A GENERAL EQUILIBRIUM MODEL OF THE MALAYSIAN REDISTRIBUTIVE POLICIES

Ragayah Haji Mat Zin

INTRODUCTION

In order to foster national unity, the Malaysian government realized that the country needs more than just a high rate of economic growth. Faced with the problems of poverty and an uneven distribution of income and wealth, the government enunciated the two-pronged New Economic Policy (NEP) in 1971. The urgency of the poverty problem arises because its incidence is disproportionately high among the Malays, while that of inequality is also due to its close correspondence with the various ethnic groups in the country. The first prong of the NEP aims at eradicating poverty by raising income levels and increasing employment opportunities among all Malaysians, irrespective of race. The second prong aspires to restructure Malaysian society to correct economic imbalance in order to reduce and eventually eliminate the identification of race with economic function and geographical location. It was targeted that the 1970 poverty level is to be reduced by about two thirds, from 49 percent to 17 percent in 1990. By the same date, the shares of the Malays and other indigenous people, collectively known as Bumiputeras, in the ownership of the corporate sector is to be increased from 2.4 percent in 1970 to at least 30 percent. In addition, the pattern of employment is supposed to reflect the racial composition of the population. The attainment of this target implies that, between 1976 and 1990, about 66 percent of total new employment in industry and 54 percent in services, will have to go to the Bumiputeras.

The more straightforward and traditional mechanism of redistribution and poverty mitigation is through taxes and public expenditures, as well as through intervening in the market directly. However, the Malaysian Government has also embarked upon a policy of direct intervention in property ownership through redistributing the ownership of industrial stock and shifting the racial pattern of employment. This restructuring goal is to be realized while concurrently permitting the ownership of equity capital by all groups in the economy to grow.

All the above-mentioned policies are incorporated into our model and their effects on the three objectives of capital ownership, income distribution, and employment pattern will be estimated.
However, the focus of this study is really on the restructuring of the ownership of share capital among the Bumiputeras and non-Bumiputeras. It is, indeed, the evaluation of this redistribution policy that will get special attention in this study.

As such, our study of Malaysia's fiscal incidence differs from the partial equilibrium incidence studies that have been undertaken for Malaysia in three important respects. Firstly, tax and expenditure incidences are modeled rather than just simply calculated. Secondly, they are studied in a general equilibrium context, whereas all existing studies of actual fiscal incidence are partial. Finally, the general equilibrium model in which tax disincentives to factor supplies, as well as the income effects of taxes, play their due role (supply-side economics) yields the desired effective incidence rather than the mostly misleading impact incidence.

The problem to be examined in this study is important because while governments may actively pursue various forms of policy intervention, their ultimate effects are determined by the responses of economic agents, households and enterprises, in the private sector. Rational behavior would tend to lead them to avoid the burden of any policy prescription by shifting it to someone else. It is therefore necessary to look beyond the statutory liabilities in order to determine who will finally lose or gain from a government policy. Numerous studies of fiscal incidence have been carried out. Studies have used two basic approaches: the partial equilibrium approach and the general equilibrium approach. However, dissatisfaction has arisen with the partial equilibrium treatment of the incidence question. This is reflected in the conclusions de Wulf draws from his survey:

The present state of incidence theory is such that no clear conclusions can be reached with respect to overall budget incidence. The estimates provided in the studies reviewed are arrived at by adopting simplifying procedures and methodologies that by their nature yield very approximate results. Their use as a basis for policy formulation is thus rather dubious, regardless of the qualifications of the individual researcher (1975, 102).

A comparison of the partial equilibrium and the general equilibrium approach is given by Devarajan, Fullerton and Musgrave (1978).

One of the reservations about the partial equilibrium approach is the assumption that the existing income distribution remains unchanged under an alternative tax/expenditure system. This assumption is invalid because no tax is really neutral and that each tax/expenditure system affects resource allocation in a number of ways. For example, if the direct effects of a government expenditure program favor the poor, it is not necessarily true that the postpro-
Program income distribution will be less unequal than the preprogram distribution due to the distributional effects of other economic changes induced by the program. Some of those who have engaged in the partial equilibrium estimation do recognize that these other economic changes will take place, but they argue that these changes are sufficiently complex to permit the assumption that the effects will cancel each other out, leaving the net distributional effects of the policy to be dominated by the direct impacts.

On the other hand, it could be argued that the indirect effects will enhance the equalizing impact of direct redistribution. If the direct benefits from the public expenditure favor the poorer, less developed sectors and redirect purchasing power from the richer sectors, then the resulting reallocation of labor demands from the latter to the former would be likely to yield net benefits for lower-skill, low-income workers. A similar consequence would emerge if the consumption by program beneficiaries is intensive in the goods produced by lower income groups while consumption of cost-bearers of the expenditure is intensive in the goods produced by high-skilled workers. In such a case, the total equalizing effect—direct and indirect—will be greater than the distributive impact considered in the partial equilibrium analysis alone. In the events that the indirect effects stimulated high-income sectors and depressed low-wage sector, the end result might still favor the low income group, though with a smaller magnitude than the direct impact. Or, it may be possible, though most unlikely, that the indirect effect of favoring the rich would swamp the direct effects of favoring the poor. Here, the net distributional impact of the policy is to increase inequality, contrary to what the partial equilibrium analysis indicate. As such, a reliable evaluation of any fiscal action must take into account both the direct and indirect redistributio nal effects. Consideration of only the direct effects may results in consequences that are contrary to the objectives of the government in the first place.

