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Enhancing Development and Solving Balance of Payments Problems: Refining IMF Financial Programming for Caribbean Conditions

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Abstract

This paper uses a fully simultaneous disaggregated model based on James (2002) to formulate a simple extension of a typical fully simultaneous IMF-type growth-oriented financial programming model to exhibit the characteristics of a typical Caribbean economy. It is shown that in its efforts to encourage budget discipline, capital accumulation, growth of output and favourable inflationary expectations government can consistently target the output of the capital producing and other capital-intensive sectors and supporting price adjustments. In addition to the usual policy instruments such as disciplined borrowing and overall spending, the structure of spending can be used as to favour the development of the capital-intensive sector in the process of stimulating overall growth. Furthermore, to eliminate systematic historical discrimination against the capital producing sector, government could undertake a consistent program of reform the financial sector to break down market discrimination and improve the flow of domestic credit to the capital producing and other capital-intensive sectors. Government *might* also be able to favourably calibrate the exchange rate in support of such initiatives if the technical coefficients allow. These findings are likely to prove more reliable than those of the traditional fully aggregated IMF-type financial programming models.

Introduction

This paper responds to the concern that IMF growth-oriented financial programming in small open economies is based largely on practical experiences obtained through country work, without adequate reflections on its theoretical foundations and applications (Mikkelsen, 1998:4; Barth and Hemphill, 2000; da Silva, 2001). It also considers whether this concern can be addressed by extending the standard framework of the IMF through growth models formulated in the spirit of Solow (1956; 1963).

The paper uses the disaggregated "dual economy" model in James (2002) to formulation a very simple extension of a typical fully simultaneous IMF-type growth-oriented financial programming model to exhibit the dualities characteristic of a typical Caribbean economy with a tight foreign exchange constraint, overall abundance of domestic capital (non-binding savings constraint) due to social and official discrimination and abundant labour supplies. Irregular movements due to random forces or dynamical (such as chaotic) behaviour are not considered, but these can readily be introduced into the story. It is further shown that in its efforts to encourage budget discipline, capital accumulation, growth of output and favourable inflationary expectations government can consistently target capital-intensive output, supporting price adjustments and reserves. Government would still be motivated to use policy instruments such as less borrowing and overall spending in a context of its revenue collection efforts and overall revenues. However, the structure of spending can be used as a policy instrument to favour the development of the capital-intensive sector in the process of stimulating overall growth. Furthermore in a context of the need to eliminate systematic historical discrimination against the capital producing sector, government would be wise to consider reform of the financial sector to break down market discrimination and improve the flow of domestic credit to the capital producing sector. Government might also be able to calibrate the exchange rate if the technical coefficients allow. Moreover, the aggregate trade patterns are explicit so that the link to wise trade liberalization can be exhibited and considered.

It is argued that these guidelines are more reliable for a Caribbean policy maker than those extracted from IMF-type fully aggregated model that rely on Solow's predictions of the rate of profit are not generally replicated in this extended model. The initiative to follow Solow was started by Khan and Montiel (1989) and further encouraged by the conclusions of Mankiw, Romer and Weil (1992) that Solow's marginal product of capital and hence his social rate of return predict with reasonable accuracy the rate of return on capital and hence the influence of savings and population growth rates on growth. However, one cannot assume that, at least with respect to a Caribbean economy, all is well with this extension since the model is fully aggregated and does not represent the duality of the Caribbean production system and the patterns of social and official discrimination against domestic capital characteristic of a Caribbean economy. It is shown in this paper that fundamental predictions of Solow's fully aggregated models fail in the face of the dualities of a Caribbean economy. The marginal product of capital does not accurately predict the rate of profit since that latter is found to depend non-linearly on the rate of return to imported productive inputs (or foreign exchange) and the wage rate. Just as important, the Solow (1963) social rate of return also does not predict the rate of profit well since it also depends on wage growth, the growth of the rate of return on productive use of foreign exchange and the growth of exports. IMF-type growth-oriented programming models based on Solow (1956) should therefore be used with considerable caution and should in general be disaggregated along the lines proposed in this paper if adequate development-oriented reforms are to be designed.

Section 1 of the paper presents an introductory view of traditional financial programming based on fully aggregated real sector modelling and summarizes the disaggregated and interdependent supply and demand relations linking production and domestic factor demand, including a foreign reserves constraint. It is observed that given the duality of the production system of a Caribbean economy, the usual conditions of duality of prices and production assumed by Solow-type models are not generally preserved in this model. Expressions that take account of the need to disaggregate the economy are provided for the growth of aggregate nominal and real output, investment and the quantity of capital per unit of imports. **Section 2** presents the corresponding equations for inflation, the change of relative prices and the pate of profit. It is shown here that the expression for the rate of profit in a Caribbean economy do not imply the Solow predictions. The implication is that the analysis of the economy must indeed be disaggregated if the role of variables such as the rate of profit in development is to be adequately represented. Such disaggregation implies that accumulation of capital per unit of imports requires that the capital producing sector grow faster than others. **Section 3 draws on this result to** exhibit equations for the money market, defined in terms of both reserves and domestic credit under conditions of discrimination towards the capital-intensive sector and the traditional free flow of credit to the traditional import-intensive sector. **Section 4** models the related dynamics of trade and foreign reserves. **Section 5** represents the key sets of budget constraints: government and the private sector, featuring that for enterprises and that for consumers. **Section 6** derives the reduced policy model implied by the equations of the other five sections and then clarifies the target hypotheses of the paper as set out in the previous paragraphs.

