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TOWARDS A COMMODITY ORIENTED DEVELOPMENT MODEL

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SOUTHEAST ASIA DEVELOPMENT ADVISORY GROUP

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TOWARDS A COMMODITY ORIENTED DEVELOPMENT MODEL

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This is an edited version of the paper presented by Drs. Walter C. Labys and Thomas F. Weaver to the SEADAG Rural Development Panel Seminar on 'Directions in Rural Development Planning' held at Delmonico's Hotel, New York City, July 9-11, 1973.

The authors are indebted to Peter Ady of Oxford University for his suggestions regarding a previous draft of the paper prepared by W. C. Labys. They have also benefited greatly from a recent paper by Jim Thoburn, 'Exports and Economic Growth in West Malaysia,' Oxford Economic Papers, 25 *(March 1973).*

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Discussions held at the September 1972 seminar of SEADAG's Rural Development Panel centered upon the range of currently available modeling techniques which might be used to assist rural development planners in their policy decision making processes.[1] The modeling techniques examined at that meeting included those associated with sectoral models and commodity models. Sectoral models help to explain development processes by establishing linkages between the micro or rural aspects of an economy and its macro or national aspects. Among the different types of sectoral models considered were multi-level planning models, micro-dynamic or recursive programming models, systems simulation models, and general equilibrium consistency framework models. Considered a less complicated approach, commodity models explain quantity flows extending from production and imports to consumption and exports. They also describe the prices which equilibrate these flows. The modeling types discussed here included equilibrium models, process models, trade models, and econometric and programming systems models.

One major outcome of the Singapore meeting was the specification of a model type which potentially could meet the planning, forecasting, and decision making requirements of the planners present. Although useful for general sectoral planning, sectoral models were criticized for sometimes being so complex that few planners could understand and use them in a practical sense. These models also tend to concentrate on one or two major economic activities whereas rural development planning requires the interaction among a number of economic and social activities including agriculture and industrial sectors. As a consequence, considerable attention was given to commodity models which normally contain a relatively simple quantitative structure and which can link agriculture or other forms of primary commodity production to industrial processing or semi-finished and finished goods production. An additional advantage of commodity models is that they can provide forecasts of demand, supply, and prices, so that returns to commodity investment within the rural sector can be evaluated. When such forecasts serve as an input to a macroeconometric or other form of development model, changes in employment, distribution of income, or other variables essential to rural planning can also be predicted. These changes in turn can be linked to requirements for the type of social overhead capital required. One model discussed at the Singapore seminar, which attempted to interrelate commodity and development activities, was that

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1. The seminar was held in Singapore from September 18-20, 1972. Copies of the report of the meeting are available on request.

of a commodity oriented development model.[2] A more detailed description of such a model is provided, together with a progress report on building a pilot version, in a later section of this paper.

THE CONTEXT OF COMMODITY DEVELOPMENT

Commodity development planning in its fullest sense embraces the production of primary products and all secondary and tertiary manufacturing or processing activities. This definition aims at expanding the narrower view of commodity studies which emphasize, in the main, aggregate demand and supply response, and which are concerned primarily with price effects for basic agricultural products.

It is the authors' contention that the failure of the primary commodity sectors to contribute more fully to both rural development and economic growth is not to be found in the usual explanations of (1) instability in the purchasing power of exports, (2) lack of long term growth of external demand, or (3) unfavorable terms of trade as the result of the tarrif structures of importing countries.[3]

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2. See the following papers by W.C. Labys, *Policy Applications of Commodity Models: The Case for Lauric Oils*, paper presented at the SEADAG Rural Development Panel seminar on *"The Commodity Approach to Sectoral Planning for Rural Development"* held in Singapore, September 18-20, 1972; *Applications of Commodity Models to Policy Analysis and Development Planning*, prepared for the Colloquium on Advanced Methodologies for Agricultural Investment and Policy Analysis, Economic Development Institute, International Bank for Reconstruction and Development, Washington, January 8 to February 2, 1972.

3. The countries of Southeast Asia have traditionally relied upon basic agricultural and mineral products, principally rice, timber, food and industrial perennial crops, and tin as the primary earners of foreign exchange. These patterns, particularly for tin, timber and perennial crops were a direct outgrowth of colonial development policy and the nature of demand in the industrializing nations of the West. It should also be noted that there has been a change, albeit slowly, of product output in response to worldwide technological developments. Indigo and gambrier, which were important export crops at the turn of the

Without entering the controversy regarding causes of export instability in primary products, the authors tend to accept the view that no strong relationship between export stability and the rate of growth of either investment or fixed capital formation has been generally demonstrated.