Furthermore, as pointed out by de Wulf, estimating net fiscal incidence is not a very useful exercise. Incidence analysis needs to render help to policy-makers in formulating ways to narrow the gap between the present and desired distribution of income. For this purpose, we shift emphasis away from general studies of budget incidence to studies that trace the distributional implications of specific policy measures. Since public policy decisions are generally marginal, pertaining to relatively small tax or expenditure changes, incidence analysis can make a valuable contribution to the income distributional implications of these measures individually rather than aggregating the results obtained from static partial analysis to give the total budget incidence.
In order to incorporate the indirect effects and tracing the distributional effects of a policy implementation, a general equilibrium approach has been developed. A sequence of responses relating the behavior of individuals or industries to changes in disposable incomes or levels of demand of goods and services can be traced following the policy change. The first sequence is the direct effects, the impact on the distribution of disposable personal income. Next, households will react to changes in disposable income, adjusting their expenditure accordingly. This will be followed by the response of producers to the changes in the levels and patterns of household demands. Estimates of the changes in output, by industry and by region, required to satisfy the changes in household demands are generated at this level. Further changes in output will induce changes in factor demands, which will affect the levels of employment of these inputs. These changes lead to changes in the market prices which might require further adjustments in consumer demands and factor supplies, and so on until a new general equilibrium is attained. In short, the direct change in money income leads to indirect effects, via changes in factor prices and employment, and via changes in purchasing power resulting from changes in commodity prices.

THE BASIC MODEL

The central focus of the present study is to investigate the probable effectiveness of the Malaysian Government’s redistributive policies, including tax-expenditure policies, and particularly the policy of redistributing capital ownership and restructuring employment among Bumiputeras, as well as the eradication of poverty, which implies the redistribution of income among income classes. This paper presents the complete set of equation system which attempts to capture the principal features of the economy and the relevant restructuring policies being carried out to attain the set targets.

For this purpose the economy is divided into six sectors, where the choice of sectors are determined by the Government target groups and the data availability. These six sectors are: (1) agriculture, livestock, forestry and fishing; (2) mining and quarrying; (3) manufacturing; (4) the rest of the secondary sector -- construction, utilities and transport; (5) tertiary sector -- wholesale and retail trade, banking, public administration, education, health and defence; and (6) urban informal sector, where the units are operated on a very small scale with relatively little use of capital. The foreign sector is abstracted from the model and assumed exogenous in order to keep it at a manageable level. While this represents the main weakness of the
model, it enables us to concentrate on the main objectives of the study. Sectors 2, 3, and 4 together are classified as the secondary sector, and with sector 5 form the urban modern sector. To generate income distribution effects, households from the three major sectors, that is, the agriculture or rural sector, the urban modern sector and the urban informal sector, are distinguished as either Bumiputeras and non-Bumiputeras.

The production technology and the producers' profit-maximizing behavior determine the demand for factors to produce output. Capital stock in each sector is fixed for each period. But since this is a long-run model, capital is stipulated to change between sectors over time through the variations in the levels of investment. Since the available estimated production functions do not incorporate different labor skills, the model is constrained to have homogeneous labor in each sector. It is also assumed that there is no difference in the quality of Bumiputeras and non-Bumiputeras labor in each particular sector. The divergence in their incomes is assumed to emanate from the differences in their capital and land ownership, and the fact that there are more non-Bumiputeras in the urban modern sector.

Factor prices are given by the intersection of factor demand and factor supply functions, and together with the quantities of factors employed determine the functional income distribution, which are then transformed into personal income distribution. Production units are converted into household units by dividing the former by the average number of earners per family. Thus, family incomes are derived from labor service, capital services and net public income from government tax-expenditure process, as well as the return from land for those in the agriculture sector. The latter assumption, that all return from land accrue to the agriculture household, is not realistic and falsely inflates the incomes of these households. Unfortunately, no information on the distribution of ownership of land income is available to facilitate the attribution of land income to the urban households, and hence this assumption is forced on to us. Household incomes determine the demand for outputs and thence factor employment. Demands for output are price responsive, where consumer demand functions are described by the own- and cross-price elasticities obtained through the Frisch scheme. Finally, supplies and demands are equated for all factors and in all sectors.

Before describing the structure of the model, a note on subscripts and superscripts is thought to be appropriate at this stage to facilitate its exposition. These subscripts and superscripts have the following meaning: sector \( s \), alternative sector \( q \) \((s = q = 1, 2, \ldots, 6)\). Subscripts 1 is the agriculture or rural sector, 2 is mining and quarrying,
3 is manufacturing, 4 is the rest of the secondary sector, 5 is the tertiary sector and 6 is the urban informal sector. However, in the labor supply equation subscripts 1 stands for the primary or agriculture sector, subscript 2 for the secondary sector, subscript 3 for the tertiary sector and subscript 6 for the urban informal sector. Household groups are divided into the three levels: rural, urban modern and urban informal, and when the variables are subscripted or superscripted by B or NB, they refer to the variables relevant to the Bumiputera and non-Bumiputera household respectively. The subscript 1 refers to each of these household income class. Subscript m refers to those variables relevant to the modern sector as a whole.

Subscripts 1 and 2 attached to $t_w'$ refer to the employees’ share and employers’ share of the social security tax respectively. Any prime ('') attached to tax variable indicates that it is a rate.

