CLIVE BELL / 1971

NATIONAL ACCOUNTS AND BALANCE OF PAYMENTS

CASH OUTPUT AT MARKET PRICES :

$$Y_q(t) = \bar{\pi}_1(t)\,X_1(t) + \frac{\pi_{2f}(t)}{r(t)}\left[E_2(t) - M_2(t)\right] + \bar{\pi}_2(t)\left[R_2(t+1) - R_2(t)\right]$$

$$+ \pi_3(t)\left[X_3(t) - E_3(t)\right] + \frac{\pi_{3f}(t)}{r(t)} \cdot E_3(t)$$

$$+ \bar{\pi}_3(t)\left[R_3(t+1) - R_3(t)\right] + \pi_4(t)\,X_4(t) + \bar{\pi}_5(t)\,XN(t)$$

$$+ \frac{\pi_{3f}(t)}{r(t)} \cdot M_3(t) - \frac{\pi_{4f}(t)}{r(t)}\left[X_{63}(t) + X_{64}(t)\right] \qquad \ldots (84)$$

REAL OUTPUT AT FACTOR COST :

$$\bar{Y}_q(t) = \bar{\pi}_1(0)\,X_1(t) + \bar{\pi}_{2f}(0)\left[E_2(t) - M_2(t)\right] + \bar{\pi}_2(0)\left[R_2(t+1) - R_2(t)\right]$$

$$+ \bar{\pi}_3(0)\left[1 - \hat{T}_3(1)\right]\left[X_3(t) - E_3(t)\right] + \bar{\pi}_{3f}(0)\left[1 - \hat{T}_{3f}(1)\right]E_3(t)$$

$$+ \bar{\pi}_3(0)\left[R_3(t+1) - R_3(t)\right] + \bar{\pi}_4(0)\,X_4(t) + \bar{\pi}_5(0)\,XN(t)$$

$$- \bar{\pi}_{6f}(0)\left[X_{63}(t) + X_{64}(t)\right] \qquad (85)$$

CASH INCOMES

$$Y_i(t) = \underline{W}(t) + \underline{\Pi}(t) + \Pi_g(t) + \underline{GDI}(t) \qquad (86)$$

where $\underline{GDI}(t)$ [Govt. debt interest payments to bond holders] is given by

$$\underline{GDI}(t) = \sum_{\tau=1}^{t-1}\left(1 - q(\tau)\right).\left(1 - z(\tau)\right).\Pi_3(\tau-1).\rho(\tau).\left(1 - \hat{T}_\Pi(\tau)\right)$$

$$+ \xi K(0)\,\rho(0) \qquad (87)$$

COMPONENTS :- Wages (before tax) $\underline{W}(t) = \sum_{j=1}^{\xi} \omega_j(t)\,L_j(t) \qquad (88)$

Profits of private sector (before tax)

$$\underline{\Pi}(t) = \sum_{j=1}^{3} \Pi_j(t) \qquad (89)$$

DIRECT TAXES :-

ON wages $T_w(t) = \underline{W}(t) - W(t)$ (90)

ON PROFITS AND RENT $T_\Pi(t) = \underline{\Pi}(t) - \Pi(t) + \xi \underline{\Pi}_3(t) \cdot \hat{T}_\Pi(t)$ (91)

where $T_w(t) = \hat{T}_w(t) \sum_{j=1}^{5} w_j(t) L_j(t)$ (92)

$$\hat{T}_\Pi(t) = \hat{T}_\Pi(t) \sum_{j=1}^{3} \underline{\Pi}_j(t) + \xi \underline{\Pi}_3(t) \cdot \hat{T}_\Pi(t) \quad (93)$$

* $\hat{T}_w(t)$, $\hat{T}_\Pi(t)$ are control variables.

SURPLUSES OF GOVT CORPORATIONS:-

$$\Pi_g(t) = \pi_1(t)\left[SR_1(t) - DR_1(t)\right] + \pi_2(t)\left[SR_2(t) - DR_2(t)\right]$$
$$+ \frac{\pi_{2f}(t)}{r(t)}\left[E(t) - M_2(t)\right] + IAK_{1,2}(t) + IAK_3(t)$$
$$- w_4(t) L_4(t) - \pi_2(t) X_{24}(t) - \frac{\pi_{6f}(t)}{r(t)} X_{64}(t) - w_5(t) L_5(t)$$

(94)

GOVT. BUDGETARY SURPLUS (in domestic currency).

$$g(t) = \Pi_g(t) - \frac{\pi_{2f}(t)}{r(t)}\left[E_2(t) - M_2(t)\right] + \frac{\pi_{6f}(t)}{r(t)} \cdot X_{64}(t)$$
$$+ T_w(t) + T_\Pi(t) + \hat{T}_3(t) \cdot \pi_3(t)\left[D_3(t) - E_3(t)\right]$$
$$+ \hat{T}_{3f}(t) \cdot \frac{\pi_{3f}(t)}{r(t)} \cdot E_3(t) + \frac{\hat{T}_{3ff}(t)}{r(t)} \cdot \pi_{3f}(t) M_3(t) \quad (95)$$
$$+ \left[1 - z(t)\right] \xi \Pi_3(t) - \underline{GDI}(t)\left[1 - \hat{T}_\Pi(t)\right]$$

CURRENT BALANCE OF PAYMENTS SURPLUS (in $)

$$CBP(t) = \pi_{2f}(t)\left[E_2(t) - M_2(t)\right] + \pi_{3f}(t)\left[E_3(t) - M_3(t)\right] - \pi_{4f}(t) M_1(t)$$

The functional form (t) indicates that the variable refers to the period (t).

$A_j(t)$; technological coefficient of the production fn. of sector j.

$A_j^*(t)$; expected value of $A_j(t)$

B_i ; constant in demand fn. for good i

$D_i(t)$; demand for good i

$DR_i(t)$; stock demand for good i

$D_{ij}(t)$; demand for good i by sector j.

$E_i(t)$; exports of good i

$G(t)$; gvt current budget surplus.

$GA(t)$; gross aid

$\overline{GA}(t)$; constant in gross aid rel^n

$\Delta GA(t)$; bargained component of gross aid.

$I_j(t)$; physical investment in machines by sector j

$IAK_j(t)$; interest and amortization on machines in sector j.

$K_j(t)$; capital in use in sector j

$\overline{K}_j(t)$; capital available in sector j.

$\underline{K}_j(t)$; lower bound on capital in use in sector j.