1. Financial Programming and Real Sector Modelling

Financial programming is the name that the IMF has traditionally given to the use of changes in macroeconomic policies to achieve macroeconomic outcomes that move an economy towards internal and external balance. Its principal rationale is that an economy generally ought not to be in disequilibrium and should live and grow within its available resources. Its principal concern is that disequilibrium tends to manifest itself mainly in terms of a very tight foreign exchange constraint and loss of reserves, high inflation rates including unstable exchange rates, and low or falling output (Barth and Hemphill, 2000:xi; 436). IMF financial programming features no special concern with balance of payments surpluses.

The general method of IMF financial programming is based on an appropriate system of national accounts (SNA), in particular SNA (1993), to construct an appropriate macroeconomic model and then to extract from this an appropriate policy model that matches a set of (endogenous) financial program objectives to program instruments. IMF programs tend to feature monetary, fiscal and exchange rate policy instruments but can incorporate other measures such as trade policies and measures aimed at increasing supply (including supply competitiveness) that minimize the loss of output and employment, or even promote expansion of opportunity, during the process of restoring equilibrium (Barth and Hemphill, 2000:436). Indeed, financial programming is designed with the long term expectation that in countries such as those of the Caribbean, development would follow if this is combined with structural adjustment, increased transparency and accountability by government, and trade liberalization. In particular, the countries that follow the combined program would tend to converge to the countries of the OECD on key indicators.

The key premise of a financial programming model is that, data apart, the model of economic adjustments through which independent projections of exogenous or program variables are filtered is structured consistently, with all the vital linkages and dynamics of the economy clearly defined. Against the background of a standard national accounting framework in which the sources and uses of savings and hence funds were adequately identified, IMF financial programming was dominated for nearly four decades by the monetarist model of Polak (1957) designed to explain the dynamics of a small open economy operating a fixed exchange rate (mostly because of IMF pressure and influence). Khan and Montiel (1989) the Polak framework modified this framework to take Solow's (1956) fully aggregated neoclassical model seriously but kept the growth of output exogenous.

Since the work of Mankiw, Romer and Weil (1992) a new generation of models has been emerging that incorporate Solow's principles and make real output growth endogenous in an effort to design a "consistent growth-oriented medium-term adjustment program" (Mikkelsen, 1998:4). The impetus from Mankiw, Romer and Weil (1992) results from their finding that Solow's model yields predictions about the influence of savings and population growth rates on growth that are consistent with the evidence. Of particular importance in this regard are two principles of considerable concern to analysts of the financial sector and to policy-makers alike. The first is the prediction that the rate of return that induces investment in physical and human capital model tends to be higher in poor countries because these resources are relatively more scarce and lower in rich countries where they are relatively more abundant. The second, even more important when one considers concerns with the social efficiency of government expenditure policy, is the prediction that social saving behaviour generates a social rate of return that predicts the private rate under conditions of equilibrium. These predictions are supposed to apply even if there are circumstances that make it necessary to disaggregate the economy in order to analyze it consistently.

Critiques of Polak (1957) or Khan and Montiel (1989) do not address the consequences of the level of aggregation. In the case of the Polak model, the main concerns are usually the following: (1) It assumes that changes in domestic credit have no influence on domestic money demand, ignoring vital influences on the structure of financial assets and interest rates; (2) It assumes a stable money demand function, ignoring the empirical evidence that inflationary conditions (expectations) cause substantial volatility in the demand for money; (3) It promotes excessive attention to neutralizing the source of stimulus for expanding the flow of domestic credit, which often leads to restraints on the expansion of domestic supply. In the case of Khan and Montiel (1989), the main concerns are usually that the possibilities of using domestic debt as a policy instrument is not considered and growth of output is exogenous. Moreover, as with the Polak model, there is no serious concern with the impact of balance of payments crises (or loss of reserves) on unemployment of labour, poverty and other social aspects of the development problem (da Silva, 2001).

However, all is not well with the level of aggregation of these models. The rationale for use of the fully aggregative model to generate the Solow predictions and shape policy is that, for some purposes, it makes sense to think of the process of accumulation as if we were in a sort of one-commodity corn-producing world even though there is none. Then, this understanding could guide the move up to many commodities in which the analysis can deal explicitly with the industrial process and hence with machines, computers and similar outputs that serve as inputs (Friedman, 1958). The works of Lewis (1954; 1964) and Best (1971, 1980) suggest that the Caribbean economy features characteristic dualities that make it necessary to construct disaggregated macroeconomics from the start and to capture explicitly the process by which capital-intensive industrial activity increasingly dominates price-taking sectors. In James (2002) it was suggested that an appropriate macroeconomics must capture these dualities in a model that recognizes that production occurs in a foreign exchange constrained model of two distinct sectors using three sets of resources, one of is domestic capital. A substantial share of domestic capital is the subject of socio-economic discrimination by the dominant (domestic and global) economy. Investment in new innovative domestic capacity and product innovation is the basis on which intensive users of domestic capital penetrates the markets of the exclusionary dominant economy. One sector competes by raising labour productivity through intensive use of foreign exchange and adopted international technology. The other competes by raising the productivity of import and saving on foreign exchange through intensive use of domestic capital to invest in new innovative capacity and adapt international technologies. To represent the process of capital accumulation in such an economy that features such dualities, one must employ a disaggregated framework in which the role of the productive sectors is distinguished.