THEORETICAL BASES OF EQUATIONS

PRODUCTION FUNCTIONS (Eqs. 1.1-1.3)

Several antecedents of empirical investigations on the functional forms and estimations of the production functions for the Malaysian economy have been undertaken. However, explorations on the conditions of production in the nonmanufacturing sector are regrettfully lacking. These foregoing studies have either employed the Cobb-Douglas function and found it to be satisfactory, or have utilized both the Cobb-Douglas and the Constant Elasticity of Substitution functions, but found that the latter are not significantly different from the former and has constant returns to scale. Based on these antecedents and owing to the lack of appropriate data series for inquiring into the production functions of sectors other than the agriculture and the manufacturing, a Cobb-Douglas technology with constant returns to scale has been assumed for these sectors. The primes attached to the coefficients of these functions indicate that they are thus estimated.

In these specifications, $Q$ is output, $A$ is a constant — a scale parameter denoting the efficiency of a technology, $L$ is labor input in each sector, $\alpha_1$ is the output elasticity of labor, $K$ is capital input in each sector, $\alpha_2$ is the output elasticity of capital, $N$ is the land input in the agriculture sector and $\alpha_3$ is its output elasticity. In the agriculture sector the inputs are labor, capital and land. The estimated production function for this sector is from Chew (1981), the choice being based on the factors described elsewhere. Production functions for the rest of the sectors are only functions of capital and labor. The parameters of the production function for the manufacturing sector
are borrowed from Leong (1983), while the parameters for the rest of the production functions are based on factor shares.

**FACTOR DEMAND (Eqs. 2.1-2.3)**

The production process and the level of output determine the demand for each of the factors. Based on the neoclassical framework, assuming that all factors are employed optimally, the demand for these factors are obtained by equating their prices with their respective marginal value products. The latter are derived from the partial differentiation of the production functions.

However, it may not be realistic to assume that the factor markets of a developing country such as Malaysia are perfect. Hence, an attempt was made to allow for the possible existence of noncompetitive and nonequilibrium conditions. Following Brown (1966), the noncompetitive conditions can be approximated by introducing the adjustment factor $E_v/E_i$ into the factor demand equations, that is, $w_i = (E_v/E_i)VMP_i$; where $w_i$ and $VMP_i$ are the price and value marginal product of factor $i$ respectively, and

$$E_v = 1 + 1/\Omega_v$$

$$E_i = 1 + 1/\epsilon_i$$

where $\Omega_v$ is the price elasticity of product demand and $\epsilon_i$ is the price elasticity of supply factor $i$. In order to test whether factor price differ significantly from its marginal value product, the difference between these should be divided by the standard error of the value marginal product. But, as these factor demand functions are not estimated within the present study, it is not possible to do this test. As such, based on extraneous information (Mazumdar 1981, where he has presented three tables for the three separate occupational groups in chapter 9 showing deviations of the logs of earnings from the overall mean to indicate labor market segmentation), it was assumed that non-competitive conditions exist in the labor market. Nevertheless, another problem exists in as much as the absolute value of price elasticities of product demand derived through the Frisch scheme are less than one, resulting in the factor prices to be negative. An explanation of this problem could be attributed to the fact that “cross-sectional data are not suitable for verifying the prevalence of nonequilibrium characteristics of an economy, due for example, to dynamic adjustment lags” (Sahota and Rocca, 1981). Consequently, it is assumed, though somewhat unrealistic, that perfect factor markets exists, and thus factors are equated to their respective value marginal products.
Factor demand functions are defined by equations (2.1-2.3). Equation (2.1) is the labor demand function where $w_s$ are wages, $p^n_s$ are net prices and $t'_{w2}$ is the social security tax rate employers have to contribute, where $t_{w2} = (1 + t'_{w2})$. The demand for labor is assumed to be affected by these social security tax contributions. Though there are four major social insurance programs in Malaysia -- the employees' provident fund (EPF), the teachers' provident fund, the employment injury insurance scheme and the invalidity pension scheme -- only the EPF is included here. Two considerations led to this decision. The crucial reason is that this is the only such program for which adequate details of information are available. Secondly, it covers the largest number of employed persons (see Saito and Schome, 1982, p. 38) since all employment is taxed through the EPF.

Note that although there are six production functions, the demand for labor are formulated into three equations only. The demand for labor (derived from their value marginal product and equated to their respective wages) in the modern urban sector is a weighted average of the demand for labor in sectors 2-5. This is because only one modern sector wage is assumed.

Equation (2.2) is the demand for capital where $r_K$ is the rental cost of capital and $P_K$ is the price of capital. These two variables ensure the equilibrium in the savings-investment market and the market for capital stock respectively. That is, $r_K$ is determined in the savings-investment market while $P_K$ is determined in the market for the supply and demand of capital stock. Similar to the demand for labor, the demand for capital in each sector is postulated to be reduced by the corporation tax rate, $t'_c$, where $t_c = (1 - t'_c)$. The only exception to this influence is the demand for capital in the urban informal sector where it is assumed that no corporation tax is paid. Since land is a state matter no consolidated information on land taxes could be obtained, and thus land taxes are not introduced into equation (2.3) where $r_N$ is the rental cost of land per hectare. The coefficients of the functions of the demand for factors are normalized to prevent over- or under-exhaustion of output, that is, $\alpha' = \frac{\alpha_i}{\sum \alpha_i}$.

**FACTOR SUPPLY (Eqs. 3.1-3.11)**

Labor supply functions have been formulated to capture the employment restructuring objective of the New Economic Policy. Specifically, this particular target requires that Bumiputera employment to be increased by 66% in the secondary sector and 54% in the tertiary sector out of any new employment created in these respective sectors.
Equilibrium Model

These labor supply functions are described by equations (3.1-3.8). Generally, all labor groups are increasing at the natural population growth rate but the supply to each particular sector is affected by the employment restructuring policy. It is assumed here that (1) labor who fills in the vacancies in the modern sector come proportionately from the rural and the urban sector according to their previous shares of the labor force; (2) it is the modern sector wage that attracts labor to the urban areas while any increase in the rural and urban informal sector wages deter migration into the modern urban sector.

