fish & fishery products	19.51	123.06	600.00	12.07	
10 Logs & other forest products	-46.91	-38.21	10.00	12.07	
11 Copper	-27.92	12.39	x	11.72	
12 Gold & other precious metals	-17.33	63.32	x	11.72	
13 Chromium ores	-59.71	44.28	0.00	11.72	
14 Nickel	-43.06	16.00	x	11.72	
15 Other metallics	-47.04	30.04	0.00	11.72	
16 Sand, stone & gravel	83.69	0.00	0.00	11.72	
17 Other non-metallic minerals	35.01	104.77	99.69	11.72	
18 Food manufactures	3.65	35.57	143.87	32.47	47.23
19 Beverage products	13.04	35.57	152.65	32.47	
20 Tobacco manufactures	-3.38	11.67	90.11	32.47	
21 Textiles & textile goods	1.41	138.38	345.47	32.47	42.77
22 Wearing apparel & footwear	81.73	138.38	118.46	32.47	57.12
23 Wood, cork & cane products	13.79	-39.19	82.13	32.47	
24 Furntrs & fxtrs, primarily of wood	29.99	116.41	82.13	32.47	
25 Paper & paper products	59.05	200.00	82.13	32.47	
26 Publishing & printing services	79.25	128.00	41.57	32.47	
27 Leather & leather products	0.52	58.38	150.00	32.47	

* Employment for industries are also available from the Statistical Yearbook. These are, however, on nine aggregate industries. We used a mapping between the nine aggregate industries and the 27 industries in the model. Then we assumed that the changes in productivity for sectors within each of the 9 aggregate industries are the same. This enabled us to estimate the change in employment in each of the 27 industries in the model. This assumption was made due to the lack of industry-specific employment data.

TABLE 3 cont'...

28 Rubber products	36.24	0.00	155.75	32.47
29 Chem. & chem. prod. except petrol & coal	15.09	38.05	83.64	32.47
30 Products of petroleum & coal	78.38	490.00	-62.78	32.47
31 Non-metallic mineral products	68.06	140.50	589.91	32.47
32 Basic metal products	-1.25	-46.27	418.73	32.47
33 Fabricated metal products	34.94	39.47	149.32	32.47
34 Machinery except electrical	50.48	207.82	299.55	32.47
35 Electrical machinery	109.43	196.79	396.79	32.47
36 Transport equipment	117.24	207.82	600.00	32.47
37 Miscellaneous manufactures	55.56	146.31	140.04	32.47
38 Construction	20.28	74.41	41.57	51.32
39 Electricity & gas	28.65	0.00	0.00	26.03
40 Water services	19.59	0.00	0.00	26.03
41 Land transport	23.82	74.41	41.57	31.15
42 Water transport services	30.14	74.41	41.57	31.15
43 Air transport services	33.85	74.41	41.57	31.15
44 Storage & services incidental to transport	10.91	74.41	41.57	31.15
45 Communication	67.33	74.41	41.57	31.15
46 Trade	46.41	74.41	0.00	25.74
47 Banking services	82.24	74.41	41.57	32.16
48 Non-banks services	50.13	74.41	0.00	32.16
49 Insurance services	36.80	74.41	41.57	32.16
50 Real estate services	66.46	74.41	41.57	32.16
51 Ownership of dwelling	22.68	0.00	0.00	24.82
52 Government services	29.87	0.00	0.00	24.82
53 Private education services	20.38	74.41	41.57	24.82
54 Private health services	36.99	74.41	41.57	24.82
55 Private business services	20.34	74.41	41.57	24.82
56 Recreational services	43.13	74.41	41.57	24.82
57 Private personal services	28.38	74.41	41.57	24.82
58 Restaurants & hotels	24.45	74.41	41.57	24.82
59 Other private services	14.53	74.41	41.57	24.82

Sources: Compiled from Philippine Statistical Yearbook, UN International Trade Statistics and FAO Trade Yearbook.