Taking into account of the structure of production, we write GDP (Y) as

1. $Y = p_a X_a + p_b X_b$

where p_a is strategic in character while p_b is exogenous, generated by global price-taking behaviour. To derive real aggregate output and address the price level and the concerns of inflation, the price index or cost of living deflator P is assumed to be a geometric mean with elasticities λ_1 linked to p_a, λ_2 linked to ε and $1-\lambda_1-\lambda_2$ linked to p_b. The geometric mean is used to write

$$2.\quad P = p_a^{\lambda_1} \varepsilon^{\lambda_2} p_b^{1-\lambda_1-\lambda_2}$$

Using the deflator in (2), real GDP is given by

$$3.\quad Q = \frac{Y}{P} = \frac{p_a^{1-\lambda_1}}{\varepsilon^{\lambda_2} p_b^{1-\lambda_1-\lambda_2}} X_a + \frac{p_b^{\lambda_1+\lambda_2}}{p_a^{\lambda_1} \varepsilon^{\lambda_2}} X_b$$

It is perhaps useful to draw attention here to the underlying rationale for full aggregation in Solow, which is that by the aggregation theorem of Hicks (1939) and Leontief (1936), if the weights in (3) are constant, then the set of commodities $\{X_a, X_b\}$ can be regarded as a single commodity whose price would be proportional to that of any member of the set and whose quantity is defined such that total expenditure on the single commodity is the sum of expenditures on the members of the set (Arrow and Hahn, 1971:7). It is clear that the aggregation theorem applies and the economy can be analyzed as a single economy only if all the prices and the exchange rate are simultaneously fixed. Since this condition is not generally applicable to a Caribbean economy, it is necessary to take full account of the duality of the economy in constructing a macroeconomics.

Following James (2002), set $\overline{d} = (\delta + d)$, where d is the differential operator describing the rate of growth and δ is the rate of capital *depreciation in the sense of replacement necessitated by capacity utilization.* Since δ is itself a change operator, $\overline{d}$ is a gross growth operator with the property $d \leq (\delta + d) \leq (1 + d)$. For simplicity, it is often useful to work with the maximum value $(1+d)$, which is to say with a circulating capital model. Also, let c be the consumption rate per worker, p_a and p_b be the foreign price of exports of X_a and X_b respectively, p_M be the price of imports, ε be the domestic price of foreign currency and M_C be the imports of various unproductive requirements by consumers and government. Define the unit amount of output a that is exported to generate import capacity as $e_{am} = \frac{E_{am}}{M^*}$ and that used from output b that is used for a similar purpose as $e_{bm} = \frac{E_{bm}}{M^*}$. The concept raises fundamental issues about both the dependence of the system on export markets and the nature of the domestic claims on export earnings that have been addressed in Best (1968) and Best and Levitt (1969). Our re-specification suppresses details on the composition of import capacity, but since the model is not export-led, the analytical loss is not significant. Expressions for X_a and X_b in James (2002) reflect the disposal of domestic output and factor supplies in the light of effective demand. These are

4. $X_a = \bar{d}(a_{aa}X_a + a_{ab}X_b) + e_{am}M^* + G_a$

$$\frac{X_b}{c} = (\phi_a b_a X_a + \phi_b b_b X_b) + \frac{1}{c}e_{bm}M^* + \frac{G_b}{c}$$

$$M^* = \varepsilon p_M \bar{d}(m_a X_a + m_b X_b) + \varepsilon p_M M_c$$

The first equation of (4) sets out the relation between supply and the effective demand for the output of sector a. This is the same as the relationship between the demand and supply of domestic capital. It describes the amount of domestic capital in effective demand and not a binding capital constraint, so it is assumed that many forms of domestic capital lie idle. The second equation does the same for the output of the import-intensive sector, which also characterizes the demand for available supplies of labour. Thus, the first and second equations do not combine to yield a binding saving constraint in the traditional sense. The third equation is the foreign exchange capacity constraint. It is assumed that this constraint is binding.

The system exhibits no duality between production and prices (or the real and monetary sectors) but discrimination in resource use and duality in the system of production and resource use imply that

5. $a_{aa} < a_{ab}$ and $e_{bm} > e_{am}$ and $b_a > b_b$ and $m_b > m_a$

In (5) the assumptions that $a_{aa} > a_{ab}$ and $e_{bm} > e_{am}$ can be traced to Best (1971; 1980) and a careful reading of Lewis (1954; 1964), in particular the conception of over-investment in imported machinery and equipment in Lewis (1964), reveals that one can already find the assumptions $b_a > b_b$ and $m_b > m_a$ in these works.