In these equations, subscript \( t \) refers to the time period, \( t-1 \) is its lagged value. \( \lambda_B \) and \( \lambda_{NB} \) are the actual shares of employment in the primary sector for Bumiputeras and non-Bumiputeras respectively, \( (1 - \lambda_B) \) and \( (1 - \lambda_{NB}) \) are their actual respective share of employment in the urban areas while \( \lambda_B^* \) and \( \lambda_{NB}^* \) are the respective targets of employment for Bumiputeras and non-Bumiputeras in the secondary sector. Similarly, \( \lambda_B^* \) and \( \lambda_{NB}^* \) are their respective targets in the tertiary sector. No definite targets of employment were actually stated for non-Bumiputeras in the urban modern sector, but the differences between the total and Bumiputera employment are taken to be the non-Bumiputera employment goals. \( \phi_i \) and \( \phi''_i \) are the coefficients of the urban and rural wages for the two racial groups, where \( i = 1, m, 6 \). Both the rural and urban informal sectors are assumed to act as the repository of unemployed labor.

More precisely, equation (3.1) has been formulated to reflect the transforming of farmers and fishermen into modern sector workers. Bumiputera labor supply in the agriculture sector grows at 2.8% per annum less those who find jobs in the urban area. The rate of out-migration depends directly on the employment restructuring objective and the strength of attraction of urban modern sector wage relative to that of rural wage, and indirectly on the poverty eradication policies being implemented. Equation (3.2) is the non-Bumiputera labor supply in the rural area. Non-Bumiputera in this sector increases at 2.4% per year minus those who leave for the urban sector, the rate of out-migration being determined by similar factors as those determining the out-migration of the Bumiputeras labor force.

Bumiputera employment in the modern sector is supposed to reflect the creation of a commercial and industrial Bumiputera community. The supply of Bumiputera labor, as specified in equations (3.3) and (3.5), and non-Bumiputera labor, as represented by equations (3.4) and (3.6), in this sector are functions of last period's employment plus the targeted change in employment, as well as the relative wages. That is, the employment of each group is formulated
to increase by the proportion of the targeted rates. The change in employment arises from the variations in the demand for labor, determined in the production sector in the process of profit maximization.

Equations (3.7) and (3.8) describe the labor supply functions for Bumiputeras and non-Bumiputeras in the urban informal sector respectively. These labor groups also increase at their corresponding growth rates, but being reduced by the number who obtain employment in the modern sector. At the same time, they also respond to the wage differentials between the modern and informal sector.

Equation (3.9) is an ex post identity of the supply of capital stock -- it is merely last year's capital stock suitably depreciated plus the amount of investment undertaken during the period. While a plethora of investment functions have been estimated for the Malaysian economy, there is none that exactly satisfies our requirement. However, after a detailed evaluation of the various econometric estimations the relatively more suitable and plausible one is chosen for the present model, which is borrowed from Nagaraj (1974). The theoretical basis and choice of the form of the investment function is discussed elsewhere. As formulated, (equation 3.10), investment is a function of the capital-output ratio and the wage-rental ratio, plus a time trend to capture the effects of technological progress.

With respect to the supply of land, based on the rate of expansion of the cultivable land made available by the government in the last decade, the supply of land is formulated to increase at a certain rate \( \omega' \) of its lagged size.

INCOME DISTRIBUTION EQUATIONS (Eqs. 4.1-4.10)

Together with the labor supply equations, the income distribution functions are designed to reflect the objectives of the New Economic policy. Household incomes are derived from the various categories of factors. The translation of factor incomes into household income is facilitated by the data on the ownership of factor quantities of the various income groups as given by the Household Expenditure Survey (1973).

Since labor is embodied within human beings the production process directly yields earnings to the household in the form of wages. Income in the form of the return from land, \( Y'''' \), is assumed to accrue only to those in the agriculture sector. It is assumed (admittedly rather unrealistic) that capital markets are competitive and Bumiputeras, on average, receive the same rate of return, \( r_K \), as non-Bumiputeras, which holds the relative position on this component of
their income constant. However, to the extent that the government subsidizes the purchase of stock from the revenue budget (that is, the government charges the PNB i* instead of the market rate of return) Bumiputera's relative income position will improve, and the fact that there is a limit of 50,000 units on the purchase of the national unit trust shares, the relative position of the poor Bumiputeras will improve. Finally, it is assumed that land and capital both have to be owned for at least a year before yielding any return.

More precisely, the wage component of income $Y'$ (equations 4.1.-6) is the gross wage income less the employees' share of the EPF contribution, where $t'_{w1} = (1-t'_{w1})$. For Bumiputeras and non-Bumiputeras in both the rural and the urban informal sectors, these are being formulated to take account of the effects of migration into the urban modern sector. It is stipulated that labor surplus exist in these two sectors, as evidenced by the existence of high unemployment rates (Snodgrass 1974, p. 28), such that total value product either remains constant or does not fall by the whole amount previously paid to the out-migrants. In other words, the percentage decrease in output is less than the percentage decrease in employment. As such, wages of those left behind are expected to improve. As pointed out before, the rate at which labor enters the urban modern sector is a function of the employment restructuring objective and the relative wages. The wage in the urban modern sector for Bumiputeras and non-Bumiputeras are the weighted average of wages in sectors 2-5 corresponding to their respective value marginal products. The wage income of the urban modern sector is obtained when the employees' contribution of the EPF has been subtracted.