$\overline{L}(t)$; available labour force

$L_j(t)$; labour force employed in sector j.

$L(t)$; labour force employed

$UL(t)$; unemployed lab. force.

$M_i(t)$; imports of good i

$m_i(t)$; constant term in structural import constraint.

$\overline{N}$; upper bound on potentially available land

$N(t)$; land in use

$N_j(t)$; land in use in sector j.

$P(t)$; population

p_j ; technical progress parameter in sector j.

q ; retention ratio of firms in sector j

q_j ; parameters in retention ratio relⁿ

$R_i(t)$; stocks of good i.

$R_f(t)$; reserves of foreign currency.

$RN(t)$; stocks of unsold land

$SR_i(t)$; sales from stocks of good i.

$SN(t)$; sales of land $\Delta R_3(t)$ change in stocks

$S_i(t)$; supply of good i

s_j ; parameters in wage relⁿ. — s_0 is subsistence minimum.

$\hat{T}_{i\perp}(t)$; purchase tax on good i.

$\hat{T}_{if}(t)$; export tax on good i

$\hat{T}_{iff}(t)$; import tax on good i.

$\hat{T}_w(t)$; direct tax on wages.

$\hat{T}_\Pi(t)$; profits tax.

$VA(t)$; aid repayments.

$W(t)$; total money wage payments

$w_j(t)$; money wage in sector j.

$X_j(t)$; output of sector j

$X_{ij}(t)$; input of good i required by sector j.

$XN(t)$; land cleared in current period.

$Y_q(t)$; national output at market prices

$\bar{Y}_q(t)$; real output at factor cost.

$Y_i(t)$; money income

$z(t)$; average propensity of to consume of bond holders.

z_j ; parameters of consumption propensity relation.

α_j ; output elasticity of capital in sector j

β_j ; " " " labour " " "

γ_j ; input-output coeff of good 2 for sector j

δ_j ; " " " " " 6 " " "

ϵ_{ii} ; own price elasticity of good i

ϵ_{ij} ; cross elasticity of demand of good i wo. good j.

ϵ_{if} ; price elasticity of demand for good i in world markets.

$\phi(t)$; parameter in demand fn for good 2 in world markets.

η_i ; income elasticity

$\xi \Pi_3(t)$; income of bond holders

$\xi K(0)$; debt to " " at time zero.

λ_i ; parameter in population, or labour force growth.

μ ; parameter in demand fn. for machines

υ ; parameter in land reclamation production function.

$\pi_i(t)$; price of good i

$\bar{\pi}_i(t)$; ceiling price of good i

$\pi_{if}(t)$; world price of good i (in \$)

$\pi_{if}(t)$; import price of good i "

$\Pi_j(t)$; profits of sector j – before tax.

$\Pi_g(t)$; surpluses of govt. corporations.

$\Lambda^{min.}(t)$; proportion of current supplies of machines going to sector 4.

Ψ ; demand constant for imports of good 3

ψ ; parameters in demand fn " " " "

Θ ; demand constant for export – home demand split for good 3

Θ ; parameter in demand fn for good 3.

τ ; dummy variable for time.

$\rho(t)$; rate of interest

$\underline{\rho}$; lower bound on rate of interest.

$\rho_a(t)$; aid rate of interest.
$\rho_f(t)$; rate of interest on bargained component.
ζ_j ; parameter in aid rel^{ns}.
χ_j ; parameter in rate of interest rel^{n}
$\bar{\imath}_j$; gestation lag of investment in sector j.
Ω_j ; depreciation parameter in sector j.

ADDENDA.

$D_a(t)$; cash demand for assets.
$\bar{D}_a(t)$; constant in rate of interest rel^{n}.
c_{1w} ; propensity of wage earners to consume good 1
$c_{1\Pi_{1,2}}$; " " farmers " " " "
$c_{1\Pi_3}$; " " bond holders " " " "
$\bar{q}(t)$; constant in rate of interest rel^{n}.
$\Delta_j(t)$; depreciating physical capital in sector j.
CBP (t) ; current surplus on balance of payments.
$\underline{SDI}(t)$; govt. debt interest payments to bond holders.
$r(t)$; rate of exchange.
ind (t) ; index of consumer prices.
u_j ; parameter in wage rel^{n} for sectors 3 and 4.

GAME. 2ND DRAFT.

Population : $P(t) = P(0)\left[1+\lambda_1\right]^t$ .... (1)

Labour : $\bar{L}(t) = \bar{L}(0)\left[1+\lambda_2\right]^t$ (2)

Land : $\bar{N} \geq N(t) \geq N(0)$ (3)

Capital : $\bar{K}_j(t) \equiv \bar{K}_j(0) + \sum_{\tau=0}^{t} I_j(\tau - \bar{\tau}_j) - \Delta_j(t-1)$

$j = 1 \ldots 4$ (4)...(7)

Production functions.

Food : $X_1(t) = A_1(t)\, K_1(t)^{\alpha_1}\, L_1(t)^{\beta_1}\, N_1(t)^{0.9-\alpha_1-\beta_1}$ (8)

Raw materials: $X_2(t) = A_2(t)\, K_2(t)^{\alpha_2}\, L_2(t)^{\beta_2}\, N_2(t)^{0.95-\alpha_2-\beta_2}$ (9)

Light manufactures:

$$X_3(t) = A_3(t).\min \begin{cases} \alpha_3 K_3(t) \\ \beta_3 L_3(t) \\ \gamma_3 X_{23}(t) \\ \delta_3 X_{63}(t) \end{cases} \quad (10)$$

Machines:

$$X_4(t) = A_4(t).\min \begin{cases} \alpha_4 K_4(t) \\ \beta_4 L_4(t) \\ \gamma_4 X_{24}(t) \\ \delta_4 X_{64}(t) \end{cases} \quad (11)$$

* $L_4(t)$ is a control variable.

Land reclamation:

$$XN(t) = A_5(t)\, L_5(t) \left[\bar{N} - \left(N(t-1) + RN(t)\right)\right]^{1+\nu} \quad (12)$$

Investment (gross)

$$X_4(t) + M_4(t) \equiv \sum_{j=1}^{4} I_j(t) \quad (13)$$

* $M_4(t)$ is a control variable, subject to $M_4(t) \geq m_4(t)\, X_4(t)$ (13) a

Technical progress is neutral.

$$1 < \frac{A_j(t)}{A_j(t-1)} = 1 + \gamma_j \left[\frac{K_j(t) - K_j(t-1) + \Delta_j(t-1)}{K_j(t-1)} \right]$$

$j = 1 \ldots 4$ (14)....(17)

Stochastic influences are neutral; the probability dist^n is normal with mean (expected) value $A_j^*(t)$ and variance σ_j, $j = 1 \ldots 5$.