1.1 Changes of Real Output

From (3), considering both long and short run forces, we get the change in real output as

6. $dQ = \gamma_a \bar{d}X_a + X_a d\gamma_a + \gamma_b \bar{d}X_b + X_b d\gamma_b$

where $\gamma_a = \dfrac{p_a^{1-\lambda_1}}{\varepsilon^{\lambda_2} p_b^{1-\lambda_1-\lambda_2}}$ and $\gamma_b = \dfrac{p_b^{\lambda_1+\lambda_2}}{p_a^{\lambda_1}\varepsilon^{\lambda_2}}$ and it is assumed that only long run changes in prices are relevant. From (3) and (6), it also follows that the growth of the nominal value of output is given by

7. $dY = P_{t-1}dQ + Q_{t-1}dP$

$$= P[\gamma_a \bar{d}X_a + X_a d\gamma_a + \gamma_b \bar{d}X_b + X_b d\gamma_b] + Q_{t-1}dP$$

We can eliminate the static terms in X_a and X_b from (4) and solve to exhibit a general relationship between the growth of output and investment in domestic capital that takes account of all the key interdependencies relevant to the development of production. In this case, we also use (6) to write the general multiplier relationship with investment that generates dX_a as

$$8. \quad I_k = \bar{d}(a_{aa}X_a + a_{ab}X_b) = \kappa_1 dX_a + \kappa_2 dQ - \kappa_3 M^* - \kappa_4 + G_a$$

where

$$9. \quad \kappa_1 = \frac{(1-\omega\phi_b b_b)\varepsilon p_M m_a \gamma_b - \varepsilon p_M m_b \gamma_a}{[\varepsilon p_M \bar{d}m_b \omega\phi_a b_a + \varepsilon p_M \bar{d}m_a (1-\omega\phi_b b_b)]\gamma_b}$$

$$\kappa_2 = \frac{\varepsilon p_M m_b}{[\varepsilon p_M \bar{d}m_b \omega\phi_a b_a + \varepsilon p_M \bar{d}m_a (1-\omega\phi_b b_b)]\gamma_b}$$

$$\kappa_3 = \frac{(1-\omega\phi_b b_b) + \varepsilon p_M M_c (1-\omega\phi_b b_b) - e_{bm} M \ \varepsilon p_M \bar{d}m_b + G_b \varepsilon p_M \bar{d}m_b}{[\varepsilon p_M \bar{d}m_b \omega\phi_a b_a + \varepsilon p_M \bar{d}m_a (1-\omega\phi_b b_b)]} - e_{am}$$

$$\kappa_4 = \frac{\varepsilon p_M m_b X_a d\gamma_a + \varepsilon p_M m_b X_b d\gamma_b}{[\varepsilon p_M \bar{d}m_b \omega\phi_a b_a + \varepsilon p_M \bar{d}m_a (1-\omega\phi_b b_b)]\gamma_b}$$

1.2 The Quantity of Capital per Unit of Imports

In so far as the central problem of an economy and related financial programming is the scarcity of foreign exchange, the central focus of development policy must be on saving foreign exchange. In the long run this requires increasing the value of output per unit of imports while accumulating domestic capital per unit of imports over time. For the quantity of domestic capital per unit of imports, we first divide all the equations of (4) by $\frac{X_b^*}{c}$ and then use the first and third equations of the resulting system to write

$$10. \quad k_m = \frac{\frac{X_a}{X_b}\bar{d}a_{aa} + \bar{d}a_{ab} + \frac{a_{aa}\bar{d}X_a + a_{ab}\bar{d}X_b}{X_b} + e_{am}\frac{M^*}{X_b} + \frac{G_a}{X_b}}{\pi_M \frac{X_a}{X_b}\bar{d}m_a + \pi_M \bar{d}m_b + \frac{\pi_M m_b \bar{d}X_b + \pi_M m_a \bar{d}X_a}{X_b} + \frac{\pi_M m_C}{X_b}}$$

It can also be shown that an alternative formulation that takes account of all interdependencies is

$$11.\ k_m = \frac{\bar{d}a_{ab} - \varepsilon p_M[\bar{d}\frac{X_b}{M^*}(m_b\bar{d}a_{ab} - a_{ab}\bar{d}m_b) - \bar{d}\frac{X_a}{M^*}(m_a\bar{d}a_{ab} - a_{aa}\bar{d}m_b) - \frac{M_C}{M^*}\bar{d}a_{ab} + \bar{d}m_b e_{am} + \bar{d}m_b\frac{G_a}{M^*}}{\bar{d}a_{ab}\bar{d}m_a + \varepsilon p_M\bar{d}m_b(1-\bar{d}a_{aa})}$$

2. Inflation, the Change of Relative Prices and the Rate of Profit

In this model, it is assumed that relative prices affect output, and moreover that this also implies that *both* domestic price changes and foreign price changes can influence the value of output. The overall rate of inflation is given as the weighted increase in sector prices and the exchange rate,

$$12.\ dP = \varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2}\lambda_1\frac{dp_a}{p_a} + ep_a^{\lambda_1}p_b^{1-\lambda_1-\lambda_2}\lambda_2\frac{d\varepsilon}{\varepsilon} + p_b p_a^{\lambda_1}\varepsilon^{\lambda_2}(1-\lambda_1-\lambda_2)\frac{dp_b}{p_b}$$