Government expenditure benefits received by households make up part of their disposable income. This income $Y''$, (Equation 4.2), is determined by the share of government expenditure benefits per household to each sector, $\theta_1$, multiplied by the proportion of government expenditure actually distributed to the household, $\theta_2$. The distribution of public expenditure benefits is adapted from Meerman (1979). Meerman estimated the value of public expenditure based on the average costs of supplying the various types of social services, which, he acknowledges, is a second best solution. Furthermore, secondary benefits and externalities are ignored as is the benefits from pure public goods -- defence, police and administration, as already mentioned earlier.

The equations describing the capital income are crucial in this model for it is these equations that will indicate the efficacy of the capital ownership restructuring policy. Capital income results from the rate of return to accumulated capital, while accumulated capital
comes from savings and investments. As such, it is important that the savings components are sketched out first. The constituents of private savings are specified in equations (4.3.1-4.3.4). In this model, saving is treated as synonymous as investment, which is an acceptable assumption in long-run model, and saving is defined to be a net measure so calculated as to keep capital intact.

The first ingredient of private savings, \( S_1 \), is a function of income as well as the rate of return. The rest of the savings components consists of compulsory institutional savings, comprising \( S_2 \), which is the contributions to the EPF (by both employers and employees) plus the weighted share of the return from past accumulations of the EPF contributions, \( \pi s t \tau^* s^*_2 \), where 
\[
S^*_2 = \sum_{j = -\infty}^{t-1} S_2, t - j.
\]
However, in order to ease the linearization process, \( S^*_2 \) is approximated by a multiple, \( \sigma \), of past savings of households in that particular sector, \( S_{slt-1} \). We assume that the government is financing borrowed capital of Bumiputeras by drawing on these past contributions and paying below the market rate of return for them at the rate \( r^* \). For the Bumiputeras, there are two more institutional savings, namely \( S_{3B} \) and \( S_{4B} \), where the former is the undistributed net rate of return from borrowed capital, \( u'(r_K - i^*) k_B^{t-1} t_c \), and the latter is the undistributed net rate of return from owned capital, \( u' r_K k_B^{t-1} t_c \). It is assumed that non-Bumiputeras own all their capital and hence their other institutional savings comes from the undistributed net rate of return from their owned capital, \( u' r_K k_N^{t-1} t_c \). These components are summed up (equation 4.3.5.i-4.3.5.ii), and when added to last year’s owned capital, as well as borrowed capital for Bumiputeras, give the stock of owned capital for the current year (equations 4.3.6.i-4.3.6.ii). Finally, equation (4.3) defines the share of Bumiputera capital ownership as a proportion of total capital.

Thus, equation (4.4.1) describes the distributed income from borrowed and owned capital of Bumiputeras, \( Y''_B \), where \((1-u')\) is the distributed share of capital income, \((r_K - i^*)k_B^{t-1} t_c\) is the return to borrowed capital less its costs and \( r_K k_B^{t-1} t_c\) is the return from owned capital. Capital income for non-Bumiputeras, \( Y''_{NB} \) (equation 4.4.2), is made up of the distributed rate of return \((1-u'')r_K\) from capital owned by non-Bumiputeras last year, \( k_N^{NB} t-1 \).

Only rural household are assumed to derive income from land ownership since information on who are the land owners and the size of their holdings are not available (equations 4.5.1-4.5.2). In reality, many land owners reside in the urban areas. Income from land ownership, \( Y''' \), depends on the rate of return from land per hectare, \( r_N \).
and the size of the holding per household, where \( \tau_B \) is the share of cultivated land owned by Bumiputeras and the rest, \((1 - \tau_B)\), goes to the non-Bumiputeras. Equation (4.5) is the land identity equation, which states that non-Bumiputera household land holdings is the total supply of land minus Bumiputera land holdings, suitably weighted. Total household income (equation 4.6) is therefore the sum of incomes derived from the various factors less the personal income tax, plus income in the form of public expenditure, benefits. The personal income tax is a partial integration of the individual income tax and the corporation income tax since individuals are allowed credits for the corporation tax paid on their behalf. Equation (4.7-4.10) are identities for total Bumiputera, non-Bumiputera, rural land and urban income respectively, where the summation are weighted by the number of households in each group.

**NET PRICE EQUATIONS**

The net price of output to each sector, \( P_{n,s} \), is defined as the gross price, \( P_s \), less the intermediate input requirements of each sector as given by the input-output table, and all the indirect domestic taxes, or commodity taxes, denoted by \( t'_{dm} \), as well as the import taxes, \( t'_m \). The net price is employed to calculate the functional income at factor cost to obtain the value of marginal product of each factor in the factor demand functions.

**SECTORAL IDENTITY**

Equation (6) specifies that the sum of aggregate demand for intermediate inputs, the total demand for output of each of each sector by each household group, aggregate investment demand, the public sector demand and exports minus imports must equal the total output of the economy. However, since exports and imports are assumed exogenous and to be equal, they are dropped out in the linearization process. The consumption function is substituted into this equation. Consumption is specified to be a function of income, the price of the commodity in question, and the prices of other commodities, where \( d_{sq} \) is the elasticity of demand for commodity \( s \) with respect to the price of commodity \( q \). These own- and cross-price elasticities are obtained via the Frisch scheme.

**SAVING-INVESTMENT EQUALITY (Eqs. 7.1-7.4)**

Equation (7.1) specifies the savings-investment equality for the private sector where the sum of private investment, \( I_P \), is equal to pri-
vate savings, \( S^p \), plus a balancing factor, \( B^d \), to ensure the equality. \( B^d \) can be regarded as government budget deficit if it is positive or government budget surplus if it is negative. Government savings, \( S^G \), is equal to the total tax revenue collected, \( T \), less government expenditure, \( G \).

