Volume Title: The Role of Agriculture in Economic Development

Volume Author/Editor: Erik Thorbecke, ed.

Volume Publisher: UMI

Volume ISBN: 0-87014-203-8

Volume URL: http://www.nber.org/books/thor70-1

Publication Date: 1970

Chapter Title: A Programming Model for a Dual Economy

Chapter Author: Jan Sandee

Chapter URL: http://www.nber.org/chapters/c3366

Chapter pages in book: (p. 219 - 234)

A Programming Model for a Dual Economy

JAN SANDEE

NETHERLANDS SCHOOL OF ECONOMICS

THE ECONOMIES of most developing countries are "dual" in many senses of the word. Few programming models for such countries take account of this fact, however. The sectoral models can, of course, be said to incorporate certain aspects of duality, because some of their sectors belong largely to one part of the dual economy only. Even so, it is generally production only that is sectored, with consumer or financial behavior being represented for the economy as a whole. Some macro models treat agricultural output exogenously, but this can hardly be said to do justice to dualism.

This paper presents a model that concentrates on dualism but is a macro model in every other sense. It is shown that the introduction of "dual" targets and instruments increases realism, and modifies conclusions reached with a "unitary" macro model.

DUALISM DEFINED

This is not the place to study dualism as it affects the greater part of mankind. We shall only give a brief list of the main traits by which the "modern" sector of a nation's economy is distinguished from the "traditional" sector.

NOTE: The present version of this paper has profited in many respects from remarks made by Prof. Dale W. Jorgenson, Dr. Ahmet Beyarslan and Dr. Louis Goreux.

The "modern" sector has factories and plantations, wage labor, cities, tap water, sewers, manufactured foods, cinemas, taxes, banks, and police. To enjoy all these advantages, people migrate towards the cities. The birth rate in the urban areas remains somewhat lower than in the rural sector. Products of the modern sector are shipped by rail or by sea to destinations within the country, and to the developed areas of the world.

Nearly all these characteristics occur jointly in the modern parts of the economy of all developing countries, and nearly all of them are lacking in the traditional parts. Because the characteristics are highly correlated, a sector may be distinguished by any one characteristic. This enables us to vary the names of the two sectors of the economy as the occasion may require.

THE MODEL ECONOMY

The model is drawn up for a "typical" developing country, where in the base year 30 million people live in the rural areas and 10 million in the cities. It is assumed that a five-year plan is being drawn up and that consistent provisional estimates have already been obtained for the major economic variables in the base year and in the final year of the planning period. These estimates are given in the table on the following page.

In the model, sixteen of these variables are endogenous and nine are exogenous. The meaning of the variables will become clearer when they are described in connection with the model. The variable TTR, however, requires some explanation. This measures, in billions of dollars, the gain to the rural sector of a change in its terms of trade with the urban sector. In the final year, the flows between the two sectors are RCM = \$1.29 billion and UCF-FIM = \$1.23 billion, or \$1.26 billion on the average. A change in the terms of trade by 1 per cent would make TTR = \$0.0126 billion.

The natural population increase in the rural areas is put at 1.2 million (i.e., 4 per cent) annually, and without migration rural population would amount to 36 million in the final year. As MIG = 0.5 million annually, this reduces to 33.5 million. Natural population growth in the cities is put at 200,000 (i.e., 2 per cent) annually, which, including migration, leads to 13.5 million in the final year.

Symbol	Description	Base year	Final year
		Billion $	
GNP	Gross national product	6.60	8.52
RPR	Rural product	3.60	4.32
UPR	Urban product	3.00	4.20
SLK	Unused urban capacity to produce	—	—
RCF	Rural consumption of food	2.70	3.09
RCM	Rural consumption of manufactures	0.90	1.29
UCF	Urban consumption of food	0.90	1.23
UCM	Urban consumption of manufactures	1.50	2.13
RAT	Urban food rationing	—	—
FIM	Food imports	—	—
OIM	Other imports	0.50	0.70
INV	Urban productive investment	0.40	0.56
HOU	Urban housing	0.12	0.12
IRR	Irrigation investment	—	—
GOV	Government consumption	0.13	0.20
EXP	Exports	0.45	0.60
SAV	Urban saving	0.60	0.84
TAX	Tax increases	—	—
TRF	Transfers to rural sector	—	0.06
SUB	Food subsidies in urban areas	—	—
TTR	Terms-of-trade gain to rural sector	—	—
FCI	Foreign capital imports	0.05	0.10
		$1000 per capita	
RSL	Rural standard of living	0.120	0.131
USL	Urban standard of living	0.240	0.249
		Millions	
MIG	Migration to urban areas	0.50	0.50

THE MODEL

The model consists of the following sixteen equations, which refer to the final-year values of the variables.