Let the factor prices be p_a the price of capital, p_M the price of imports, and w the going wage. We adopt a mark-up pricing system that reflects the growing importance, even dominance, of the capital-producing and capital-intensive sector. Let $\bar{r}$ and $\bar{j}$ be the rates of accumulation, respectively of capital and imported productive means of production. A similar interpretation might be needed of the real wage depending on its dynamism relative to prices in the economy and the extent to which the wage is really a payment for the domestic capital embodied in workers. Thus, the set of price equations are as follows:

$$13.\ p_a = \bar{r}p_a a_{aa} + \bar{j}\varepsilon p_M m_a + p_b\omega\phi_a b_a$$
$$p_b = \bar{r}p_b a_{ab} + \bar{j}\varepsilon p_M m_b + p_b\omega\phi_b b_b$$
$$\frac{p_b}{p_M} = \pi$$

where $\omega = \frac{w}{p_b} = \frac{w}{\pi p_M}$, the real wage defined as the ratio of the money wage to the price of the import-intensive commodity.

With regard to the structure of prices, let $p = \frac{p_a}{p_b} = \frac{p_a}{\pi p_M}$. Substitution of the third equation of (13) into the second and then dividing the first and second equation by πp_M gives the system of relative prices as

$$14.\ p = \bar{r}pa_{aa} + \bar{j}\varepsilon m_a^* + \omega\phi_a b_a$$
$$1 = \bar{r}pa_{ab} + \bar{j}\varepsilon m_b^* + \omega\phi_b b_b$$

where $m^* = \frac{m}{\pi}$. We know that π and p_M are fixed exogenously. We also treat $\bar{r}$ and $\bar{j}$ as differential operators for reasons that are worth pursuing further. We also should keep in mind that for p_b the endogenous variability is principally on the cost side of the equation and that besides the technical conditions, costs are usually adjusted by varying either the exchange rate, ε ,or the wage, ω or p or $\bar{r}$ or $\bar{j}$. To reflect all aspects of the interdependence shaping p and treat import capacity as scarce, one must pay attention to the role of the technical import coefficients in the formation of domestic relative prices. Thus, instead of the traditional approach of eliminating the ω, we eliminate $\bar{j}$ in (14). We get,

$$15.\ p = \frac{m_a^* - \omega\phi_b b_b m_a^* + \omega\phi_a b_a m_b^*}{m_b^* - r(a_{aa} m_b^* - a_{ab} m_a^*)}$$

The result highlights the central role of the technical import conditions of production and growing structural interdependence in shaping relative prices.

The Rate of Profit

If we eliminate p in (14), it is straightforward to show that the rate of return to domestic capital is given by

$$16.\ \bar{r} = \frac{1 - \bar{j}\varepsilon m_b^* + \omega\phi_b b_b}{a_{aa} + \bar{j}\varepsilon(m_a^* a_{ab} - m_b^* a_{aa}) + \omega(\phi_a b_a a_{ab} + \phi_b b_b a_{aa})}$$

and is integrally and nonlinearly related to the returns to labour and to imported productive inputs. Use of (16) in (15) yields relative prices in terms of the rate of profit on domestic capital, the rate of return to imported productive inputs and the real wage. The rate of return on domestic capital predicted in (16) is important because it motivates the analysis of domestic credit as well as saving behaviour in the economy. It demonstrates that under the conditions of duality in the Caribbean economy, the rate of profit that motivates the demand for domestic and international credit depends on the rate of return linked to imported productive inputs, the price of scarce foreign exchange, and the wage. In general, this rate of profit is not the same as that predicted by the Solow model. As Mankiw, Romer and Weil (1992) remind us, the scarcity principle of Solow means that the marginal product of capital predicts the rate of profit on domestic capital. This reduces to the claim that the Mankiw, Romer and Weil results predict that only a special case of (16) will apply in economies such as the Caribbean. In general, this is the case in which (16) behaves as a plane in (r, j, w) space that would ensure stability in the growth dynamics. However, apart from the need to assume that workers work at the desired speed, the conditions for such a plane to exist are

17. $(m_a^* a_{ab} - m_b^* a_{aa}) = 0 \quad (\phi_a b_a a_{ab} + \phi_b b_b a_{aa}) = 0$

so that all sectors use domestic capital and imports with the same relative intensity. Under such conditions, it would also be true that prices are independent of relevant quantities such as the quantity of capital per unit of imports (James, 2002). Further, it would hold that Caribbean countries would differ from others in their rate of return to domestic capital according to the relative degree of development and the associated intensity of employment of domestic capital as a factor input in its productive sectors. However, these conditions cannot hold in the presence of the form duality that expresses the prevalence of vast amounts of unemployed domestic capital, systematic discrimination, and the resulting need for some sectors to use domestic capital more intensively than in others in an effort to innovate and break into the mainstream markets (Best, 1971). In particular, the marginal product does not adequately predict the rate of profit since the latter also it depends on how technologies differ among sectors and in particular on the systematic differences in the import intensity of production in the sectors of the economy fostered by conditions of duality in the production system.