The identity of savings and investment in the public sector is ensured by the introduction of foreign capital inflow, \( F \). Thus the sum of private savings and government savings, plus foreign capital inflow is equal to private investment plus public investment.

CONCLUSION – THE SOLUTION TECHNIQUE

Although considerable advances have been made in solution algorithms which can solve directly for complex nonlinear model specifications, we have followed Johansen’s method of linearizing the general equilibrium model. We have employed the standard procedure of linearization, like that of Goldberger (1959), Ando and Goldfeld (1968), and Sahota (1975), by taking total derivative of the equations.

The linearization process requires the absolute values of all the variables involved. Sahota (1975) points out that the choice of which year values depends on the objective of the study. If the purpose is to make predictions, the final-year values of the variables in current prices should be used, but if it is to explain the data the appropriate values are the sample mean in constant prices. However, in our case, these two options are not opened to us due to the paucity of data. Hence, our choice was made on the basis of which year has to most data available, and by this criterion 1973 was chosen as the base year. For those variables that do not have their 1973 values, we have used the Consumer Price Index to inflate or deflate the available values to their 1973 equivalents.

With regards to the choice of the solution technique, Gupta (1983) argues that, on the one hand, a nonlinear solution algorithms has the superiority of being free of the so-called linearization errors associated with the linear method. On the other hand, “its cost is severe reduction in the flexibility of operation of the model, particularly with respect to the different model closures that can be imposed” (p.126). In addition, the choice of the linear method is strengthened by the work of Dixon, Parmenter, Sutton, Vincent and Orani (1982) which shows that the linearization errors are small, even for considerable changes in predetermined variables.

The choice of the solution technique is also partly a function of the analytical objective of the researcher, as Sahota (1975, pp. 10-11;
Equilibrium Model

1982, p. 316) points out. Nonlinear solutions are theoretically superior computationally if simulation is elected to be the analytical technique owing to the fact that they are neither too complex nor too expansive. However, should the choice of analytical technique be optimal control, then nonlinear solutions of huge models become computationally prohibitive. The simulation technique is appropriate for planning or policy formulation when experiments are done by stipulating varying levels of policy instruments over the planning period to discover the different types of objective-variable path. It starts with a certain set of means and determines the outcomes expected to be attained. This option gropes for the optimum and thus computationally it is a laborious and time consuming method. On the other hand, the optimal control method sets the goals of policy objectives and solves for the optimal paths of the instrument variables in order to achieve them. In short, simulation follows an instrument-oriented approach while control theory follows a target-oriented approach.

In our case, it appears that both the simulation and the optimal control technique analysis would be appropriate. Simulation is suitable since the Malaysian Government has set targets on the rates of increase in employment of Bumiputeras in the various sectors, and because it has set several policies to achieve Bumiputera capital ownership objective, namely, the cost of borrowing capital by Bumiputeras and the amount involved. With simulation, the paths taken by the various policy instruments can be traced and we can ascertain whether the NEP targets will be achievable by 1990 or not. And if not, we can carry out experiments by varying the available policy instruments and identify the most effective and viable ones in moving towards the targets. Moreover, we can also take the difference between the target and base values, calculate the rate of change, and simulate. On the other hand, optimal control is also fitting as the Government has set targets to be attained by 1990. The latter option would indicate the optimal policy of combination of policies to be followed in order to ensure the attainment of the NEP goals. Here, we have opted for the simulation technique because of the above arguments and owing to the fact that this solution algorithm is the most accessible to us.

We have mentioned that the principal reason for employing the computable general equilibrium methodology is to take into account the direct and indirect influences of the predetermined variables. It does by tracing the effects from the initial source through the set of all endogenous variables back to the exogenous variables. To do this we start with the structural form of the model, which can be written
\[ A_0 \dot{Y}_t = A_1 \dot{Y}_{t-1} + B_0 \dot{X}_t \]  
(8)

as where \( A_0 \) and \( A_1 \) are 91 x 91 matrices while \( B_0 \) is a 91 x 16 matrix, and \( Y \) is the column vector of the endogenous variables, \( Y_{t-1} \) is that of the lagged endogenous variables and \( X \) is that of the exogenous variables. The symbol \( \dot{\cdot} \) indicates that all these variables are expressed as proportionate changes, for example, \( \dot{Y} = dY/Y \).

However, this system of equations describe the endogenous variables in terms of the exogenous variables only in an implicit way since each of its equations describes only part of the structure of the economy, and with some of the endogenous variables being described in terms of the other endogenous variables in several of its equations. We overcome this problem by solving the system\(^4\) with respect to the dependent variables for the reduced form, as in equation (9):

\[ \dot{Y}_t = A^{-1}_0 A_1 \dot{Y}_{t-1} + A^{-1}_0 B_0 \dot{X}_t \]  
(9)

**PRODUCTION FUNCTIONS**

\[(1.1)\] \( Q_1 = AL^{z_1} K^{z_2} N^{z_3} \)  
(1 eq. for the agriculture sector)

\[(1.2)\] \( Q_3 = AL^{z_1} K^{z_2} \)  
(1 eq. for the manufacturing sector)

\[(1.3)\] \( Q_s = AL^{z_1} K^{z_2} \)  
(4 eq. one for each sector)