TABLE 4

Estimates of Unobservable Variables

Sector	Labour Productivity Change	Technical and Taste Shift	Foreign Demand	Import Domestic Twist
Palay	-9.68	3.66	13.23	-99.97
Corn	-9.68	-11.81	85.27	-99.89
Coconut/copra in farms	-9.68	-35.08	-96.66	x
Sugarcane	-9.68	7.87	x	x
Banana	-9.68	-46.56	-40.14	x
Other crops incl agrie services	-9.68	12.89	211.98	-410.08
Livestock	-9.68	33.12	81.75	199.44
Poultry	-9.68	39.42	706.43	206.11
Fish & fishery products	-9.68	-12.92	510.47	-498.65
Logs & other forest products	-9.68	-49.51	-99.28	423.04
Copper	-63.45	40.44	112.24	x
Gold & other precious metals	-63.45	-58.96	225.37	x
Chromium ores	-63.45	-81.69	171.75	532.33
Nickel	-63.45	-76.39	-14.70	x
Other metallics	-63.45	-30.49	13.33	523.26
Sand, stone & gravel	-63.45	20.37	400.87	-23.37
Other non-metallic minerals	-63.45	-43.30	190.00	-80.59
Food manufactures	7.97	-17.74	39.32	151.69
Beverage products	7.97	-10.23	48.47	124.55
Tobacco manufactures	7.97	-21.24	27.35	76.93
Textiles & textile goods	7.97	11.69	148.91	406.66
Wearing apparel & footwear	7.97	12.03	242.51	163.52
Wood, cork & cane products	7.97	3.35	-98.89	758.49
Furniture & fixtrs. primarily of wood	7.97	-31.34	11.39	113.53
Paper & paper products	7.97	20.43	551.57	91.38
Publishing & printing services	7.97	39.49	634.22	166.74
Leather & leather products	7.97	8.54	-60.06	67.34
Rubber products	7.97	6.97	357.68	64.94
Chem. & chem. prod. except petrol & coal	7.97	12.20	113.32	193.68
Products of petroleum & coal	7.97	62.09	185.17	203.10

TABLE 4 cont'...

Non-metallic mineral products	7.97	24.93	533.12	-20.07
Basic metal products	7.97	34.76	98.46	245.96
Fabricated metal products	7.97	42.57	450.78	183.90
Machinery except electrical	7.97	15.67	560.54	27.90
Electrical machinery	7.97	103.54	597.12	50.80
Transport equipment	7.97	37.61	405.63	42.07
Miscellaneous manufactures	7.97	-13.91	610.06	900.22
Construction	32.26	-32.26	340.01	56.30
Electricity & gas	15.22	-10.64	x	x
Water services	15.22	-13.50	x	x
Land transport	15.74	-9.70	81.74	417.63
Water transport services	15.74	-41.76	89.30	404.72
Air transport services	15.74	-20.51	84.73	442.55
Storage & services incidental to transport	15.74	-29.99	89.30	624.72
Communication	15.74	6.96	80.25	238.27
Trade	22.04	1.48	80.25	x
Banking services	23.55	36.63	81.74	15.47
Non-banks services	23.55	44.06	81.74	x
Insurance services	23.55	7.84	80.25	373.33
Real estate services	23.55	13.03	81.74	347.58
Ownership of dwelling	x	9.50	x	x
Government services	0.28	-26.97	22.73	x
Private education services	0.28	-19.04	191.22	399.41
Private health services	0.28	-3.59	184.30	337.11
Private business services	23.55	5.44	115.55	342.43
Recreational services	0.28	6.78	81.74	161.09
Private personal services	0.28	4.52	81.74	453.38
Restaurants & hotels	0.28	-18.30	81.74	152.69
Other private services	0.28	-9.63	117.57	474.91

x Not applicable due to zero values in employment, import or export.