(1) GNP = RPR + UPR

(2) RPR = RCF + (UCF − FIM) + IRR

(3) RCM = (UCF − FIM) + TTR + TRF + IRR

(4) UPR = (UCM + UCF + TTR) − SUB + SAV

(5) SAV + FCI = INV + HOU + IRR + GOV + TRF

(6) FIM + OIM = EXP + FCI

(7) RPR = 4.320 + 0.686 TTR + 1.000 IRR

(8) UPR = 3.600 + 1.072 INV − SLK

(9) OIM = 0.167 UPR

(10) RCF = 1.660 − 0.230 MIG + 11.780 RSL − 0.500 TTR

(11) UCF = 0.501 + 0.228 MIG + 2.470 USL − 0.500 TTR + + 0.500 SUB − RAT

(12) SAV = 0.20 (UPR − TTR + SUB) + TAX − SUB

(13) RSL = 0.030 (RCF + RCM) + 0.010 MIG − 0.005

(14) USL = 0.074 (UCF + UCM) − 0.046 MIG + 0.023

(15) MIG = 4.230 (USL − RSL)

(16) HOU = 0.171 MIG + 0.034

Observations on each equation follow:

1. Definition of GNP.
2. This definition of RPR assumes that rural output consists entirely of "food" supplied to rural and urban areas but not exported and of the construction of irrigation dams and canals.
3. Purchases by the rural sector from the cities, called "rural consumption of manufactures," are paid for out of the proceeds of food sales to the cities, transfers received, and the remuneration from operation of irrigation facilities which is supposed to be fully paid in money.
4. Income disposal of urban sector.
5. Joint capital and government balance.
6. Balance of payments.
7. Rural supply function. The elasticity of supply with respect to relative price is put at 0.2. As the (UCF-FIM) and RCM flows average $1.26 billion in the final year, whereas RPR = $4.32 billion, the coefficient is determined as 0.2 × (4.32/1.26) = 0.686.

If IRR expands linearly from the base year to the final year and a slight time lag occurs between IRR and the corresponding increase in RPR, one unit of IRR in the final year will correspond to two units in the part of the plan period in which it can still contribute to RPR in the final year. We would then have the following pattern of irrigation activities in the plan period:

First year	0.2 units
Second year	0.4 units
Third year	0.6 units
Fourth year	0.8 units
Fifth year	1.0 unit

In the first four years this would total two units, and these might all contribute to agricultural output in the final year. Assuming a capital/output ratio of 2, the coefficient is $2/2 = 1.000$.

As will be explained later, a term -0.323 MIG may be added to this equation to represent the effect of the withdrawal of labor.

8. Urban production function. As with irrigation, one unit of INV in the final year represents two units during the plan period that can already contribute to UPR. The capital/output ratio is put at the wholly imaginary value of 1.855 (there had to be some difference with the COR of IRR). The constant is adjusted to match the final year values of the variables. As in the preceding equation, one term may be added to represent the effect of migration on urban output.

9. The average urban propensity to import is 16.7 per cent.

10. Rural food consumption function. One million more migrants during the final year are considered to correspond to 2.5 million more migrants during the five-year plan period, decreasing the rural population by 2.5 million persons. This is the result of a linear expansion of migration from the base-year level to a final-year level raised by 1 million annually (cf. the treatment of irrigation in equation 7). One million rural persons consume $3.09/33.5 =$ \$0.092 billion worth of food annually, and 2.5 million would consume \$0.230 billion worth, which explains the coefficient of MIG.

Income elasticity of food demand is put at 0.5, and with RSL $= 0.131$ and RCF $= 3.09$ in the final year, the coefficient of RSL is put at $0.5 \times (3.09/0.131) = 11.780$. It should be remembered that RCM includes all purchases from the urban sector, even fertilizer. It is quite realistic to make fertilizer purchases depend on RSL, but the complement of RCM, that is RCF, will then show a lower income elasticity with respect to RSL. Whether the value of 0.5 adequately represents this argument is a matter of judgment.