**Factor demand**

(a) Labor

\[(2.1)\] \( w_s = \frac{\alpha' Q_s p^n_s}{L_s t_{w_2}} \)  
(3 eqs. one each for the agriculture, urban modern and urban informal sectors)

\[ s = 1, m, 6 \]

where:

\[ w_m = \frac{w_2 L_2 + w_3 L_3 + w_4 L_4 + w_5 L_5}{L_2 + L_3 + L_4 + L_5} \]

(b) Capital

\[(2.2.i)\] \( r_k = \frac{\alpha' Q_s p^n_s t_c}{p_k K_s} \)  
(5 eqs. one for each sector except the urban informal sector)

\[ s = 1,2,...,5. \]
Equilibrium Model

(2.2.ii) \[ r_k = \frac{\alpha' 2 Q_6 P^n_6}{P_k K_6} \] (1 eq. for the urban informal sector)

(c) Labor

(2.3) \[ r_N = \alpha' 3 Q_1 P^n_1 \] \[ \frac{N_1}{N} \] (1 eq. for the agriculture sector)

where: \( \alpha' i = \frac{\alpha i}{\Sigma \alpha i} \)

Factor Supply

(a) Labor

(3.1) \[ L_{1Bi} = L_{1Bi-1} e^{0.28 t} - \lambda_{B1}^* \lambda_{B2}^* \left( L_{2t} - L_{2t-1} \right) \]

- \( \lambda_{B1}^* \lambda_{B3}^* \left( L_{3t} - L_{3t-1} \right) - \left( w^{\phi_1}_{m} - w^{\phi_2}_{t} \right) \)

(3.2) \[ L_{1NBi} = L_{1NBi-1} e^{0.24 t} - \lambda_{NB1}^* \lambda_{NB2}^* \left( L_{2t} - L_{2t-1} \right) \]

- \( \lambda_{NB1}^* \lambda_{NB3}^* \left( L_{3t} - L_{3t-1} \right) - \left( w^{\phi_1}_{m} - w^{\phi_2}_{t} \right) \)

(3.3) \[ L_{2Bi} = \lambda_{B2}^* L_{2t-1} + \lambda_{B2}^* \left( L_{2t} - L_{2t-1} \right) + \left( w^{\phi_{i}'}_{m} w^{\phi_{j}'}_{1} w^{\phi_{j}'}_{6} \right) \]

(3.4) \[ L_{2NBi} = \lambda_{NB2}^* L_{2t-1} + \lambda_{NB2}^* \left( L_{2t} - L_{2t-1} \right) + \left( w^{\phi_{i}'}_{m} w^{\phi_{j}'}_{1} w^{\phi_{j}'}_{6} \right) \]

(3.5) \[ L_{3Bi} = \lambda_{B3}^* L_{3t-1} + \lambda_{B3}^* \left( L_{3t} - L_{3t-1} \right) + \left( w_{m}^{\phi_{i}'} w^{\phi_{j}'}_{1} w^{\phi_{j}'}_{6} \right) \]

(3.6) \[ L_{3NBi} = \lambda_{NB3}^* L_{3t-1} + \lambda_{NB3}^* \left( L_{3t} - L_{3t-1} \right) + \left( w_{m}^{\phi_{i}''} w^{\phi_{j}''}_{1} w^{\phi_{j}''}_{6} \right) \]

(3.7) \[ L_{6Bi} = L_{6Bi-1} e^{0.28 t} - \left( 1 - \lambda_{B1}^* \right) \lambda_{B2}^* \left( L_{2t} - L_{2t-1} \right) \]

- \( \left( 1 - \lambda_{B1}^* \right) \lambda_{B3}^* \left( L_{3t} - L_{3t-1} \right) - \left( w^{\phi_{i}''}_{m} w^{\phi}_{6} \right) \)

(3.8) \[ L_{6NBi} = L_{6NBi-1} e^{0.24 t} - \left( 1 - \lambda_{NB1}^* \right) \lambda_{NB2}^* \left( L_{2t} - L_{2t-1} \right) \]

- \( \left( 1 - \lambda_{NB1}^* \right) \lambda_{NB3}^* \left( L_{3t} - L_{3t-1} \right) - \left( w^{\phi_{i}''}_{m} w^{\phi}_{6} \right) \)

(8 eqs., 1 for each income group).

(b) Capital

(3.9) \[ P_{Ki} K_t = (1 - \delta) P_{Ki} K_{t-1} + I_t \] (1 equation).
(c) Private investment

\[ I^p = A \left( \frac{Q_t}{K_{t-1}} \right)^{\eta_1} \left( \frac{w}{r_K} \right)^{\eta_2} e^{\eta_3 t} \]  

(1 equation).

(d) Land

\[ N_i^p = (1 + \omega) N_{i-1}^p \]  

(1 eq. for the agriculture sector).

Income distribution equations

(a) Wage income

\[ Y_{1B} = \frac{w_1 L_{1B} t_{w1}}{L_{1B} - [\lambda_{B1} \dot{X}_{B2}(L_{21} - L_{21-1}) + \dot{\lambda}_{B1} \dot{X}_{B3}(L_{31} - L_{31-1})] - (w_m^* w_{11}^*)} \]

\[ Y_{1NB} = \frac{w_1 L_{1NB} t_{w1}}{L_{1NB} - [\lambda_{NB1} \dot{X}_{NB2}(L_{21} - L_{21-1}) + \dot{\lambda}_{NB1} \dot{X}_{NB3}(L_{31} - L_{31-1})] - (w_m^* w_{11}^*)} \]

\[ Y_{m_B} = w_m t_{w1} \]

\[ Y_{mNB} = w_m t_{w1} \]

\[ Y_{6B} = \frac{w_6 L_6B t_{w1}}{L_6B - [(1 - \lambda_{B1}) \dot{X}_{B2}(L_{21} - L_{21-1}) - (1 - \dot{\lambda}_{B1}) \dot{X}_{B3}(L_{31} - L_{31-1})] - (w_m^* w_6^*)} \]

\[ Y_{6NB} = \frac{w_6 L_6NB t_{w1}}{L_6NB - [(1 - \lambda_{NB1}) \dot{X}_{NB2}(L_{21} - L_{21-1}) - (1 - \dot{\lambda}_{NB1}) \dot{X}_{NB3}(L_{31} - L_{31-1})] - (w_m^* w_6^*)} \]