Table 5
Decomposition of Changes in Macroeconomic Variables, 1985 to 1992 (%)

Variable & Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1 Gdp	6.34	3.66	-0.96	1.54	-0.68	1.83	7.90	20.51	1.89	27.09												
2 Gni	6.11	3.76	1.06	1.49	1.69	1.83	15.59	19.72	6.38	40.94												
3 Consumption	6.11	3.76	1.06	1.49	1.69	1.83	15.59	19.72	4.73	34.62												
4 Investment	6.11	3.76	1.06	1.49	1.69	1.83	15.59	19.72	36.67	71.43												
5 Government	6.11	3.76	1.06	1.49	1.69	1.83	15.59	19.72	4.89	35.76												
6 Exports	7.93	2.91	21.05	0.23	3.61	50.88	-4.50	27.07	-26.89	74.41												
7 Imports	7.41	2.18	25.16	-0.10	-1.21	51.48	54.78	25.34	0.21	140.88												
8 Balance of Trade (% of Gdp)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.07												
9 Employment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.33	0.00	20.33										
10 Capital Stocks	4.50	6.03	2.77	2.97	1.06	3.49	14.43	20.42	5.37	29.23												
11 Aggregate Price of Capital	0.35	5.11	-0.94	-1.57	0.04	1.66	-2.56	10.35	6.20	65.04												
12 Real Wage	6.54	5.35	7.95	1.38	3.26	0.08	37.92	-4.30	-0.52	20.35												
13 Investment Price Index	0.34	5.05	-3.49	-1.65	0.04	1.39	3.81	0.31	6.29	50.62												
14 Consumers Price Index	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.40	0.00	61.40										
15 Import Price Index	1.28	-0.52	6.36	-1.86	5.97	8.93	-39.36	5.32	65.02	51.21												
16 Export Price Index	0.07	-0.30	4.94	2.96	0.22	1.93	-16.16	-1.26	74.20	64.14												
17 Terms of Trade	1.21	0.22	-1.52	-0.20	-5.75	6.96	23.20	-3.04	9.16	12.93												
18 Real Devaluation	1.36	-1.05	7.84	-1.54	7.95	11.45	-40.44	0.78	12.78	20.29												
19 Nominal Exchange Rate	1.28	-0.52	6.48	-1.85	5.75	8.94	-39.31	5.32	65.24	50.44												
20 Total Factor Productivity	3.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
21 Import/Domestic Price	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
22 Total/Import Saving/Technical Change	0.00	0.00	2.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

TABLE 6
Decomposition of Changes in Industry Outputs, 1985 to 1992 (%)
 Changes attributable to