(18)... (22)

the production functions are subject to the availability of factors.

capital constraints: eq^{ns} (4)....(7)

labour constraint: $\bar{L}(t) \geq L(t) \equiv \sum_{j=1}^{5} L_j(t)$ (23)

raw material constraint: eq^{ns} (47) ... (49)

land constraint: $N(t) \equiv N_1(t) + N_2(t)$ (24).

non-substitutable import: $X_{63}(t) + X_{64}(t) \leq R_6(t) + M_6(t)$ (25).

* $M_6(t)$ is a <u>control</u> variable.

<u>SUPPLY.</u>

Food and raw materials:

Farmers maximize <u>expected</u> net income subject to risk avoidance. They take the ceiling prices of food and raw materials as best estimates of the prices which will rule during the current year. Thus they choose expected outputs $X_1^*(t)$, $X_2^*(t)$ — and hence, by implication, $L_1(t)$, $L_2(t)$, $K_1(t)$, $K_2(t)$, $N_1(t)$, $N_2(t)$ so as to

maximize

$$\underline{\Pi}_1^*(t) + \underline{\Pi}_2^*(t) = \bar{\pi}_1(t) X_1^*(t) + \bar{\pi}_2(t) X_2^*(t) - \omega_1(t) L_1(t) - \omega_2(t) L_2(t) - IDK_{1,2}(t) \quad (26)$$

subject to the constraints

$$K_1(t) \geq \underline{K}_1(t), \quad L_1(t) \geq \underline{L}_1(t), \quad N_1(t) \geq \underline{N}_1(t) \quad (27)\ldots(29)$$

and to the ^{ns}

$$N_1(t) + N_2(t) = N_1(t-1) + N_2(t-1) + SN(t) \quad (30)$$

$$\omega_1(t) = \omega_2(t) = \omega_S(t)$$

$$= \frac{S_0}{S_1}\bar{\bar{\pi}}_1(t) + \frac{S_1}{S_2}\frac{\partial X_1(t)}{\partial L_1(t)} \cdot \bar{\bar{\pi}}_1(t) + \frac{S_2}{S_1}\frac{\partial X_2(t)}{\partial L_2(t)} \cdot \bar{\bar{\pi}}_2(t) \quad (31)$$

and to the ^{ns} (4), (5), (8), (9), (14), (15), (18), (19), (23), (80) – (83)

Actual net income for these sectors is

$$\underline{\Pi}_1(t) + \underline{\Pi}_2(t) = \bar{\pi}_1(t) X_1(t) + \bar{\pi}_2(t) X_2(t) - \omega_1(t) L_1(t) - \omega_2(t) L_2(t) - IAK_{1,2}(t) \quad (32)$$

Interest and depreciation on fixed assets:

$$IAK_{1,2}(t) = \sum_{\tau=t-9}^{t} \left\{ \bar{\pi}_4(\tau)\left[I_1(\tau) + I_2(\tau)\right] + \bar{\pi}_5(\tau) SN(\tau) \right\} \left\{ \frac{1}{10} + \frac{(\tau+10-t)}{10} \right\}_{(t)} \quad (33)$$

Market control

(FOOD) A 'fair' (ceiling) price is set; if demand threatens to exceed supply at that price, stock will be offloaded onto the market. There are three possibilities:–

(i) $X_1(t) = D_1(t)$ at a price $\bar{\pi}_1(t) \leq \bar{\bar{\pi}}_1(t)$ (34)

so that $R_1(t+1) = R_1(t) + DR_1(t) + M_1(t)$ (35)

(ii) $D_1(t) > X_1(t)$ at $\bar{\bar{\pi}}_1(t)$;

then put $SR_1(t) = D_1(t) - X_1(t)$ at $\bar{\bar{\pi}}_1(t)$ (36)

so that $R_1(t+1) = R_1(t) + DR_1(t) + M_1(t) - SR_1(t)$ (37)

$$\geq 0$$

(iii) $D_1(t) > X_1(t) + R_1(t) + DR_1(t) + M_1(t)$ at $\bar{\bar{\pi}}_1(t)$; (38)

then the market is cleared at a price $\bar{\pi}_1(t) > \bar{\bar{\pi}}_1(t)$

such that $D_1(t) = X_1(t) + R_1(t) + DR_1(t) + M_1(t)$ at $\bar{\pi}_1(t)$ (39)

and $R_1(t+1) = 0$ (40)

* $\bar{\bar{\pi}}_1(t)$, $\Delta R_1(t)$ and $M_1(t)$ are <u>control</u> variables. The world market price of food in \$, $\pi_{1f}(t)$, is given exogeneously.

(RAW MATERIALS) As in the case of food, a ceiling price is set and stock is offloaded if demand threatens to exceed supply at that price.

If $X_2(t) + R_2(t) > X_{23}(t) + X_{24}(t)$, then $M_2(t) = 0$ (41)

<u>Cases $M_2(t) = 0$.</u>

(i) $D_2(t) = X_2(t)$ at a price $\pi_2(t) < \bar{\bar{\pi}}_2(t)$ (42)

so that $R_2(t+1) = R_2(t) + \Delta R_2(t) - E_2(t)$, (43)

where $E_2(t) \geq 0$, subject to $R_2(t+1) \geq 0$ and the export revenue maximization policy given below (c.f. eq^{ns}) (44)

(ii) $D_2(t) > X_2(t)$ at $\bar{\bar{\pi}}_2(t)$;

then put $SR_2(t) = D_2(t) - X_2(t)$ at $\bar{\bar{\pi}}_2(t)$ (45)

so that $R_2(t+1) = R_2(t) + \Delta R_2(t) - E_2(t) - SR_2(t)$ (46)

subject to (44)

<u>Cases $M_2(t) > 0$</u>

If $R_2(t+1) = 0 \Rightarrow E_2(t) < 0$,

then put $E_2(t) = 0$ and $M_2(t) > 0$, subject to balance of payments constraints. (47)