The meaning of the term -0.5 TTR may be interpreted as follows. If food sold to the cities fetches 5 per cent more in terms of manufactures than before, $2\frac{1}{2}$ per cent more food will be supplied to the cities, and correspondingly less food will be consumed, apart from the income effect of the price change which is incorporated in the RSL term. Our coefficient thus reflects a supply elasticity out of current output of 0.5, as compared to a supply elasticity of 0.2 for output to be produced additionally (equation 7). The constant is adjusted to fit the final-year value of 3.09 for RCF.

11. Urban food demand. The coefficient of USL represents an income elasticity of 0.5. The coefficients of 0.5 for TTR and SUB are to be interpreted as demand (substitution) elasticities with respect to price. The UCF flow represents the raw food content of food purchases only; imported manufactured foods are entirely excluded from it. This might point to somewhat lower elasticities than the ones used.

12. Urban "saving" equation. The marginal propensity to "save" out of "real" income (UPR − TTR + SUB) equals the average propensity. TAX is an instrument variable designed to increase domestic financing by appropriate government policies. There are no explicit taxes in this model. Such taxes as exist already in the final year may be thought of as incorporated in SAV. Food subsidies SUB, while coupled to food consumption UCF, are treated as negative taxes.

13. Definition of rural standard of living as per capita rural consumption. The 33.5 million rural population explains the 0.030 coefficient. One million migrants more in the final year are considered to reduce the population in the final year by 2½ million, or by 7.5 per cent (2.5/33.5). RSL = 0.131 in the final year, and 7.5 per cent of 0.131 equals 0.01. The constant is adjusted as before.

14. Definition of urban standard of living on same lines as rural.

15. Migration is considered to be proportional to the difference between USL and RSL. The coefficient is derived from the final year estimates.

16. Housing and allied expenditure is considered to be proportional to the rate of increase of the urban population. In the final year, the urban population grew by 0.2 million through natural increase, and by 0.5 million through migration, while HOU = 0.12. Thus the coefficient is $0.12/(0.2 + 0.5) = 0.171$. The constant is adjusted as before.

Of the twenty-five variables, nine are made exogenous.

The reduced form of the model is given in Table 1.

As usual, the reduced form shows us how variations in exogenous variables affect the endogenous variables. An increase in TAX by one unit, for instance, increases GNP by 1.455 units.

A PROGRAMMING EXPERIMENT

By means of the model we will now try to improve upon the provisional five-year plan, making a judicious use of some exogenous variables as

TABLE 1

Model for Typical Developing Country Based on Major Economic Variables
(reduced form)

Endogenous Variables	Exogenous Variables								
	EXP	TAX	TRF	FCI	IRR	SLK	SUB	RAT	GOV
GNP	-0.394	1.455	-1.299	1.070	-0.299	-1.366	-0.958	-0.394	-1.464
RSL	-0.036	0.009	0.025	-0.019	0.025	-0.016	0.019	-0.036	-0.017
USL	0.039	-0.004	-0.057	0.088	-0.057	-0.046	0.037	0.039	-0.049
RPR	-0.531	0.129	-0.026	-0.314	0.974	-0.202	0.250	-0.531	-0.217
UPR	0.137	1.326	-1.274	1.384	-1.274	-1.163	-1.208	0.137	-1.247
FIM	0.977	-0.221	0.213	0.769	0.213	0.194	0.202	-0.023	0.208
OIM	0.023	0.221	-0.213	0.231	-0.213	-0.194	-0.202	0.023	-0.208
RCF	-0.110	0.024	0.389	-0.095	0.389	-0.014	0.027	-0.110	-0.015
RCM	-1.194	0.293	0.548	-0.677	0.548	-0.483	0.588	-1.194	-0.518
UCF	0.556	-0.117	-0.202	0.550	-0.202	0.006	0.425	-0.444	0.007
UCM	0.172	0.027	-0.787	0.923	-0.787	-0.701	0.116	1.172	-0.751
INV	0.128	1.237	-1.188	1.291	-1.188	-0.152	-1.127	0.128	-1.163
HOU	0.054	-0.009	-0.059	0.077	-0.059	-0.021	0.013	0.054	-0.023
SAV	0.182	1.228	-0.247	0.368	-0.247	-0.174	-1.115	0.182	-0.186
TTR	-0.774	0.188	-0.037	-0.457	-0.037	-0.295	0.365	-0.774	-0.316
MIG	0.318	-0.055	-0.346	0.452	-0.346	-0.125	0.074	0.318	-0.134

instruments. A survey of the exogenous variables leads to the following list of instrument variables, with upper and lower bounds to their changes estimated from the provisional magnitudes in the final year.