Regarding external demand and the role of the export sector in development, there is strong appeal to the argument presented by McBean[4] that international trade cannot provide a differential diagnosis for explaining varying country growth rates. For example, during the nineteenth century exports from India and Ceylon expanded just as rapidly as did those of the United States. A strong external demand for a given commodity, while undeniably helpful, is apparently neither a necessary nor sufficient condition for economic growth. In this vein, McBean suggests that external demand, by almost any measure, has in recent decades been larger, relative to the economic size of the developing nations than was the case for the developing nations in the previous century. By historical standards, the export record of today's developing nations compare favorably to those found in the late 19th century. At the same time, however, the export performance of the developing nations does not appear satisfactory when compared to that of the advanced countries, over the past two decades. An argument can be made that it has been a failure on the part of the developing nations to take full advantage of world market opportunities that has limited their share of world trade. Those developing countries such as Malaysia, which have in comparative terms been relatively successful in expanding their export sectors have done so by seeking new markets for their traditional products and by diversifying their exports both in terms of new product lines and a small amount of value added processing to traditional export primary commodities.

No doubt changes in patterns of trade due to unfavorable tariff structure have been a deterrent to the development of primary product exports. However, it is our contention that lack of investment in the

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century, are today primarily exhibits in botanical gardens. It is to the credit of the early agricultural research workers that they were able to identify a mix of perennial crops in response to changing market conditions which maintained a viable estate sector.

4. See A.I. McBean, *Export Instability and Economic Development* (Cambridge: Harvard University Press, 1966).

primary product sectors has been the major reason for the lack of expansion of markets for primary products. Particularly notable in Southeast Asia, has been the absence of any secondary effects on the total economy. With the value added to particular industrial agricultural crops being minimal, there has been little multiplier effect through investment in secondary and tertiary processing industry.

Export earnings have been primarily channeled into consumption, government accounts, and fixed capital investment in import substitution industries, the latter to conserve and increase the supply of foreign exchange earnings. In many instances such industries are relatively capital intensive and provide few employment opportunities. Internal markets are small thus restricting opportunities for achieving economies of scale and market expansion is limited to internal growth. The latter is generally true because the countries of the region tend to import the same mix of consumer and manufacturing items and all follow similar import substitution policies. This often results in similar joint ventures in different countries, involving the same foreign firms. There is, therefore, little incentive for the development of export lines except at the instigation of associated multinational firms. It is the authors' contention that this type of investment policy has limited impact on national growth for most countries and does not provide a strong base for industrial development.

By contrast, the industrial development potential of perennial crops such as rubber, timber, oil palm, and coconut have scarcely been explored by either Southeast Asian governments, or the private sectors of their economies. This seems a serious omission in both rural and national economic planning. It is not uncommon, for example, as in Malaysia, to find that forest resources are being rapidly and wastefully exploited in concert with land resettlement programs for perennial crops. This form of increasing employment, income distribution, and foreign exchange earnings may not be justified. To some extent the division of acreage, to focus on Malaysia, between oil palm and rubber is dictated by both a desire to diversify the export base and future price expectations for the two commodities. It may well be, however, that employment opportunities, higher foreign exchange earnings, and the multiplier effects could be increased through investment in secondary and tertiary processing facilities in the forestry, rubber, and oil palm industry, either in addition to or in lieu of land resettlement.

The reasons why secondary and tertiary and in some instances primary processing facilities have not developed to any significant degree in Southeast Asia are many. A list of the more apparent reasons, would include:

1. High ocean freight rates for manufactured as compared to primary products;

2. Import barriers to manufactured items;

3. Lack of knowledge of market institutions in the consuming nations;

4. Lack of access to current technology;

5. Lack of trained manpower at all skill levels;

6. Lack of effective export promotions;

7. Market control by large multinational corporations;

8. Lack of knowledge of consumer preference in consuming nations;

9. Lack of market information;

10. Lack of technology; and

11. Lack of research facilities.

The technology and research issue requires special attention. It is noteworthy that Malaysia, the most successful Southeast Asian nation in establishing and maintaining primary agricultural exports, has also been comparatively active in research. Natural rubber has undoubtedly survived as the country's major export crop due to Malaysian research efforts in increasing output and reducing costs. On the other hand, research in wood technology has been almost non-existant and as a result, millions of board feet of timber have probably been lost to the commercial market. It is not a case that Malaysia has failed to adopt technologies of other nations, but rather that no research, world wide, has been carried out on the potential of species which are currently unused.