The Social Rate of Return

Now, associated with (16) is a social rate of return that is crucial for guiding the efforts by government to devise practical fiscal policy interventions that could ensure socially optimal allocation of government resources. How the social return is aligned with the predicted rate of return in (18) is an important concern from the viewpoint of the policy-maker managing the budget balance consistent with the other policy targets. It is widely accepted to be sensible for government to eliminate spending on market development in cases where the social rate is below the private rate, except in so far as this spending is needed to support the efforts of the poor to acquire their share of the attractive capital. However, where the social rate of return is predicted to be above the private rate, the problem of market failure would abound unless government intervenes with appropriate public sector investment programs and financial sector reforms. A good example of this is programs that establish student credit systems to allow investment in education capital.

Now since growth is explicitly in the model above and the stocks of capital and imported productive inputs are growing in each period, it is interesting to use (11) in specifying the social rate of return since it focuses on the quantity of domestic capital per unit of imported capital. Here, keeping in mind the value of total output in (1) and (4), the value of output per unit of imported inputs can be written in terms of the value of capital per unit of imported inputs in a Caribbean economy as

18. $\gamma_m = (1+g)(k_m + e_m - 1) + c_m + m_{mc}$

So, the quantity of output per unit of imports procured with scarce foreign exchange is a function of investment in domestic capital relative to investment in imported inputs, exports per unit of imported productive inputs, worker consumption of domestic output per unit of imported after taking account of the influences of state policy and consumption choices. The output per unit of imported productive inputs generated in each of two distinct periods can now be represented as

$$19.\ \gamma_{m1} = (1+g)(k_{m1} + e_{m1} - 1) + c_{m1} + m_{mc1}$$
$$\gamma_{m2} = (1+g)(k_{m2} + e_{m2} - 1) + c_{m2} + m_{mc2}$$

The idea is that in order to start with output γ_{m1} and generate output γ_{m2} the economy must install and operate capital per unit of imported inputs k_{m2}. Now, in order to move from one technique to another, in time, output must first be produced against the background of a new temporarily reduced consumption level of $\bar{c}_m + \bar{m}_{mc}$. Then a new technique can be introduced through investment. The output of period 1 must be consistent with the reduced consumption scheme, so we must have

$$20.\ \gamma_{m1} = (1+g)(k_{m2} + e_{m2} - 1) + \bar{c}_m + \bar{m}_{mc}$$

Let $c^* = \bar{c}_m + \bar{m}_{mc}$. Following Solow, the *social rate of return* is treated as the ratio of gain in consumption capacity tomorrow, which is to say the growth of consumption per unit of imports, to the sacrifice or real savings today. That is

$$21.\ \rho = \frac{c_2 - c_1}{c_1 - c^*}$$

On the monetary side, the general claim is that the rate of profit at which a specific domestic capital/import is chosen (or a switch of technique occurs) is equal to the social rate of return. The rate of profit from any technique identifies the objective gain households consider in return for the sacrifice of saving. The intertemporal interpretation of efficiency prices also follow from this. Prices measure intertemporal efficiency in the sense that they give rise to a rate of profit which equals the social rate of return on saving and hence measures the gain in consumption due to saving (abstinence). From the model of distribution in (13) or (14), we can get

$$22.\ y_m = (1+r)k_m + \omega(l_m + m_{cm}) + (1+j)\varepsilon$$

and the equations for two time periods can be written as

$$23.\ y_{m1} = (1+r)k_{m1} + \omega_1 l_{m1} + \omega_1 m_{cm1} + (1+j_1)\varepsilon_1$$
$$y_{m2} = (1+r)k_{m2} + \omega_2 l_{m2} + \omega_2 m_{cm2} + (1+j_2)\varepsilon_2$$

Substitution from (19) and (20) into (21) gives

$$24.\ \rho = \frac{(y_{m2} - y_{m1}) - (1+g)(k_{m2} + e_{m2} - 1) + (1+g)(k_{m1} + e_{m1} - 1)}{(1+g)(k_{m2} + e_{m2} - 1) - (1+g)(k_{m1} + e_{m1} - 1)}$$

Substitution from (23) into (24 then gives

$$25. \quad \rho = \frac{(1+r)(k_{m2}-k_{m1})+(\omega_2 l_{m2}-\omega_1 l_{m1})+(\omega_2 m_{cm2}+\omega_1 m_{cm1})+(1+j_2)\varepsilon_2-(1+j_1)\varepsilon_1}{(1+g)[(k_{m2}+e_{m2}-1)-(k_{m1}+e_{m1}-1)]}-1$$

The result indicates that the social rate of return will tend to be different from the private rate, depending on whether growth is non-zero and whether this growth is based on changes in the quantity of capital per unit of import capacity and exports per unit of import capacity over time as well as changes in the wage rate, the rate of profit and the exchange rate.