We now have eq^n (45), but eq^n (46) is replaced by

$$R_2(t+1) = R_2(t) + \Delta R_2(t) + M_2(t) - SR_2(t), \quad (48)$$

with $R_2(t+1) = 0$

If $M_2(t)$ as constrained by balance of payments considerations does not admit $R_2(t+1) = 0$ at $\bar{\bar{\pi}}_2(t)$, then

$D_2(t) - \Delta R_2(t)$ given by eq^n ( ) does not admit a solution to the market clearing eq^n. The realized price of good 2 will then be $\pi_2(t) = i_2 \bar{\bar{\pi}}_2(t)$ $(i_2 > 1)$ (49)

(EXPORTS AND IMPORTS OF GOOD 2). The marketing board attempts to maximize

foreign currency earnings subject to the constraints imposed by eqns (42) – (46). Thus it chooses $E_2(t)$ so as to maximize

$$\bar{\pi}_{2f}(t)\, E_2(t),$$

where
$$E_2(t) = \begin{cases} E_2(0)\left[1+\phi(t)\right]^t \bar{\pi}_{2f}(0)^{\epsilon_{2f}} \\ \int \bar{\pi}_{2f}(t)^{-\epsilon_{2f}} \end{cases} \tag{50}$$

and
$$\epsilon_{2f} = 2 \quad \text{for } E_2(t) < E_2(0)\left[1+\phi(t)\right]^t \tag{51}$$

$$\epsilon_{2f} = \tfrac{1}{2} \quad \text{for } E_2(t) > E_2(0)\left[1+\phi(t)\right]^t \tag{52}$$

If $M_2(t) > 0$, the supply price in \$ is given exogeneously (say) $\bar{\pi}_{2ff}(t)$

* $\bar{\pi}_2(t)$, $\Delta R_2(t)$ are control variables

GOOD 3

Capitalists choose a level of output $X_3(t)$ and stock change $\Delta R_3(t)$ so as to maximize money profits in the current period – net of interest and depreciation on capital but gross of direct taxes. Thus they maximize

$$\begin{aligned} \Pi_3(t) = {} & \bar{\pi}_3(t)\left[1-\hat{T}_3(t)\right]\left[D_3(t)-M_3(t)\right] + \frac{\bar{\pi}_{3f}(t)}{r(t)}\left[1-\hat{T}_{3f}(t)\right]E_3(t) \\ & - I\Delta K_3(t) - w_3(t)\,L_3(t) - \bar{\pi}_2(t)\,X_{23}(t) \\ & - \frac{\bar{\pi}_{6f}(t)}{r(t)}\,X_{63}(t) \end{aligned} \tag{53}$$

where
$$I\Delta K_3(t) = \sum_{t=\tau-9}^{t} \left[\bar{\pi}_4(t)\, I_3(\tau)\right]\left[\frac{1}{10} + \left(\frac{\tau-t+10}{10}\right)\rho(t)\right] \tag{54}$$

the constraints on this maximization are :–

$$X_3(t) + R_3(t) > D_3(t) - M_3(t) + E_3(t), \tag{55}$$

$$R_3(t+1) \geq 0 \quad ; \tag{56}$$

the demand split between home and export markets.

$$\frac{D_3(t)-M_3(t)}{E_2(t)} = H\left\{ \frac{\bar{\pi}_3(t)\left[1-\hat{T}_3(t)\right]}{\frac{\bar{\pi}_{3f}(t)}{r(t)}\left[1-\hat{T}_{3f}(t)\right]} \right\}^{\theta_1} \tag{57}$$

where $D_3(t) - M_3(t) + E_3(t) = X_3(t) + \Delta R_3(t)$; (58)

the money wage eq^n

$$w_3(t) = w_4(t) = (1+u_1)\, w_1(t)\left[1 + \left(\frac{\pi_1(t)}{\pi_4(0)}\right)^{u_2}\right] ; \quad (59)$$

and finally eq^{ns} (6), (10), (16), (23), (25), (47)–(49), (60), (68)–(72).

[A NOTE

If $X_{63}(t) + X_{64}(t) \geq R_6(t) + M_6(t)$ and/or

$X_{23}(t) + X_{24}(t) > R_2(t) + M_2(t) + X_2(t)$, the available supplies of goods 2 and/or 6 are split between sectors 3 and 4 pro rata wo. $[X_{23}(t), X_{24}(t)]$ and/or $[X_{63}(t), X_{64}(t)]$]

IMPORTS OF GOOD 3

$$M_3(t) = \Psi . D_3(t) . \left\{ \frac{\pi_3(t)}{\left(\frac{\pi_{3f}(t)}{r(t)}\right)} \left[1 - \hat{T}_3(t)\right]\left[1 - \hat{T}_{3ff}(t)\right] \right\}^{\mu_1} \quad (60)$$

* $\hat{T}_3(t)$, $\hat{T}_{3f}(t)$, $\hat{T}_{3ff}(t)$ and $r(t)$ are control variables. The world market price of good 3 in \$, $\pi_{3f}(t)$, is given exogeneously.

(GOOD 4)

Supply of good 4, $S_4(t) \leq [1-\Lambda][X_4(t) + M_4(t)]$ (61)

at the supply price $\pi_4(t)$

* $\pi_4(t)$, Λ are control variables.

(LAND)

Supply of land is $RN(t) \geq SN(t)$, sales at price $\pi_5(t)$ (62)

$$RN(t+1) = RN(t) - SN(t) + XN(t) \quad (63)$$

* $\pi_5(t)$ is a control variable.

(GOOD 6)

Supply of good 6 $S_6(t) \leq R_6(t) + M_6(t)$ (64)

at the world market price in \$, $\pi_{6\$}(t)$ - i.e. $\pi_{6\$}(t)/r(t)$ in domestic currency.

$$R_6(t+1) = R_6(t) + M_6(t) - S_6(t), \quad (65)$$

and $$R_6(t+1) \geq 0 \quad (66)$$

* $M_6(t)$ is a control variable.

DEMAND.