(b) Government expenditure benefits

\[ Y_{st} = \frac{\theta_{1st} \theta_2 G}{H_{st}} \]
(c) Capital income

Capital accumulation depends on the rates of savings, where the savings functions are:

\[(4.3.1) \quad S_{s1} = Y_{s1} - Y_{r1s1} + \gamma_2 r_K\]
\[s = 1, m, 6; \quad l = B, NB.\]

\[(4.3.2) \quad S_{s2} = w_s(t_{w1} + t_{w2}^l) + \pi_{sl} r^* s^*\]

\[(4.3.3.i) \quad S_{sB} = u'(r_K - i^*) k_{t-1}^B t_c\]

\[(4.3.3.ii) \quad S_{sNB} = u''r_K k_{t-1}^{NB} t_c\]

\[(4.3.4) \quad S_{sB} = u' r_K k_{t-1}^{B''} t_c\]

\[(4.3.5.i) \quad S_B = S_{sB} + S_{s2} + S_{sB} + S_{s4B}\] (3 eqs., 1 for each Bumiputera income group).

\[(4.3.5.ii) \quad S_{NB} = S_{sNB} + S_{s2NB} + S_{s3NB}\] (3 eqs., 1 for each non-Bumiputera income group).

\[(4.3.6.i) \quad k_{st}^{B''} = k_{st-1}^{B''} + k_{st-1}^B + S_{sB}\] (1 equation).

\[(4.3.6.ii) \quad k_{st}^{NB} = k_{st-1}^{NB} + S_{sNB}\] (1 equation).

\[(4.3) \quad K_B = \frac{H_B k_{st}^{B''}}{H_B k_{st}^{B''} + H_{NB} k_{st}^{NB}}\] (1 equation).

Therefore, capital income is:

\[(4.4.1) \quad Y_{sB}''' = (1 - u') [(r_K - i^*) k_{st-1}^{B''} + r_K k_{st-1}^{B''}]\]

\[(4.4.2) \quad Y_{sNB}''' = (1 - u'') r_K k_{st-1}^{NB}\]
(d) Income from land ownership

\[(4.5.1) \quad Y''_1B = r_N \frac{\tau_B}{H_{1B}} N_{t-1} \]

\[(4.5.2) \quad Y''''_{1NB} = r_N \frac{(1 - \tau_B)}{H_{1NB}} N_{t-1} \]

\[(4.5) \quad N_{NB} = \frac{1}{H_{NB}} N - \left( \frac{H_B}{H_{NB}} \right) N_B \]  

(e) Total income

\[(4.6) \quad Y_{sl} = (Y''_s + Y''''_s + Y''''_1) t_y + Y''_s \]  

\[(4.7) \quad Y_B = Y_{1B} + Y_{2B} + Y_{3B} \]  

\[(4.8) \quad Y_{NB} = Y_{1NB} + Y_{2NB} + Y_{3NB} \]  

\[(4.9) \quad Y_R = Y_{1B} + Y_{1NB} \]  

\[(4.10) \quad Y_U = Y_{mB} + Y_{mNB} + Y_{6B} + Y_{6NB} \]  

Net price equations

\[(5) \quad P^n_s = P_s - (\sum_l a_{sq} P_q + t'_d + t'_m). \]  

Sectoral identity

\[(6) \quad \sum P_s Q_s = \sum Q_{sq} + \sum C_{sl} + I + G \]  

where

\[(6.1) \quad C_{sl} = \gamma_{0} + \gamma_1 Y_{sl} + \Sigma_q d_{sq} \]  

(1 equation).

(6 eqs., 1 for each income group).

(1 equation).

(1 equation).

(1 equation).

(1 equation).

(6 eqs., 1 for each sector).

(6 eqs., 1 for each sector).

(30 equations).
Equilibrium Model

Savings-investment equality

\[(7.0) \quad I^p + I^G = S^p + S^G + F \quad \text{(1 equation)}\]

where

\[(7.1) \quad I^p = S^p + Bd \]
\[(7.2) \quad I^G = S^G - Bd + F \]
\[(7.3) \quad S^p = \Sigma S_l L_l \]
\[(7.4) \quad S^G = T - G \]

and

\[(7.4.1) \quad T = t'_{dm}(\Sigma Q) + t_M(\Sigma M) + \Sigma t'_{Y_l} Y_l L_l + \Sigma t_c u'(r_K - i^*) k_{1t-1}^{B_t} + \Sigma t_c u' r_K k_{1t}^{B_t} + \Sigma t_c u' r_K k_{1t}^{N_t} \]

NOTES

1In this paper, the terms Malays and Bumiputeras, are used interchangeably. Bumiputeras literally means 'sons of the soil'. The word is used to refer to Malays and other indigenous groups.
2Malaysia here refers only to West Malaysia or Peninsular Malaysia, where about 85 percent of the population resides, due to the nature of data availability.
3The rest of the introduction relies heavily on Golladay and Haveman [1977 pp. (1-12)].
4The existence of a solution requires that \(A_0\) is a nonsingular matrix.

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