One important consequence of (25) for the new Solow oriented models underlying its IMF financial programming is that none of the standard conditions normally mentioned in Solovian analysis ensures that the social rate of return predicts the private rate of profit. First, it is usual to hold that for $\rho = r$ and hence for the neoclassical theory of capital pricing and convergence of the social and private rates of return to make sense over time, it is necessary and sufficient that $g = 0$ and the economy operate in a stationary state. Under this condition, it makes sense to hold that household savings are elicited by prospective rewards of future consumption at a rate of return (interest) equal to the general rate of profit on productive assets, and that this is underpinned by a marginal productivity pricing process. One can then use the social rate of return (and hence the general rate of profit) as a discounting rate to determine the future value stream which will compensate for the current level of sacrifice of consumption. It would then follow that the equilibrium wage rate must be that which allows this rate of return to exist, and hence must be that rate which is consistent with marginal productivity pricing. The wage rate is therefore that which is consistent with intertemporal utility maximization. One consequence of having $g = 0$ would then be that the rate of profit and prices can be explained completely in intertemporal terms. However, apart from the fact that the condition of zero growth is untenable in Caribbean economies if development is to occur, equation (25) does not yield the result that $\rho = r$ when $g = 0$.

Second, one way out of the above problem is usually to claim that the social rate would converge to the private rate if $g_1 k_{m1} = g_2 k_{m2}$ and the growth rate is the same in both periods. One can extend this to assume that $ge_{m2} = ge_{m1}$ and the growth rate of exports is the same in both periods. That is, if the economy is experiencing steady growth, then Solovian claims about savings behaviour and pricing make sense. However, when these conditions apply, (25) yields

$$26. \quad \rho = \frac{(\omega_2 l_{m2}-\omega_1 l_{m1})+(\omega_2 m_{cm2}+\omega_1 m_{cm1})+(1+j_2)\varepsilon_2-(1+j_1)\varepsilon_1}{(k_{m2}-k_{m1})+(e_{m2}-e_{m1})}+\frac{r(k_{m2}-k_{m1})-(e_{m2}-e_{m1})}{(k_{m2}-k_{m1})+(e_{m2}-e_{m1})}$$

which also does not suggest that $\rho = r$. Specifically, the social rate of return is now the ratio of the rate of profit times a factor that depends on the difference in the quantity of capital per unit of imported inputs and the difference in the quantity of exports per unit of imported productive inputs plus an additional factor that features three additional elements in a ratio to the difference in the quantity of capital per unit of imported inputs and the difference in the quantity of exports per unit of imported productive inputs. The first is the change in the product of the wage rate and the quantity of labour per unit of imported inputs. The second is the change in the product of the wage rate and the quantity of consumption of imports per unit of imported productive inputs. The third, perhaps most interesting, is the change in the product of the rate of return and exchange rate. Equation (26) yields $\rho = r$ if and only if

27. $e_{m2} - e_{m1} = 0$ and $(\omega_2 l_{m2} - \omega_1 l_{m1}) + (\omega_2 m_{cm2} + \omega_1 m_{cm1}) + (1 + j_2)\varepsilon_2 - (1 + j_1)\varepsilon_1 = 0$

In Solow's story, at t_1 there is a given labour-force among the consumers making the sacrifice. Over time, this labour force is growing at some given rate $(g_n + \gamma)$ after adjusting for growth of worker efficiency due to improvements in management skills and technological conditions including those embodied in domestic capital and imports. It is widely accepted that there are direct and spillover gains which accrue from this growth and from the sacrifice of current consumption to ensure they can work with adequate capital and imports. Solow's model actually implies larger gains to a larger population and one would expect that the same applies to the supply of import capacity. However, this does not imply that the different supplies are growing at the same rate in all periods. It follows that per capita gains are changing and might be either smaller or larger. If we allow technological change in, the gains per capita of the employed labour force are usually larger due to changes in labour or import efficiency. The historical evidence is that this has affected the wage rate or the returns to imported productive inputs and that at least different wage and rates of return to imported productive inputs underlie the shift from c_1 to c_2.

So in a typical Caribbean economy where all of these factors are expected to change as development proceeds, it is not true that the Solow story makes sense of either the pricing process or the manner in which the system induces a flow of savings of foreign exchange and domestic value to facilitate accumulation of capital per unit of imports. Instead, we now have a system which induces savings flows through a social rate of return that does not predict the private rate of return well because it is larger or smaller depending on the way changes occur in the identified factors. This is perhaps not surprising because under the conditions of a dual economy in which development is the primary concern, there is no reason why movement from one time period to another should leave the growth rates the same, especially k_m is changing as the system saves of scarce foreign exchange by changing the quality and productivity of capital and imported productive inputs.