Index of consumer prices,

$$ind(t) \equiv \frac{\pi_1(t)}{\pi_1(0)} \cdot \frac{X_1(0)\,\pi_1(0)}{X_1(0)\,\pi_1(0) + X_3(0)\,\pi_3(0)} + \frac{\pi_3(t)}{\pi_3(0)} \cdot \frac{X_3(0)\,\pi_3(0)}{X_1(0)\,\pi_1(0) + X_3(0)\,\pi_3(0)} \quad \ldots \quad (67)$$

(FOOD AND TEXTILES)

$$\frac{D_1(t) - DR_1(t)}{D_3(t)} = \frac{\left\{ W(t) \cdot \left[c_{1W} \frac{W(t)}{W(0) \cdot ind(t)} \right]^{\eta_1} + \Pi_{1,2}(t) \cdot \left[c_{1\Pi_{1,2}} \cdot \frac{\Pi_{1,2}(t)}{\Pi_{1,2}(0)\, ind(t)} \right]^{\eta_2} + z \sum \Pi_3(t) \left[\frac{c_{1\Pi_3} \cdot \sum \Pi_3(t)}{\sum \Pi_3(0)\, ind(t)} \right]^{\eta_3} \right\}}{\left[W(t) + \Pi_{1,2}(t) + z \sum \Pi_3(t) \right] \left[\frac{\pi_1(t)}{\pi_3(t)} \right]^{\epsilon_{13}}} \quad \ldots \quad (68)$$

$$\pi_1(t) \left[D_1(t) - DR_1(t) \right] + \pi_3(t)\, D_3(t) = W(t) + \Pi_{1,2}(t) + z \sum \Pi_3(t) \quad (69)$$

The retention ratio of firms in sector 3 is

$$q(t) = q_0 + q_1 \cdot \frac{\Pi_3(t-1) - \Pi_3(t-2)}{\Pi_3(t-2)} \quad (70)$$

so that the dividend to equity holders is $[1 - q]\,\Pi_3(t-1)$. The propensity of wage earners and rentiers to consume is unity, but that of equity holders is $z(t)$ where

$$z(t) = z_0 * - z_1 \frac{\sum \Pi_3(t)}{\sum \Pi_3(0)} \quad (71).$$

Savings are used to buy bonds which yield the current rate of interest in perpetuo. Hence the total income of equity holders in period (t) is — after tax —

$$\xi[\Pi_3(t)] = \Pi_3(t-1)\left[1-p\right]\left[1-\hat{\Pi}_n\right] + \sum_{\tau=0}^{t-1}$$

$$\xi[\Pi_3(t)] = \left[1-\hat{\Pi}_n(t)\right]\left[\Pi_3(t-1)\left[1-p(t)\right] + \sum_{\tau=0}^{t-2}(1-z(\tau))(1-p(t))(1-\hat{\Pi}_n(\tau))\right]$$

$$\xi \Pi_3(t) = \left[1 - \hat{T}_\Pi(t)\right]\left\{\Pi_3(t-1)\left[1-\varphi(t)\right] + \sum_{\tau=\beta}^{t-1}(1-\varphi(t))\left(1-\hat{T}_\Pi(\tau)\right)\left(1-z(\tau)\right)\Pi_3(\tau-1).p(\tau)\right.$$
$$\left. + \xi K(0)\,p(0)\right\} \quad (72)$$

$$\xi \Pi_3(t)\left[1-\hat{T}_\Pi(t)\right] = \xi \Pi_3(t) \quad (72)a$$

* $\hat{T}_\Pi(t)$ is a control variable.

(RAW MATERIALS)

$$D_2(t) = B_2\,\bar{\pi}_2(t)^{-\epsilon_{22}} + \left[\frac{1}{\gamma_3}X_3(t) + \frac{1}{\gamma_4}X_4(t)\right] + DR_2(t) \quad (73)$$

(GOOD 4)

Demand from sectors 1 and 2 is given by the constrained maximization eqⁿ (26) ..... etc.

$$D_{41}(t) + D_{42}(t) = I_1(t) + I_2(t) \equiv K_1(t) + K_2(t) + \Delta_1(t-1) + \Delta_2(t-2) \ldots - K_1(t-1) - K_2(t-1) \quad (74)$$

Demand from sector 3 is

$$D_{43}(t) = B_4\left[\frac{\Pi_3(t-1).\bar{\pi}_4(0)}{\bar{\pi}_4(t)}\right]^{\eta_4}\left[\frac{Y_q(t-1)-Y_q(t-2)}{Y_q(t-2)}\right]^{\eta_5}.\frac{\bar{\pi}_4(t).(1-\mu)^{-1}}{\sum_{\tau=(t-1-n)}^{t-1}\mu^{t-1-\tau}\,\bar{\pi}_4(\tau)} \quad (75)$$

at least

the government appropriates a proportion $\Lambda(t)$ of the total current supplies of good 4. * Λ is a control variable.

Hence $I_4(t) \geq \Lambda(t)\left[X_4(t) + M_4(t)\right]$. (76)

Thus the realized demand ex post of the private sectors for good 4 is

$$\sum_{j=1}^{3} I_j(t) \equiv D_4(t) = \min\left\{\begin{array}{l}\left[1-\Lambda(t)\right]\left[X_4(t)+M_4(t)\right] \\ D_{41}(t)+D_{42}(t)+D_{43}(t)\end{array}\right. \quad (77)$$

(LAND)

the demand for land is given by the constrained maximization eqⁿ (26) ... etc. $D_5(t) = \Delta N(t)$ (78)

(GOOD 6)

$$D_6(t) = X_{63}(t) + X_{64}(t) \quad \text{at the going price in domestic currency} - \frac{\bar{\pi}_{6f}(t)}{r(t)} \tag{79}$$

(THE RATE OF INTEREST)

Cash demand for assets is

$$D_a(t) = \bar{\pi}_4(t)\left[D_{41}(t) + D_{42}(t) + D_{43}(t)\right] + \bar{\pi}_5(t) D_5(t) \tag{80}$$

If $$D_{41}(t) + D_{42}(t) + D_{43}(t) \leq \left[1 - \lambda(t)\right]\left[X_4(t) + M_4(t)\right] \tag{81}$$

then the rate of interest is given by

$$\rho(t) = \bar{\rho} + \chi_1\left[\frac{\bar{q}(t) - q(t)}{\bar{q}(t)}\right] + \chi_2\left[\frac{D_a(t) - \bar{D}_a}{\bar{D}_a}\right] \tag{82}$$

If, on the other hand, the inequality (81) is not satisfied then the rate of interest rises until $\sum_{j=1}^{3} D_{4j}(t)$ falls so as to make

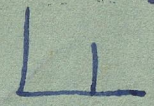
$$\sum_{j=1}^{3} D_{4j}(t) = \left[1 - \lambda(t)\right]\left[X_4(t) + M_4(t)\right] \tag{83}$$

Equilibrium in domestic markets occurs when supply and demand are brought into equality; the price at which this occurs will be the ruling price for that period. The price of good 6 is given - shortfalls or not, but shortfalls in the supply of good 2 are covered in detail above.