In terms of the effect on rural development, commodity development planning appears to offer substantial potential. The authors' believe that area development planning itself should proceed on the basis of a careful analysis of commodity potential. This appears to be particularly true for perennial crops where long gestation periods mitigates against rapid price response on the part of cultivators.

Not all of the restrictions and constraints to commodity development can be quantified in commodity models. However, a commodity development approach does seem to offer, in many situations, a promising direction for both rural development planning and for participation of a broader section of the rural population in the benefits of modernization.

THE MODELING PROCESS

The approach taken in designing a commodity oriented development model is summarized in Figure 1. The approach consists of the following five steps:

1. Identifying the policy problems to be solved;
2. Adopting modeling approach to achieve a solution;
3. Model specification and selection;
4. Model validation and refinement; and
5. Applying the model to policy decisions in rural development.

The single most important aspect of this approach is that it is an iterative one. For example, if the model does not explain the behavior of a particular variable well, or if the model does not provide the answers needed for the policy questions posed, then the model designer returns to an earlier stage to improve the model specification or even to suggest that other types of questions are more important.

Briefly reviewing the application of this approach to the commodity oriented development model, the major policy problem to be solved involves determining how the investment of land, labor, and capital in basic commodities can lead to increased employment and an improved distribution of income. The particular aspect of the problem requiring special attention is learning how industrialization, such as commodity processing, influences growth within the rural sector.

With respect to the modeling technique to be used, the model would integrate several simple equilibrium commodity models with a simple macroeconomic model which demonstrates the multiplier effects of commodity investment and resulting export income on factor income and employment changes in the rural sector. The proportion of factor income which generates additional income changes in the rural sectors is measured through a second round of multiplier effects.

The model specification required to achieve these results suggests that the model structure be divided into a world sector, an export sector, and a domestic or rural sector. These sectors have been further described using behavioral relationships to explain the major endogenous variables of interest, although no results of econometric estimation are presented. Thus, we do not proceed beyond Step 3 in this paper; model selection, validation, and application are the subjects of future research.

BACKGROUND TO THE MODEL

Malaysia has been selected as a country where rural development can be appropriately described with the proposed modeling process. There are several reasons for this choice. It is one of the richest countries in Southeast Asia and its exports constitute nearly one-half of the national product. Thus, some relationship between exports and income growth should exist. The commodities of major importance also are sufficiently few for modeling purposes; Malaysian exports in 1971 were concentrated on rubber (45 percent), tin (18 percent), timber (17 percent), and palm oil (8 percent). Malaysia also has the advantage of a strong statistical framework for conducting quantitative analysis both in the availability of official records over long periods of time and in the availability of private industry reports.

With respect to selecting a general framework for the model, the principal interest is in tracing commodity impact from the world level to the export level and finally to the agricultural and industrial activities at the rural level. As indicated, this requires dividing the model into a world sector, an exports sector, and a rural sector. The importance of including the world sector is that it overcomes the limitations of previous models which assumed exports to be exogenous. It is known that the production and exports of primary commodities from certain developing countries such as Malaysia are of such magnitude as to influence world prices. The effects of downward fluctuations in these prices resulting from improper planning can be severe enough for countries which are major producers, but can be even more disasterous for small countries which may not have experienced any increase in volume. Thus, the proposed model attempts to endogenize, as it were, commodity variables relevant to the world market such that, for example, changes in exports influencing the world price will, in turn, determine the impact of commodity investments on employment and income.