Variable Description	1	2	3	4	5	6	7	8	9	10
	Factor Productivity	Labour Productivity	Taste/ Input Saving	Household Growth	Import Price	Change in Domestic Import Preferences	Shifts in Export Demands and Supplies	Employment	Other Macro Economic Factors	Total
1 Palay	-4.91	3.62	-4.36	2.35	-0.61	3.72	1.82	16.65	-5.06	8.26
2 Corn	4.95	-3.63	-13.02	2.50	0.31	8.79	-3.10	16.98	5.67	8.11
3 Coconut/copra in farms	3.06	6.42	18.64	0.76	-0.22	3.43	-4.47	9.41	-9.37	29.33
4 Sugarcane	4.91	-3.49	0.09	2.53	-0.61	3.61	1.95	16.63	-4.85	13.56
5 Banana	4.30	-6.78	2.81	1.75	1.46	7.05	-34.61	17.49	14.69	21.21
6 Other crops incl agric services	4.30	-3.58	13.70	5.95	0.25	8.35	-2.76	15.65	1.70	23.44
7 Livestock	5.07	-3.18	40.82	2.99	-0.78	3.24	-4.08	17.33	-1.35	61.73
8 Poultry	4.83	-2.23	51.25	3.75	-1.03	3.12	6.69	16.91	3.11	80.16
9 Fish & fishery products	4.74	-3.40	5.59	4.17	-0.65	2.04	5.38	16.65	-3.83	19.51
10 Logs & other forest products	3.56	8.98	21.57	0.43	0.57	2.05	-15.24	10.69	-4.79	38.53
11 Copper	8.36	-16.65	12.66	1.87	-0.73	1.75	-20.99	23.91	13.63	28.77
12 Gold & other precious metals	7.47	20.38	2.53	1.21	0.20	0.81	-18.49	24.16	14.04	16.53
13 Chromium ores	7.69	31.30	-16.96	0.89	0.92	3.85	-34.20	27.94	-18.55	59.71
14 Nickel	9.26	14.10	17.90	3.15	-1.13	0.33	-28.53	20.96	-15.09	-43.06
15 Other metallics	6.30	-6.40	-14.78	1.32	-0.38	-41.56	-3.34	20.32	-5.87	-47.04
16 Sand, stone & gravel	7.66	-10.22	4.63	1.75	-0.71	2.51	17.79	24.54	18.96	57.66
17 Other non-metallic minerals	8.06	-10.84	19.60	0.52	1.14	51.87	-12.98	24.62	-7.87	34.93
18 Food manufactures	4.84	-3.64	8.08	2.29	-0.61	3.75	1.78	16.38	-5.09	4.10
19 Beverage products	3.18	-2.59	11.41	3.85	-2.03	3.67	10.03	12.81	3.60	13.78
20 Tobacco manufactures	3.79	-4.11	-28.31	3.56	-1.80	-1.84	10.24	12.97	1.93	-2.56
21 Textiles & textile goods	7.03	1.03	5.25	-0.54	-0.33	-16.35	-4.48	27.17	13.64	3.08
22 Wearing apparel & footwear	6.21	3.29	7.15	0.63	-0.24	11.10	47.16	31.96	-6.92	99.09
23 Wood, cork & cane products	4.17	8.55	37.95	0.91	-0.17	1.40	21.75	12.96	0.19	27.10
24 Furnirs & fixts, primarily of wood	6.31	-0.74	10.34	0.92	0.71	10.82	-14.48	22.43	-7.80	26.51
25 Paper & paper products	8.88	3.48	31.30	0.69	-1.02	5.92	9.62	27.36	-7.25	60.17
26 Publishing & printing services	7.09	1.71	50.38	-1.18	-0.64	-7.20	7.53	25.01	2.54	76.73

TABLE 6 cont'...