0.5 $\frac{1}{5}$ Π_3 1·2 7·2 100 120

0.6 5 48 50 .65

55



Mr. Clive Bell
I.D.S.

$$I_{43}(t) = B_4\left[\frac{\Pi_3(t-1)\cdot\pi_4(o)}{\pi_4(t)}\right]^{\eta_4}\left[\frac{\Delta Y_i(t-1)}{Y_i(t-2)}\right]^{\eta_5} \text{ falling in}$$

$$\times\ p(t)^{-\epsilon}$$

Capitalists attempt to work at full capacity subject to labour, raw material, and import constraints. this defines their level of output.

$$\Pi_3(t) = \pi_3(X_3 - H) + \pi_{3f}\cdot E - w_3 L_3 - \pi_2\frac{X_{23}}{\gamma_3} - \pi_6\frac{X_{63}}{\gamma_3} - IAK.$$

Retention ratio

$$q(t) = q_0\cdot\left[1+\frac{\Delta\Pi_3(t-1)}{\Pi_3(t-1)}\right]^{q_1} \qquad 15 \quad 0.75$$

$$= q_0 + q_1\left[\frac{\Delta\Pi_3(t-1)}{\Delta\Pi_3(t-2)}\right]$$

50 + 15 $\frac{65}{120}$ 35 45.

A DEVELOPMENT GAME: DECISION MAKING IN A SIMULATED LESS DEVELOPED ECONOMY

CLIVE BELL

CLIVE BELL was born in 1943. He read Mechanical Science and Economics at Cambridge, and then took an M.A. in Development Economics at the University of Sussex. In 1967 he joined the Institute of Development Studies where he is currently the Shell Research Fellow in Economics. His main interests are in the fields of Planning and Unemployment in less developed countries.

I *Introduction*

All simulation models are influenced to some degree by the nature of the problems to which they are addressed, or the use which is to be made of them. In general, the scientist—whether physical or social—effects a transformation of the real world into a representation. However, the quality and extent of that transformation is not arbitrary; it is shaped by the scientist's perception of the problem he faces. Certain aspects of reality may be simplified drastically in some cases, but not in others; certain variables may be included, others discarded. Hence the need for a brief sketch of the background to the development of EDSIM. This may shed some light on a factor which has played a powerful role in determining the structure of the model, as well as providing a rationale for a project which is rather ambitious in relation to the complexity of its subject.

One of the main activities of the Institute of Development Studies consists in designing and running a series of seminars on specific problems which confront less developed countries (LDC's). A major objective of the seminars is to improve the ability of senior civil servants from such countries to make rational and well-informed decisions. After some initial experience with these courses, it was felt that some of them would benefit from the introduction of an exercise which simulated certain features of the development process. This constituted a fairly vague brief, and in the absence of any information on a suitable extant Game, work began from scratch early in 1968.

The basic concept crystallised very quickly. The core of the Game was to be a mathematical model of a less developed economy which would be sensitive to the stimuli provided by a group of economic decision variables. Although this "economy" was to be open to international trade, formal interaction among players was excluded. In this way attention could be focused entirely on structural interdependence, a bias which is a reflection of the author's primary interest in the problems of large LDC's such as India, Pakistan and the UAR. There are, of course, a large number of small, mono-crop economies whose development depends heavily on the outcome of a particular n-person game. But that situation demands a radically different treatment from that which is described in this paper.

The first estimates of the size and complexity of a model possessing the right characteristics proved to be wildly optimistic. This was due partly to inexperience. However, as the number of elements (not to speak of equations) grew draft by draft, it became clear the reason lay quite as much in the process of having a dialogue with oneself as in some law of inexorable escalation. At each stage, the following questions posed themselves:

(i) In relation to the overall objectives, does the "economy" have a sufficient number of properly constrained economic activities and actors?

(ii) Would a planner expect to have at his disposal at least this number and these kinds of policy instruments?

These questions were provisionally satisfied when the model was defined by about 130 equations and constraints, of which three-quarters were behavioural or structural, and the remainder indentities.

So much for the preamble. We now turn to the structure of the model.

II *The Model*

This hypothetical economy produces five sorts of goods: food, raw materials, a manufactured consumer good, machines and reclaimed land, with the aid of three primary factors of production: labour, land, and machines. The production processes for manufactured consumer goods ("textiles") and machines also require intermediate inputs of raw materials and of a good which cannot be produced domestically. With the exception of land, all goods may be imported, whereas only raw materials and textiles may be exported.

The agricultural sector, which produces food and raw materials, and the textiles sector are privately owned; machines and reclaimed land are produced by government operations. Firms in the textiles sector have shareholders who channel part of their savings into fixed-interest government bonds. Hence the society has the classical class categories of workers, capitalists and rentiers. Although workers do not save, both rentiers and capitalists do so. The savings function may therefore be described as quasi-classical.

The population is currently 25 million and population growth is confidently predicted to be 2.5 per cent per annum throughout the foreseeable future. Of these 25 million, just under half are of working age. The labour force is growing at 2 per cent per annum initially, but it will accelerate later as the effects of a recent fall in infant mortality rates work their way through the age-structure of the population as a whole. The only major natural resource the country possesses is some good cultivatible land. About 20 million acres are currently under cultivation, but surveys indicate that an additional 5 million acres could be brought into use through reclamation and irrigation schemes.

That, in barest outline, is the shape of the economy. Its salient features are now described in detail. We begin with agriculture by virtue of its importance—it accounts for more than half of both GNP and exports in the current period. The ownership of land is concentrated entirely in the hands of a fairly small group of rich peasants. The remainder of the rural population form a large proletariate whose only means of subsistence is through wage-labour on the kulaks' farms. The kulaks are

well aware of the range of production possibilities and constraints which face them. These are represented by Cobb-Douglas production functions for food and raw materials. Labour may be switched freely between food and raw material production, and newly purchased land and machinery likewise. However, existing land and machinery may be switched in limited amounts only in any one year. This switching constraint may be interpreted as both technical (crop rotation) and behavioural (risk aversion). Uncertainty regarding the weather and the close proximity of bare subsistence combine to impose yet another constraint: certain minimum inputs of labour, land and capital are committed to food production however profitable it may be to do otherwise.