The export sector of the model will include details on rubber, tin, and palm oil; commodities relevant at this time not only to Malaysia but to the world situation. Rubber, long suffering from the encroachment of synthetics, now faces some new market prospects. Agricultural technology has raised natural rubber production and lowered natural rubber prices, while the OPEC has increased petroleum prices with reinforcement offered by the relative world scarcity. Thus with growing demand, the users' strategy should shift towards natural rubber inputs. Palm oil is also undergoing changes in usage patterns in world markets with Malaysia the major producer, and the oil becoming increasingly more price competitive with other oils and fats. Malaysian oil output has increased from 90,000 tons in 1960 to 510,000 tons in 1971 with planned increases to 1,400,000 tons and 1,750,000 tons by 1975 and 1980 respec-

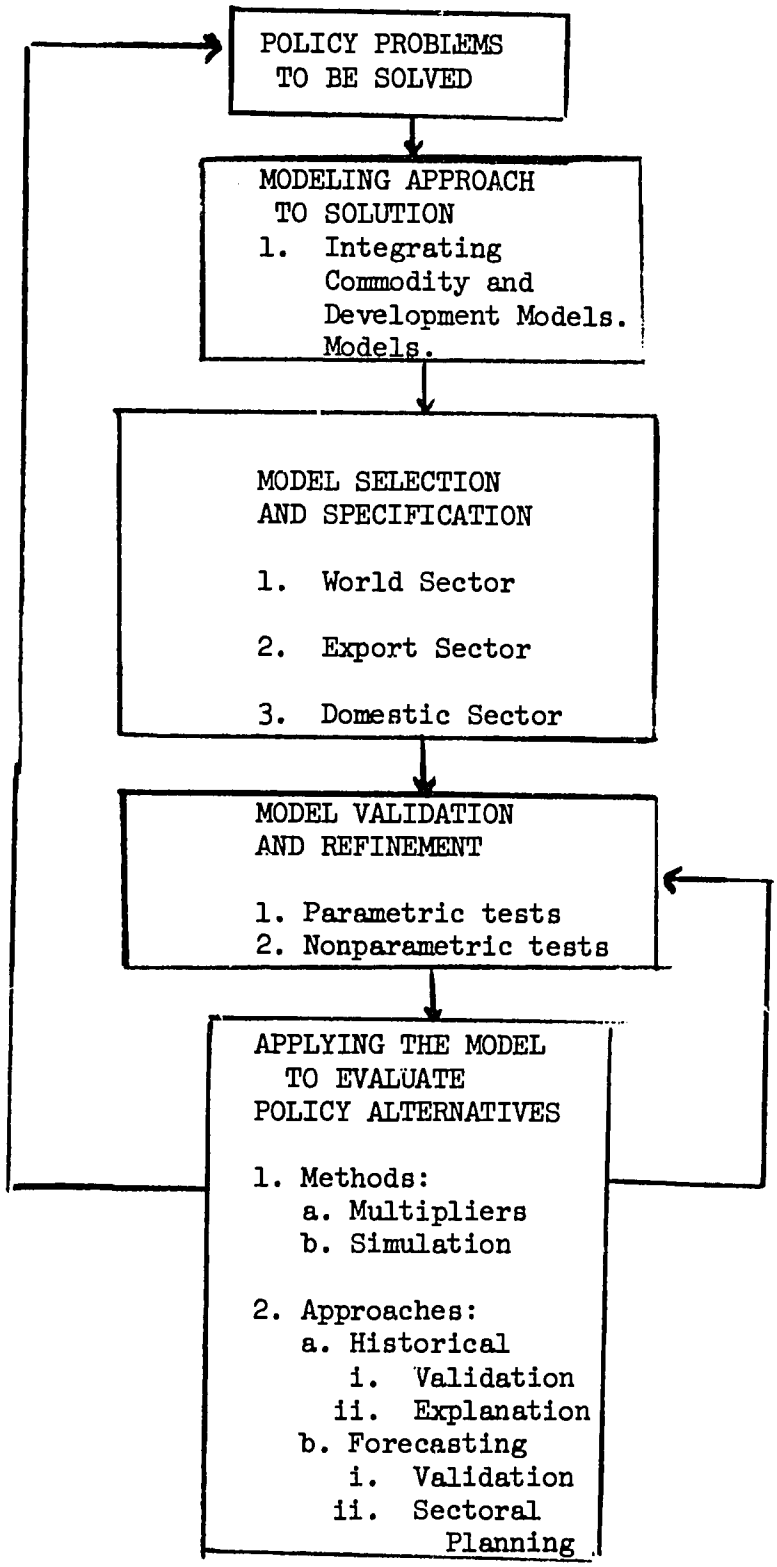

FIGURE 1

Procedure for Developing and Applying Commodity Models

tively. Finally, the tin industry has contributed significantly to Malaysia's growth as a result of both better management and technological improvements in mining.