Instruments	Upper Bound	Lower Bound
EXP	—	−0.10
TAX	+0.40	—
TRF	+0.40	—
FCI	—	−0.05
IRR	+0.10	—
SUB	+0.12	—
RAT	+0.12	—

To give one example, TAX was zero in the provisional estimates, and may now vary between zero and 0.4 billion.

As targets we may consider GNP, RSL, or USL. It is desirable that none of these should come out lower than in the provisional estimates. To raise USL without at the same time raising RSL would aggravate the large difference in living standards and would in many countries be considered undesirable. Hence, two targets remain: GNP and RSL, while USL is not allowed to decline.

Table 2 shows the effects of the two "extreme" targets, obtained by means of linear programing:

TABLE 2

Effect on Target Variables of Changes in Instruments

	Target	
	Max. GNP	Max. RSL
Optimal changes in instruments		
TAX	+0.400	+0.400
EXP	–	-0.073
RAT	+0.041	–
SUB	–	+0. 120
Resulting change in targets		
GNP	0.566	0.495
RSL	0.002	0.009
USL	–	–

While the model offers little hope of a dramatic improvement in rural conditions as long as urban living standards cannot be lowered with respect to provisional estimates, at least it shows the trade-off between such improvement of RSL as is possible, on the one hand, and GNP, on the other.

Little need be said about migration. MIG would, of course, vary according to equation 15, and in the two extremes mentioned above, it would change by 8,000 and 38,000, respectively, hardly enough to merit further discussion. This aspect of duality is probably of far less importance than food prices, food subsidies, and food rationing.

POSITIVE MARGINAL PRODUCTIVITIES OF POPULATION

It was perhaps rather extreme to assume that increased migration to the cities would not affect rural or urban output at all. In order to show the effect of the extreme opposite assumption in this area migration terms can be added to the two production functions (equations 7 and 8).

For *rural* output it may be assumed that 1 per cent less rural population would mean 1 per cent less rural output or that marginal productivity would equal average productivity. In the final year rural output per head is $129, and with the factor of 2.5 translating migration variations in the final year to population variations in that year (cf. equation 10), the coefficient of MIG becomes -0.323.

For *urban* output it may be assumed that 1 per cent more urban population would mean ½ per cent more urban output, or that marginal productivity would equal one-half of average productivity. As the average urban output per head is more than double the rural output per head, the term to be added to equation 8 becomes $+0.389$ MIG.

The reduced form is only slightly altered, and the optimal programs even less, as shown in Table 3.

VIRTUES OF AUSTERITY IF FOOD IMPORTS ARE NONEXISTENT

It has been shown that a stiff increase in taxation could speed up growth, even if foreign aid is no longer forthcoming. This is explained by the assumption that food imports will be reduced through higher food prices and food rationing so that other imports become possible. The pro-

TABLE 3

Effect on Target Variables of Rural-to-Urban Migration

	Zero Marginal Productivity		High Marginal Productivity	
	Max. GNP	Max. RSL	Max. GNP	Max. RSL
Optimal changes in instruments				
TAX	+0.400	+0.400	+0.400	+0.400
EXP	–	-0.073	–	-0.058
RAT	+0.041	–	+0.047	–
SUB	–	+0.120	–	+0.120
Resulting changes in targets				
GNP	0.566	0.495	0.561	0.481
RSL	0.002	0.009	0.002	0.008
USL	–	–	–	–

visional-plan estimates themselves, however, show no food imports, and this will be the realistic assumption for most developing countries.

The linear programming exercises can be repeated with a lower limit of zero on food imports FIM. The results are shown in Table 4. Apparently, there remains a possibility of increasing GNP through increased taxation, provided this is reinforced by other measures. The "rural" optimum (target RSL) has so little to say for it that it can safely be ignored. But the first column shows that a moderate increase in taxation and the full use of opportunities for agricultural investment can raise GNP by $123 million, or 1½ per cent (in five years), without any further inflow of foreign capital.

How Bad Is Food Aid?

Apparently the model does not much "approve" of food imports. Food aid naturally increases food imports. How bad, then, is this form of aid, as compared to no aid at all or to untied capital aid?