27 Leather & leather products	7.15	-2.46	11.91	-1.50	-1.13	-11.88	-12.92	25.81	-8.85	6.14
28 Rubber products	7.78	-3.64	9.87	-1.15	1.08	5.83	6.67	26.94	-3.68	35.88
29 Chem/chem prod except petrol/coal	7.05	-4.53	18.92	-2.36	-1.07	23.60	2.09	23.84	-5.01	15.32
30 Products of petroleum & coal	6.74	-4.16	66.79	0.59	-0.71	13.07	3.93	22.62	-4.35	78.38
31 Non-metallic mineral products	8.51	-4.53	-2.37	1.55	-1.06	-0.79	24.76	26.49	17.47	70.04
32 Basic metal products	7.87	-9.54	28.11	1.98	-0.89	3.37	35.27	20.86	-11.62	-1.85
33 Fabricated metal products	6.73	-3.92	12.08	0.54	-0.11	-16.18	2.60	22.44	9.86	34.04
34 Machinery except electrical	8.79	-0.96	-1.98	0.22	3.75	6.68	6.92	33.60	2.38	59.40
35 Electrical machinery	3.87	0.01	-47.10	-0.19	-1.80	3.72	123.91	15.07	-7.61	89.89
36 Transport equipment	8.61	-0.58	32.63	1.20	2.51	34.91	0.46	30.60	-0.82	109.53
37 Miscellaneous manufactures	8.27	-1.07	19.99	-0.34	0.40	4.07	1.33	34.74	-10.59	56.80
38 Construction	5.52	-6.46	-31.33	1.64	-1.49	1.47	12.87	17.29	23.34	19.90
39 Electricity & gas	6.92	-1.68	-4.22	-0.59	-0.84	-0.17	6.97	24.67	-2.40	28.65
40 Water services	5.74	-1.73	-12.40	-0.10	-1.82	2.68	13.10	19.59	1.08	20.80
41 Land transport	6.44	-3.75	-5.46	0.49	-0.88	-7.90	16.03	22.18	3.30	23.86
42 Water transport services	9.24	-6.91	-8.70	0.55	0.25	8.98	-3.23	30.88	-10.75	20.31
43 Air transport services	10.09	-2.61	-14.19	3.39	-0.66	1.00	11.41	28.79	-11.15	26.07
44 Stor & serv incidental to transport	7.35	-9.71	3.45	0.35	2.04	5.51	-14.57	30.05	-13.61	10.85
45 Communication	8.70	-5.95	5.74	1.56	-0.48	-2.37	20.19	23.41	-7.50	43.31
46 Trade	7.79	-2.35	5.09	-0.52	-0.82	-0.07	14.78	25.72	-2.04	47.59
47 Bunking services	5.79	22.63	18.90	-0.67	1.92	13.58	-1.02	32.13	9.22	84.03
48 Non-banks services	9.58	4.51	5.59	1.03	0.76	7.96	2.11	30.94	-7.27	55.21
49 Insurance services	6.86	-4.22	11.72	-2.00	-1.55	-10.51	14.42	23.47	-1.94	36.26
50 Real estate services	8.51	-0.46	14.88	-0.31	-0.53	-1.56	21.73	25.89	-5.06	63.08
51 Ownership of dwelling	12.09	-9.37	-1.31	10.05	-0.15	-4.49	10.11	17.63	-11.88	22.68
52 Government services	5.87	-3.67	-1.32	1.39	-1.62	-1.67	14.66	19.12	1.29	34.05
53 Private education services	7.97	-6.60	-24.49	-3.69	-4.19	-5.54	34.38	21.12	2.21	21.16
54 Private health services	6.87	-4.08	-3.56	-3.82	-3.07	-4.18	24.37	23.07	3.14	38.72
55 Private business services	6.82	7.58	11.05	-0.03	0.70	-2.19	-10.81	25.90	-11.77	27.24
56 Recreational services	8.54	-3.38	14.47	0.37	0.76	0.87	2.71	28.44	-8.65	44.13
57 Private personal services	6.25	-4.85	4.69	-1.92	-1.53	-10.64	14.39	21.72	-2.04	26.07
58 Restaurants & hotels	8.05	-4.16	28.01	-1.81	3.15	4.94	-24.75	30.89	-17.92	26.40
59 Other private services	4.72	-4.92	-16.17	-2.36	-1.17	2.66	3.96	16.48	11.20	14.41

APPENDIX 1

Relevant Equations for the Assessment of Structural Change*

1. Source Specific Intermediate Input Demand

$$x_{I_{ct}} - a_{I_{ct}} = x_{I_{ct,i}} - \sigma_1 COM_c (p_{I_{ct}} + a_{I_{ct}} - p_{I_{ct,i}}) \\ - (SRCDOM_i - SIDOM_i) \times twist_src, \\ c \in COM, s \in SRC, i \in IND \quad (1)$$

2. Demand for Investment Goods Equations

$$x_{2_{ct}} - a_{2_{ct}} = x_{2_{ct,i}} - \sigma_2 COM_c (p_{2_{ct}} + a_{2_{ct}} - p_{2_{ct,i}}) \\ - (SRCDOM_i - S2DOM_i) \times twist_src, \\ c \in COM, s \in SRC, i \in IND \quad (2)$$