With respect to the rural sector of the model, a primary objective is to determine what might be the optimal allocation of land, labor, and material resources among the commodities of interest. Policies relative to commodity diversification and concentration as well as the role of industrialization in the rural economy will also be considered. The performance measures used to evaluate the benefits of alternative allocations are employment, export income, income distribution, savings, and tax revenue. Also of importance is providing a quantitative measure of some of the backward and forward linkages which have taken place between commodity investment and the rural sector. Backward linkages for all commodities demonstrate the extent to which the associated industries use material resources as well as capital. Forward linkages for tin are minimal but in the case of rubber and palm oil they extend to processing. The final demand linkages to be evaluated relate to the proportion of export income spent locally as well as the multiplier effects of changes in export income on rural expenditure. The latter may give rise to further investment through a form of accelerator mechanism. It should be added that the inclusion of industrial or mining as well as agricultural commodities enables the expansion of rural sector analysis beyond its traditional concentration on agriculture.

STRUCTURE OF THE MODEL

A preliminary specification as to how the commodity oriented development model would appear is given in Figure 2. The model consists very simply of a world sector which together with the export sector for rubber, tin, and palm oil, provides a general indication of world market balance and its feedback on foreign exchange earnings and income. The rural sector is shown to derive its income from estate and industry earnings in the form of profits and dividends, wages paid to labor, and payments for materials. These are the levels of earnings disagregation which seem possible from Thoburn's analysis of the cost and payments structure of the rubber and tin industries.[5] The domestic sector also contains

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5. J. T. Thoburn, "Exports and Economic Growth in West Malaysia," *Oxford Economic Papers*, 25 (March 1973)