The answer will depend on the amount of aid considered. Table 5 gives the results for amounts of $50 millions. The target of the optimum

TABLE 4

Effect on Target Variables Assuming No Reduction in Food Imports

	High Marginal Productivity	
	Max. GNP	Max. RSL
Optimal changes in instruments		
TAX	+0.205	+0.174
TRF	–	+0.060
IRR	+0.100	–
SUB	+0.120	+0.120
RAT	+0.061	–
Resulting changes in targets		
GNP	0.124	0.054
RSL	0.004	0.005
USL	0.002	–

TABLE 5

Effect of Capital Aid, With and Without Food, on GNP Under High Marginal Productivity

	With Food	Untied	No Aid
Assumed changes			
FCI	+0.050	+0.050	0
FIM	+0.050	0	0
Resulting changes in instruments			
TAX	+0.194	+0.400	+0.205
TRF	+0.034	+0.013	–
IRR	+0.100	+0.100	+0.100
SUB	+0.120	+0.120	+0.120
RAT	–	–	+0.061
Resulting changes in targets			
GNP	0.139	0.465	0.124
USL	–	–	–
RSL	0.006	0.008	0.004

program will be GNP in all cases, and the "high marginal productivity" assumption will be made throughout.

Untied capital aid has a tremendous effect on GNP. This is to be expected, because the urban import-to-product ratio is 0.167 so that each dollar of additional imports allows urban product to rise by six dollars.

If, however, the additional imports have to take the form of food aid, the favorable effect on GNP is much reduced. Compared to the optimal program without additional aid of any kind there is, in fact, hardly any improvement at all.

CONCLUSION

A macro model incorporating the nondual features of the model presented here would have counted five equations. What have we learned from sixteen equations?

First, that migration, housing, and marginal productivities of labor are far less important (for programming) than is often assumed by those who have seen the squalor of "bidonvilles" or "bustees." Within the limits of a five-year plan with minimal social expenditure, little can be done in these fields and little impact on over-all growth is to be expected.

The other conclusions could just as well have been reached if MIG and HOU and equations 15 and 16 had been omitted. Such a reduced model would also have shown the benefits of increasing rural output by means of investment in agriculture, and the benefits of food subsidies, which will increase demand for food, thereby encouraging domestic food production. Where food is being imported, it may be better to reduce such imports by means of urban taxation, the proceeds of which can be used for productive investment. Finally, food aid is at best a means of reducing unpopular food rationing; it is hardly a development aid in itself.

While these conclusions have to be verified for each individual country, they have an average validity that has made it worthwhile to employ a sixteen-equation model instead of a five-equation one.

Comment

DALE W. JORGENSON, UNIVERSITY OF CALIFORNIA

Separate treatment of the agricultural sector is now becoming quite fashionable in both explanatory and programming models of economic growth. Professor Sandee was a leader in this development with his pioneering model of India dating from the late 1950's.[1] To begin my comments I would like to draw attention to two additional features of the model that add realism and relevance to the analysis of economic growth: (1) a very substantial increase in the number of policy instruments explicitly represented, and (2) incorporation of substantial price-incentive effects on both supply and demand sides for the two commodities, food and manufactured goods, treated explicitly in the productive sectors—reflecting empirical evidence from demand analysis and budget studies on the consumption side and studies of agricultural supply response such as those of Dean,[2] Falcon,[3] Krishna,[4] and Stern.[5]

The great advantage of Professor Sandee's model for a dual economy over more elaborate multisector models is that in it the most important differences among sectors in an underdeveloped economy coincide with the split between agricultural and nonagricultural or rural and urban. With relatively few equations the salient features of economic duality may be incorporated into the analysis of alternative economic policies. While smaller models lack realism from a descriptive point of view, the use of larger models for analysis of alternative policies is necessarily limited to purely mechanical manipulation of policy instruments without a clear understanding of the underlying economic mechanism. A programming model of a dual economy is just the sort of artful simplifica-

[1] Jan Sandee, *A Demonstration Planning Model for India*, New York, 1960.

[2] Edwin Dean, *The Supply Response of African Farmers*, Amsterdam, 1966.

[3] Walter P. Falcon, "Farmer Response to Price in a Subsistence Economy: The Case of West Pakistan," *American Economic Review*, May 1964, pp. 580–91.