3. Equations for Household Demands

$$x_{3_{ct}} = a_{3_{ct}} + x_{3_{ct,i}} - \sigma_3 COM_c (p_{3_{ct}} + a_{3_{ct}} - p_{3_{ct,i}}) \\ - (SRCDOM_i - S3DOM_i) \times twist_src, \\ c \in COM, s \in SRC \quad (3)$$

4. Zero Pure Profits in Production

$$p_{l tot} - a_{l tot} = \frac{1}{VITOT} \left\{ \sum_{c \in COM} VIPUR_{c,i} (p_{l_{ct,i}} + a_{l_{ct,i}}) \right. \\ \left. + VIPRIM_c \times (p_{l prim} + a_{l prim}) + alprimgen \right\} \\ + VIOCT_c \times (p_{l oct} + a_{l oct}) \quad i \in IND \quad (4)$$

5. Equations Allowing Use of Historical Data on Employment

$$\sum_{c \in COM} VILAB_{c,i} (employ9_i - p_{llab9_i}) = 0 \quad i \in LAB9 \quad (5)$$

$$\sum_{c \in COM} VILAB_{c,i} (p_{llab9_i} - p_{llab_i}) = 0 \quad i \in LAB9 \quad (6)$$

$$a_{llab_{1,i}} - \sum_{i \in LAB9 \text{ group}} a_{llab9_i} = f_{llab9_i} \quad i \in IND \quad (7)$$

6. Equations for Measuring Import/Domestic Preferences

$$twist_src = twist_src_bar + f_twist_src, \quad (8)$$

7. Equations for Measuring Export Demand Shifts

$$x_{4c} = f4q_c + EXP_ELAST [p4_c - phi - f4p_c] \\ c \in TRADEXP \quad (9)$$

8. Technological and Taste Change Equations

$$al_{ct} = ac_c + fal_{ct} \quad (10)$$

$$a2_{ct} = ac_c + fa2_{ct} \quad (11)$$

$$ffx3_{ct} = ac_c + ffx3_{ct} \quad (12)$$

where:

A. Variables

Variable	Set/Dimension	Description
ac_c	COM	uniform taste/tech shifter
$al_{ct,i}$	$COM \times IND$	input-augmenting technical change for commodity c in industry i for current production
$a2_{ct,i}$	$COM \times IND$	input-augmenting technical change for commodity c , from source s for current production in industry i
$alprimgen$	$SRC \times IND$	All-industry all-factor augmenting technical change
$a2_{ct,i}$	$COM \times IND$	input augmenting technical change for composite commodity c used by industry i for capital formation
$a2_{ct,s}$	$COM \times SRC \times IND$	input-augmenting technical change for commodity c from source s for capital formation in industry i
$a3_{ct,i}$	$COM \times SRC \times IND$	taste change variable for commodity c from source s in industry i
$allab_{ct,i}$	IND	labour augmenting technical change in industry i
$allab9_i$	$LAB9$	labour productivity shift, 9-wide group
$a_{l oct,i}$	IND	other "cost ticket" augmenting technical change in industry i
$alprim_i$	IND	all factor augmenting technical change industry i for current production
$al_{tot,i}$	IND	all input augmenting technical change in industry i for current production
$employ9_i$	$LAB9$	employment in 9-wide group
$fal_{ct,i}$	$COM \times SRC \times IND$	intermediate shift
$fa2_{ct,i}$	$COM \times SRC \times IND$	investment shift
$ffx3_{ct,i}$	COM	taste shift variables
$ftwist_src$	COM	twist shifter by commodity
$fx3_{ct,i}$	COM	consumption structure variables
$f4p_c$	COM	price (upward) shifter in export demand for commodity c
$f4q_c$	COM	quantity (right) shifter for export demand for commodity c
$pI_{ct,i}$	$COM \times IND$	price of commodity composite c used by industry i for current production
p_{llab9_i}	IND	price of labour composite in industry i for current production
p_{llab9_i}	$LAB9$	nominal wages in 9-wide groups

* There are 76,415 equations and 98,986 variables in the model. In this appendix, we included only the relevant equations for measuring unobservable structural variables. These equations are linked with other equations in the model. For further details, see Buettner (1995).