Within these technical and psychological constraints, the overriding feature of the kulaks' behaviour is that they attempt to maximise their expected net incomes in the current year. They base their price expectations partly on the prices of food and raw materials which ruled in the preceding year, and partly on the price support levels to which the government has committed itself for the current year. The investment criterion is a simple one. Current investment in machinery or land proceeds to the point at which the expected marginal value product of capital or land equals the current interest charges on a new machine or a newly reclaimed acre. The money wage in this sector also depends heavily on price expectation. It comprises a subsistance minimum and a "bonus" which is related to the expected marginal value products of labour in the production of food and raw materials. This web of expectations, together with maximising behaviour and the above constraint set, determines the demand for, and the allocation of, primary factors of production in privately owned agriculture.

The third production activity in the rural sector is organised by the state. At the beginning of each year, the government makes an *ex ante* estimate of the numbers of agricultural workers who will not find employment on the farm. It then offers the same number of jobs at the current money wage ruling in the rural sector. The labour supply schedule is such that in the absence of any other constraints, these jobs would always be taken up. However, if the number of such employment offers rises very rapidly from one year to the next, organisational difficulties will prevent recruitment reaching the desired level. The labour which does find effective employment in this scheme is used in rural works programmes aimed at extending the area under cultivation. No machinery is required in this activity, but sharply diminishing returns appear as the total land area in use approaches 25 million acres.

The production of textiles and machinery is concentrated entirely in the urban sector. Although the textiles industry is privately owned, it is not monopolistically organised. Moreover, as the production function is of the Leontief type and manufacturers do not carry stocks, the competitive nature of supply implies that all firms in the industry will work at full capacity—subject to the availability of variable inputs. The demand for investment in this industry is governed largely by the volume of retained post-tax profits; but expectations of future profits and demand also have an important influence on demand, as do past capacity utilisation rates. The demand for labour in this sector is determined by the level of production. The money wage rate is appreciably higher than that ruling in the agricultural sector, but the two rates do bear some general relation to each other. A major difference is that trade union

pressure keeps urban money wages rigid downwards, and there is also a retrospective adjustment for changes in a cost of living index tied to the price of food.

The state-owned machine building industry has a number of features in common with the textiles industry. Fixed factor proportions and constant returns to scale rule in production, although government policy can aim at deliberate overmanning as a means of reducing the level of open unemployment . Money wage rates are the same as those prevailing in the textiles industry. There are also a number of significant differences. The period of production is a full year, so that current inputs do not yield any new machines until the beginning of the following year. Moreover, the gestation lag between the installation of a new machine and the time when it comes on stream is at least two years in the machine building sector, compared with one year in textiles and no lag at all in agriculture. This lag may lengthen to three years on some investment if there are pronounced shortages of foreign-trained personnel. Technical progress is also present and is embodied largely in new machines. Thus the rate of technical progress depends heavily on the gross investment rate. Such Arrovian "learning-by-doing" effects are particularly strong in the production of machinery.

Government intervention and activity also extend into a number of other areas of the economy. If there is excess demand for any good, or factor, the state corporations have first call on the available supply. Excess demand for raw materials or non-substitutable imports raises the price only to the private sector, but excess demand for labour increases money wage rates in all sectors and accelerates the drift of labour into the towns.

Less directly, perhaps, the state also conducts a number of operations in domestic markets. It may intervene to prevent food prices from rising above—though not falling below—some price level chosen in advance, for as long as stocks last. Food prices can be supported by buying to add to stocks, but the extent of such buying must be chosen *ex ante*. A marketing board handles all transactions, both domestic and foreign, in raw materials. The price guaranteed to farmers is set by the central government at the beginning of each year, but the selling price in world markets is left to the discretion of the board. As it happens, the structure of world supply in this good is oligopolistic. Quite rationally, therefore, the marketing board operates only on the elastic part of the demand schedule in an attempt to maximise its foreign exchange receipts, even at the cost of accumulating large stocks.

The market for capital goods is a crucial component of the economic mechanism. In any year, the total supply of machinery is the sum of current imports and the previous year's production. The share of current supply which is to be invested in the state sector is a policy variable, while the remainder is sold to the private sector through the state bank. All sales are made on credit terms which extend over ten years and incur annual charges which change *pari passu* with changes in the rate of interest. The function of this bank is to vary the price of new machines within a chosen range for the rate of interest until the market is cleared.

A more familiar option open to the government is that of levying income taxes on urban wage-earners and all profits, and imposing purchase tax on manufactured consumer goods. The latter are also subject to export and import taxes, but the degree of state control over foreign trade is far more extensive than is commonly the

case. Apart from the operations of the marketing board for raw materials, the state is the sole importer of food, machinery, and the non-substitute good. In fact, the import levels of all goods, with the exception of textiles, are policy variables subject to an overall foreign exchange constraint. This is set by a level of foreign exchange reserves at the beginning of each year plus the amount of net aid received during the same year. The level of aid disbursements on easy terms (so-called "soft" aid) fluctuates in sympathy with the climate of opinion and aims of foreign policy in the rich world. If more aid is needed, the terms will grow rapidly less favourable. Repay-payments of past loans are, of course, determined by past decisions.

So far, the discussion has been confined largely to the process of decision-making in production. But these in turn, lead to demands for factors, and hence generate incomes. The chain is thus completed by a link between disposable incomes and the supply of the two consumer goods. The supply of foodgrains and the nature of government intervention has been described above. The supply of textiles depends on exports and imports, as well as on production; and both are dependent on the domestic-world price ratio for that good. On the demand side, the income elasticity of demand for food is high for workers, but low for rentiers and capitalists. Hence the composition of demand for food and textiles is dependent both on the distribution of income and on relative prices. When this market for consumer goods is in equilibrium, the annual cycle of economic activity is complete.

III *EDISM as an Educational Device*

Players may attempt to control the pace and direction of development of the "economy" by means of twenty-three instrumental variables. Most of these have been mentioned in section II, but for the sake of completeness, they are listed in Appendix A.