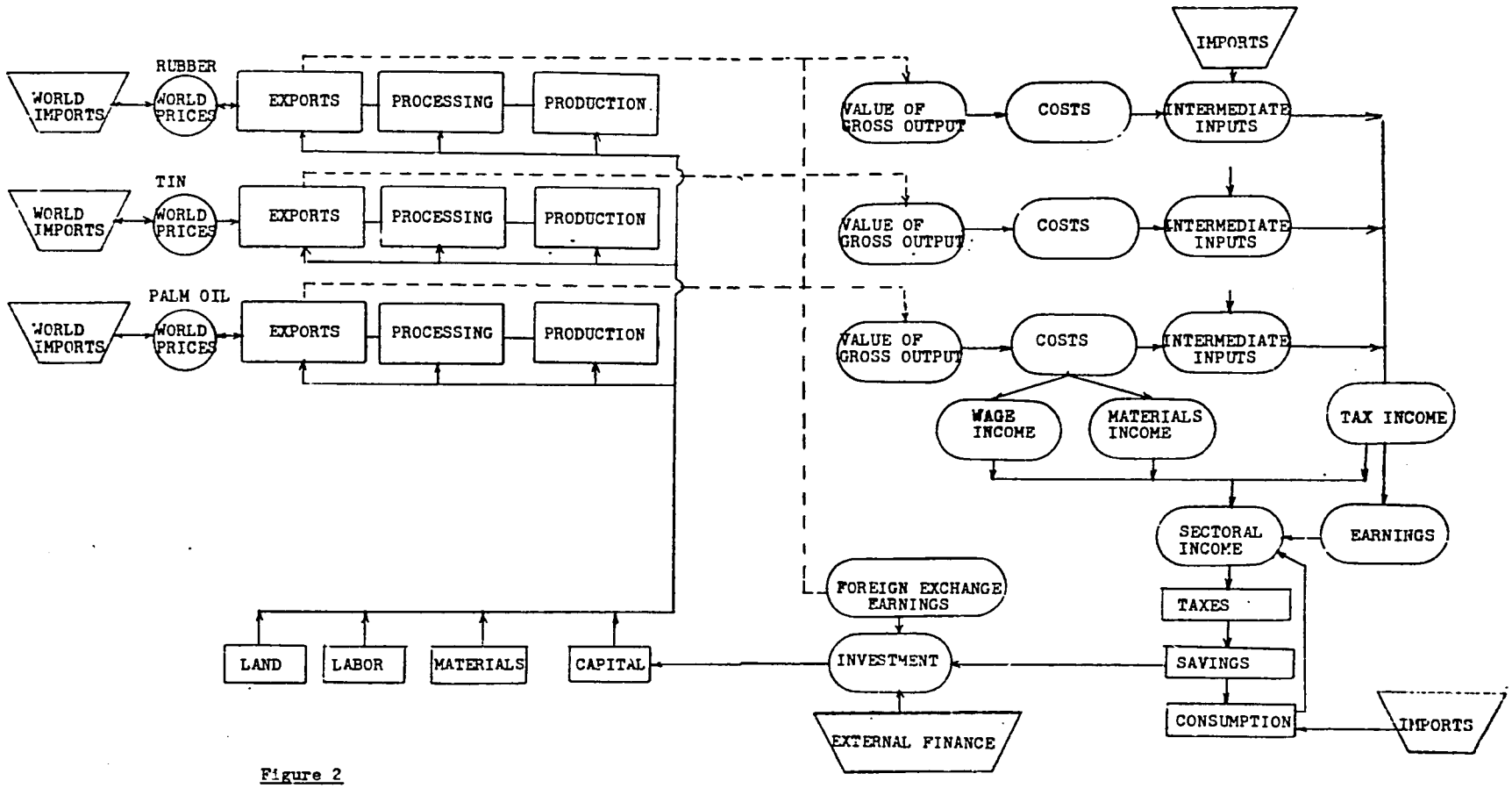

Figure 2

COMMODITY ORIENTED DEVELOPMENT MODEL FOR MALAYSIA

flows which show multiplier effects of local income and expenditures on income itself and investment. In a sense, the model also focuses on the balance of payments aspects of the rural sector since it can determine differences between exports and imports as well as differences between needed investment and the supply of domestic savings and foreign investment.

The world sector of the model would provide estimates of world prices, PW_i, for the three commodities through the use of world market equilibrium models. Each of these models would represent a variation on the following form

$$D_i = f(D_{i-1}, PW_i, O_i, PS_i, Z_i, U_i)$$

$$Q_i = f(Q_{i-1}, PW_{i-\theta}, A_i, Z_i, U_i)$$

$$PW_i = f(PW_{i-1}, S_i - S_{i-1}, U_i)$$

$$S_i = S_{i-1} + Q_i - D_i$$

i = 1, 2, 3 commodities

θ = gestation lag between investment and output

where D_i is world demand, O_i is income, PS_i is price of substitutes, Z_i represents other appropriate exogenous variables, Q_i is world supply, A_i defines agronomic or technological factors, S_i is world stocks, and U_i is a stochastic disturbance term. No expectations variables are included in these and later functional relationships to simplify the analysis at this point. The actual specification of the world models would obviously follow closely that of models already constructed. Of interest in this respect is the work of Ady, Behrman, and Cheong, on rubber; Desai on tin, and Labys on palm and coconut oils.[6]

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6. P. Ady, Rubber studies prepared for the Commodities Division of UNCTAD (Geneva); T. Cheong, *An Economic Model of the Malayan Rubber Industry*, unpublished Ph.D. dissertation (London School of Economics, 1973); Jere R. Behrman, "Econometric Model Simulations of the Third World Rubber Market," in L. P. Klein (ed.) *Essays in Industrial Dynamics*, Vol. III (Philadelphia: Wharton School of Finance and Commerce, 1971); M. Desai, "An Econometric Model of the World Tin Economy, 1948-61, *Econometrica*, 34 (1966). W. C. Labys, "Projections and Prospects for the Lauric Oils," *Journal of the American Oil Chemists' Society*, Vol. 49, No. 6 (June 1972); *An Econometric Model of the International Lauric Oils Market: Considerations for Policy Analysis*, UNCTAD/CD/Misc. 43/Rev/1, (Geneva: United Nations Conference on Trade and Development, 1971); *Dynamic Commodity Models: Specification, Estimation, and Simulation* (Lexington, Massachusetts: D. C. Heath and Co., 1973).