Measurement of unobservable structural variables involves changing the closure (the endogenous exogenous split of the variables in the equation system). For example, in estimating the changes in import/domestic preferences in tunctional simulation, we endogenise the variable $twist_src$ and exogenise the known volume of imports.

Variables cont' ...		
<i>p_{tot}</i>	<i>IND</i>	average input/output price received/paid by industry i
<i>p_{clock}</i>	<i>IND</i>	price of 'other cost' tickets in industry i for current production
<i>p_{prim}</i>	<i>IND</i>	effective price of primary factor composite in industry i for current production
<i>p_i</i>	<i>COM</i> × <i>SRC</i> × <i>IND</i>	purchaser's price of commodity c from source s for current production in industry i
<i>p_{2..}</i>	<i>COM</i> × <i>IND</i>	price of commodity composite c used by industry i for capital formation
<i>p_{2..}</i>	<i>COM</i> × <i>IND</i>	purchaser's price of commodity c from source s for capital creation in industry i
<i>p_{3..}</i>	<i>COM</i>	price of commodity composite c for household consumption
<i>p_{3..}</i>	<i>COM</i> × <i>SRC</i>	purchaser's price of commodity c from source s for household consumption
<i>p_{4..}</i>	<i>COM</i>	export price of commodity c in Pesos
<i>p_{fu}</i>	i	Exchange Rate
<i>twist_src</i>	<i>COM</i>	source composition twister by commodity
<i>twist_src_bar</i>	i	Common twist
<i>x_{lab..}</i>	<i>IND</i>	demand for composite labour by industry i for current production
<i>x_{2..}</i>	<i>COM</i> × <i>IND</i>	demand for commodity composite c by industry i for capital formation
<i>x_{2..}</i>	<i>COM</i> × <i>SRC</i> × <i>IND</i>	demand for commodity c, from source s, by industry i for capital formation
<i>x_{3..}</i>	<i>COM</i>	demand for commodity composite c for household consumption
<i>x_{3..}</i>	<i>COM</i> × <i>SRC</i>	demand for commodity c from source s by households
<i>x_{4..}</i>	<i>COM</i>	demand for exports for commodity c

B. Coefficients

Coefficient/ Parameter	Description
<i>SRCDOM_c</i> , <i>SIDOM_c</i>	dummy coefficient, equal to 0 if c is imported, 1 otherwise share of domestic commodity c over the total purchases of commodities from two sources being used by industry i for current production
σ_{1COM}	Elasticity of substitution between commodities from domestic and foreign sources for current production in all industries. This is known as Armington elasticity
σ_{2COM}	Armington elasticities for capital formation
σ_{3COM}	Armington elasticities for household demand
<i>S2DOM_c</i>	share of domestic commodity c over the total purchases of commodities from two sources being used by industry i for capital creation
<i>EXP_ELAST_c</i>	Export demand elasticity for traditional export commodity c
<i>VITOT</i>	sum of payments by industry i for purchases of intermediate inputs, primary inputs and other cost tickets
<i>VIPRIM</i>	purchases of primary inputs by industry i
<i>VIPUR</i>	purchases of intermediate input c by industry i
<i>VIOCT_c</i>	payments for other cost tickets by industry i
<i>VILAB</i>	payments for labour by industry i

C. Definitions

Sets

COM is a set composed of 59 commodities
IND is a set of 59 industries
SRC is a set denoting imported and domestic sources of commodities
LAB9 9-wide employment/industry group

Subscript

c denotes the set *COM*
s denotes the set *SRC*
i denotes *IND*
underscores preceding a subscript mean that the variable is summed over that set