The sheer complexity of the model is not the only problem which players face. All production processes are subject to normally distributed stochastic shocks analogous to the vagaries of the weather or teething troubles with industrial plant. Hence some combinations of policies will raise the variance of outcomes more than others. Among the exogeneous variables, the trend of world prices, and the volume of "soft" aid are set by the umpire. He might just prove to be more capricious than a mere random number generator. And as a timely reminder that the development process is not purely mechanistic, certain distributions of income will spark political upheaval. There is, however, no set of outcomes which will "win" the Game. Players are required to formulate in advance what their objective functions are—that is, they must make explicit the relative weights they attach to, *inter alia*, growth, price stability, balance of payments, the distribution of income, and independence of foreign aid. Each team is then assessed according to two criteria:

(i) its success in achieving its initially-stated objective function, modified by:

(ii) how difficult that function is to achieve.

A "play" of the Game normally covers some ten to twelve moves ("years") spread over two days. This number of moves is fairly desirable, since it first renders players prisoners of a past for which they had no responsibility, and then allows them to experience the effects of self-inflicted mistakes.

At the most general level, it is hoped that the educational impact of the exercise will lie in the fact that players will be faced with the problems of controlling a complex, highly interdependent, multivariate system. A rapid learning process through intelligent analysis of the system's behaviour in response to the instrumental stimuli is therefore of critical importance. However, the best ways of using the game and the lessons to be drawn from it depend heavily on the user. In the case of civil servants, for example, the main purpose is to teach that variables *are* interrelated, rather than *how* they are interrelated. Practical men often work explicitly, or more commonly implicitly, with very simple and occasionally uni-causal models. The purpose of this exercise is to wean them from such intellectual habits and to open their minds to the need for the analysis of complex systems. The aim is more in the nature of a therapy for intellectual cramps than the presentation of a universal model.

The scope for students and professional economists is more far reaching. Economic analysis is sometimes hamstrung by assumptions of *ceteris paribus* and *mutatis mutandis* conditions. Freed from the limbo which these conditions often impose, such users can seek to use their analytical tools in order to explore fully the characteristics of a general equilibrium system. Moreover, the programme need not be used in the "play" mode alone. It can also be used as the basis for exercises in comparative statistics or sensitivity analysis.

IV *Experience with EDSIM*

At the time of writing, teaching experience with the Game is limited to a "play" on each of two seminars: one concerned with issues in Aid and Trade, and the other with Development Planning. The programme used on those occasions was a prototype which is prone to behave in a rather eccentric manner. In spite of that drawback, however, the results—in educational terms at least—were encouraging.

The teams were intentionally heterogeneous in composition, though in view of the great range of countries represented, they could scarcely have been otherwise. It was hoped that the preliminary stage of agreeing on objectives and strategy would produce a strong interaction through the sheer diversity of the participants' backgrounds. This proved to be the case. Some were extremely concerned about inflation, others employment, while a cavalier few wanted growth at any cost. Even where objectives were similar, there was often a strong clash of opinion on the best policies to achieve them. As the "play" proceeded, the factions tended to re-group as the impact of the model's behaviour became more important than professional experience. Objectives, too, were re-assessed, but to a lesser extent than policy positions. None of the six teams concerned attempted to draw up quantitative plans beyond the immediate "year". Foresight or—more frequently—force of events, led to revisions in strategy, but only in a purely qualitative way. Even in the transitional phase between one strategy and another, the planning of quantitative policy did not appear to stretch into subsequent moves.

Only one full evaluation was carried out. Various combinations of large-scale unemployment, stagnation, and inflation had occurred at some stage or other, and these symptoms of failure attracted more attention than specific success. Certainly the "validity" of the model came in for a deal of criticism, especially from participants from small countries. Yet it was agreed that the exercise had confronted the teams

with a broad perspective on many economic aspects of development, and the main stress on the importance of structural interdependence appeared to be well taken.

V *Future Developments*

The usefulness of the model does not end at providing a teaching device: it also suggests some exciting research possibilities. Two extensions suggest themselves. The first is a new sub-system for education, thereby giving rise to two categories of labour. The second involves the possibility of radically transforming the composition of output and the structure of the economy—principally by means of import substitution and "learning by doing". The model would then assume a form permitting very long-run simulation studies. In particular, research could be directed towards examining which combinations of instruments are optimal with respect to certain subsets of objectives. The implications of radically different development strategies—for example, an agricultural as opposed to industrial bias in planning—could also be compared. Then there are issues revolving around stability and sensitivity. Obvious questions in this context are: does the model possess unstable domains; which areas are sensitive to which instruments; what is the impact of parametric variations; and how will changes in behavioural assumptions affect the model's performance?

There are two further substantive issues arising out of the project discussed in this paper. The first is the extent to which political and social factors impinging on the development process should and could be accommodated within the kind of structure discussed above. A few political scientists and sociologists have expressed some interest in modifying and expanding certain crucial relationships which, in their view, are currently far too oriented towards an economist's conception of the world. Two obstacles to major changes of this kind are the difficulties of expressing political and sociological variables in quantitative functional relationships, and the fragility of interdisciplinary sympathy. The real block, however, is posed by the present inability of social scientists of different disciplines to effect a fusion of their separate paradigms. Moreover, the nature of the development process is quite as much political and social, as it is economic. The able and sceptical political scientist who remarks: "Qualitatively infeasible", may not be helpful, but cannot be ignored.

The second issue concerns the criticism which will inevitably be levelled at the implicit, not to say stealthy, ideological biases in the model. Insofar as EDSIM is presented merely as a "black box", such criticisms are wholly justified. If, however, a thorough and detailed discussion of the model's structure is included as an integral part of the exercise, these arguments lose their force. As Myrdal has shown, many of the concepts of economics are value-loaded—as witness, for example, by the advantage accruing to Britain through the dominance of free trade theory in the last century. How is it, therefore, that only those economists who build simulation models are guilty of using their discipline as a vehicle for their ideology?

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APPENDIX A

EDSIM has the following policy decision variables

Food Imports (tons)
Raw Material Imports (tons)
Exchange Rate
Number of Machines Imported
Gross Aid ($)
Non-substitutable Imports (tons)

Intervention Price for Food ($)
Price Support Level for Raw Materials ($)
Rate of Interest—Lower Limit
Rate of Interest—Upper Limit
Price of Land ($)
Proportion of Investment to State Corporation

Purchase Tax Rate on Textiles
Export Tax Rate on Textiles
Import Tax Rate on Textiles
Income Tax Rate on Wages
Income Tax Rate on Profits and Rent

Employment in Machine Building
Employment in Land Reclamation
Number of Trainees sent Abroad
Input of Raw Materials for Machine Building (tons)
Input of Non-substitutable Imports for Building (tons)
Demand for Food Stocks (tons)

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