The domestic or rural sector of the model depends on the prices generated from the world model. The actual specification of the domestic sector indicated is only a tentative one and changes of the overall flows of income, investment, employment and expenditures will occur as the implied structure is compared with the empirical framework. There is also the possibility of adjusting the structure based on results recently obtained by Robless.[7] The present specification of the domestic sector begins with an explanation of the level of exports to be attained for each commodity. Exports would be a function of world prices and of capacity changes generated by world prices θ years earlier together with domestic agronomic - technological factors A_i, and cost factors R_i.

$$X_i = f(X_{i-1}, PW_{i-\theta}, A_i, R_i, Z_i, U_i) \qquad (1)$$

The next step, a most difficult one, requires that the export income be proportioned and divided to represent the level of income actually entering the rural sector. At this point, we consider profit or dividend income, tax income, materials income, and wage income. With respect to profit and dividend income, Thoburn[8] has shown that as high as one-third of dividends are paid to local shareholders. These earnings denoted by E are shown to be a function of individual commodity earnings.

$$E = \sum E_i \text{ where } E_i = f(X_i PW_i, U_i) \qquad (2)$$

Materials income could be estimated from accounting data on costs. Thoburn[9] found electricity to be the single most important input in this respect and its contribution to local income would be a function of exports levels for each commodity.

$$G = \sum G_i \text{ where } G_i = f(X_i, Z_j, U_i)$$

Tax income from the commodity operations could be expressed in somewhat the same fashion, only in terms of earnings.

$$H = \sum H_i \text{ where } H_i = f(E_i, Z_j, U_i)$$

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7. C. L. Robless, *Malaysian Development Alternatives, 1971-78: A Two Gap Approach,* unpublished Ph.D. Dissertation (Bloomington: Indiana University, 1972).

8. J. T. Thoburn, *op. cit.*

9. *Ibid.*

The demand for labor is a function of exports and wages, assuming that available labor is not a constraint on output.

$$L_i = f(L_{i-1}, X_i, W_i, Z_i, U_i) \quad (3)$$

The wages paid to labor are functionally related to past wages and the level of employment, the latter given by L^*_i.

$$W_i = f(W_{i-1}, L^*_i, Z_i, U_i) \quad (4)$$

Total wage income to the domestic economy is derived from the individual wage flows.

$$V = \sum V_i = \sum L_i W_i \quad (5)$$

The sectoral income is thus determined by a summation of the above income determinants.

$$Y = E = G + H + V$$

Based on income, domestic variables such as savings S, tax revenues T, and consumption C are appropriately derived.

$$S = f(S_{-1}, Y, B, Z_j, U_j) \quad (6)$$

$$T = f(T_{-1}, Y, B, Z_j, U_j) \quad (7)$$

$$C = f(C_{-1}, Y, GNP, E, Z_j, U_j) \quad (8)$$

Balance of payments aspects of the model can be introduced by also estimating the imports that would be generated by the additional commodity earnings, assuming other domestic sectors unchanged.

$$M = f(M_{-1}, E, Z_j, U_j) \quad (9)$$

From earnings, the level of investment in the export sectors can be estimated, although this factor can also be considered as exogenous in the model.

$$I - f(I_{-1}, X, H, Z_j, U_j) \qquad (10)$$

At this point no identities have been introduced which would close the model. It is obvious that feedback of imports and savings into the investment block could be introduced such that imbalances between exports and imports and investment and savings could give the model a 'two-gap' character.

POLICY APPLICATIONS AND CONCLUSIONS

The policy planning problem of principal concern in the rural sector of Malaysia is that of the diversification of the country's economy and planned development of new areas for settlement schemes. Thus, it is suggested that the Federal Land Development Authority would be the principal beneficiary of a commodity oriented development model. The model could provide guidelines as to the returns to be expected from alternative uses of land and resources in the major commodities to be considered. These land schemes are a major instrument for raising incomes, and one of the performance measures expected from the model is the change in export and sector incomes which would result from allocating land and resources. The advantage of the proposed model is that it should generate the world commodity prices and export prospects which are so essential to measuring the impact the allocation of land will have on export earnings and income.

In conclusion, it is believed that the following benefits for development planning could be obtained from a model such as the one proposed:

1. A measure as to what effects commodity development in the rural sector might have on employment and distribution of income;

2. A clearer understanding how the distribution of factor inputs and materials between commodity sectors might be reallocated with advantage;

3. Useful information how world demand and prices might be influenced by expansion of production of any of the included commodities, and vice-versa, and;

4. Development of a methodology which can forecast desireable or undesireable economic results before policies are implemented.