[4] Raj Krishna, "Farm Supply Response in India-Pakistan: A Case Study of the Punjab Region," *Economic Journal*, September 1963, pp. 477–87.

[5] Robert M. Stern, "The Price Responsiveness of Egyptian Cotton Producers," *Kyklos*, Vol. 12, No. 3, 1959, pp. 375–84; and "The Price Responsiveness of Primary Producers," *Review of Economics and Statistics*, May 1962, pp. 202–7.

tion of economic reality that makes model building valuable for practical policy making.

To enhance the reader's understanding of the economic mechanism underlying the programming of a dual economy, Sandee presents a number of interesting exercises illustrating the use of policy instruments to promote growth. One central conclusion from these exercises is that austerity is a good thing for growth. By increasing taxes and using the proceeds to promote investment, the economy can realize a nice increase in gross national product.

The exercise of increasing taxation illustrates another feature of the model. The main instruments at the disposal of the government—TAX, SUB, TRF, and GOV—are assumed to work independently. If a government opts for TAX, the proceeds are assumed to flow nicely into investment with no leakage into GOV, the level of government spending. In short, the government itself is viewed as entirely exogenous in the model, confronting no internal constraints on its own activity.

To illustrate this point, let us consider a model of the government sector in which every tax increase is accompanied by some leakage into government expenditures. Sandee has considered one extreme possibility —no leakage. To heighten the contrast with his results suppose we consider the opposite extreme—one hundred per cent leakage or, algebraically, GOV = TAX. Then Sandee's Table 2 is replaced by:

	GNP	RSL
Assumed changes in instruments		
TAX	+.400	+.400
EXP	—	−.073
RAT	+.041	—
SUB	—	+.120
GOV	+.400	+.400
Resulting changes in targets		
GNP	−.020	−.091
RSL	−.005	.002
USL	−.020	−.020

The new table of targets and instruments illustrates the result of one hundred per cent leakage. While this assumption is extreme, the conclusions are interesting. The level of GNP falls with a tax increase and corresponding increase in government spending. The rural and urban standards of living also decline. An increase in taxes and government spending accompanied by food subsidies and a decrease in exports raises the rural standard of living slightly, but at the expense of a substantial drop in GNP. These calculations, unlike those of Sandee, are not the result of optimization; but they do illustrate both the underlying economic mechanism and the usefulness of the model in considering various policy alternatives.

A second aspect of the model that deserves further scrutiny is its treatment of fiscal policy. Incentive effects of various forms of taxation are ignored. Even within a model limited to two producing sectors, differential effects of taxes on land, income taxes, business taxes, sales taxes, etc., must be incorporated. In the present model all taxes are imposed on the urban sector. Since rural product is responsive to price, it might be worthwhile to consider taxation of agriculture to pay for investment in irrigation.

Some notion of the effects of taxes on agriculture can be formed by calculating the effects of a negative subsidy on food minus SUB accompanied by IRR, dollar for dollar, to use Sandee's notation. Increasing negative food subsidies has much the same effect on GNP as taxation and investment with no leakage (TAX). However, negative food subsidies or food taxes are especially effective in depressing both urban and rural standards of living while increasing investment and preserving balance of payments equilibrium. A tax on food is the ideal means to implement an austerity program. Increasing irrigation investment dampens the growth in GNP, but raises the rural standard of living while further reducing the urban.

We conclude that a tax on food falls on the urban standard of living and is not a means of taxing agriculture. Again, this hypothetical calculation illustrates the usefulness of the model and suggests one way that the model might be made even more useful—by incorporating additional policy instruments through the calculated incentive effects of particular taxes. This can be done while preserving the characteristic economic dualism of the model. This avenue of development has already been explored by Sandee, but the results suggest that further exploration would be valuable.

Finally, the one real weakness of the model as it stands is the failure to include the effects of monetary policy. For many developing countries, especially in Latin America, the interrelationship between inflation and development is critical in evaluating alternative economic policies. This problem is important largely because of constraints internal to government activity, but it is nevertheless one to be reckoned with. By treating the government as partly endogenous the realism and usefulness of the model can be further enhanced.

In summary, Sandee's programming model of a dual economy is an important step forward. It succeeds in capturing key features of economic duality and policy making in a dual economy. The model is simple enough to be thoroughly understood from the economic point of view. It is complicated enough to provide a measure of descriptive realism and a means of considering a substantial range of alternative policies for promoting economic growth.