3. Domestic Credit and the Money Market

Once the Solow conditions break down, other special issues related to the fact that r is just (a component of) an equilibrium (which need not be stable) can be considered. For example, the striking feature of (16) is the separation of the rate of return to capital from that to imports. In general, there is much going for the expectation that $j > r$ for reasons of the very tight balance of payments conditions and many aspects of the institutional conditions of employment of imported factors long identified by Best (1968). This is actually only a general representation of a larger problem in which some forms of domestic capital earn rates of return below the marginal product of capital due to discrimination on the employment side and the creation of artificially large numbers of unemployed tacit and codified knowledge and other domestic capital. Further, absorption of discriminated capital occurs under conditions of innovation in the Caribbean, as in most places in the world. The rate of return that would validate such innovations would tend to be significantly larger than the marginal product of capital. All of these would contradict the finding that Solovian scarcity and the marginal product of domestic capital shapes the rate of return to domestic capital. The results also sheds light on the concerns addressed in World Bank circles that the rate of return on human capital is not converging with sufficient speed around the world (De Ferranti, et al, 2003; Psacharopoulos and Patrinos, 2002). Of particular importance here, the failure of the Solow conditions brings into the open that power of monetary dynamics in a Caribbean environment rests on the sophistication of the financial sector to move resources, generally and import capacity in particular, from the import-intensive sector to the capital intensive sector as development occurs (James, 2002). The instruction for the financial programming model is that, keeping in mind the history of capital accumulation in the Caribbean, with particular regard to the exclusion of domestic capital from many of the dominant credit sources and the failure of the financial sector to develop adequate instruments to accommodate and manage risk in this sector, it is necessary to disaggregate the money supply sufficiently if monetary policy is to be adequate.

Domestic Credit

For this purpose, we write the equations for total domestic credit (*dL*) as the sum of credit to government *(dL_g)*, credit under conditions of discrimination to the capital-intensive sector *(dL_a)* and the traditional free flow of credit to the traditional import-intensive sector *(dL_b)*,

28. $dL = dL_g + dL_a + dL_b$

It is known that because of discrimination even when the sector is innovating, dL_a does not grow in a close relation with output but dL_b does. So bearing in mind the second equation of (4), the flow of credit to sector *b*, essentially a combination of working capital and consumer credit, is assumed to be of the form

29. $dL_b = \theta dY$

Money Supply

The conception of the money supply as the sum of foreign reserves (Z) and total domestic credit (L) to domestic entities is adopted, so we can write

$$30.\ dU_s = dL + dZ$$

If reserves of a certain level are being targeted, it would be achieved by varying the exchange rate, so we also follow the RMSM-X model in writing

$$31.\ dZ \;=\; \varepsilon dZ^*$$

Money Demand

As indicated in Polak (1957) and Barth and Hemphill (2000), if the conception of the velocity of money (V) is that of income velocity (as distinct from the transactions velocity), it is appropriate to write the change in demand for money as

$$32.\ dU_d = \frac{dY}{V}$$

Money Market Equilibrium

In a dynamic mode, the assumption of money market equilibrium gives

$$33.\ dU_d = dU_s$$

4. Trade and the Foreign Exchange Constraint

The basic system for the analysis of the foreign exchange supply constraint is exhibited in (4). If a policy concern is to retain a certain level of reserves, then we can use (4) to write the change in reserves as the trade balance plus the cover provided by foreign inflows. That is

$$34.\ dZ = E^* - M^* + dF$$

where, note, $E^* = p_a E_a + p_b E_b$. Foreign capital inflows are given by

$$35.\ dF = \varepsilon dF^*$$

$= dF_g + dF_p$

Imports

It is assumed that consumer imports, M_C, grow as innovative capacity accumulates abroad. In the long-run, domestic consumption of imports vary directly with $\frac{p_a}{\varepsilon p_M}$,the terms of trade between competing capital-intensive products and imports, Y the level of output and income in the system as a whole, $\frac{M_a}{X_{aa}}$ the measure of the relative levels of imported innovative capacity and domestic innovative capacity and p_b the price of exports of X_b (Best, 1980). In particular,

$$36.\ M_C = \alpha_c p_b^{\psi_b} (\frac{\varepsilon p_M}{p_a})\psi_C (\frac{M_a}{X_{aa}})^{\gamma} Y^{\pi}$$

where α_c is a constant, $\psi_C < 0$ is the relative price (terms of trade) elasticity of demand for final consumer imports, $\psi_b > 0$ is the elasticity of demand for final consumer imports with respect to changes in the price of X_b, $\gamma > 0$ is the technology elasticity of demand for imports and $\pi > 0$ is the income elasticity of demand for consumer imports. Observe that the measure of domestic capacity to innovate is X_{aa}, the level of domestic capital installed in sector a. Thus,

$$37.\ \frac{dM_C}{M_C} = [\psi_b \frac{dp_b}{p_b} + \psi_C \frac{d\varepsilon}{\varepsilon} + \frac{dp_M}{p_M} - \frac{dp_a}{p_a}) + \gamma(\frac{dM_a}{M_a} - \frac{dX_{aa}}{X_{aa}}) + \pi \frac{dY}{Y}]$$

Further, from (4), the real quantity of imports is given by

$$38.\ M = \frac{M^*}{\varepsilon p_M} = \overline{d}(m_a X_a + m_b X_b) + M_C$$

So,

$$39.\ \varepsilon p_M dM + M p_M d\varepsilon + M \varepsilon dp_M = dM^*$$

From the second equation of (38),

$$40.\ dM = d[\overline{d}(m_a X_a + m_b X_b) + M_C \frac{dM_C}{M_C}]$$

Then, following the strategy of the RMSM-X model of Easterly (1999) and Kenny and Williams (2001), we use (37) in (40) and write the autoregressive form of the growth of the value of imports as

$$41.\ M^* = M^*_{t-1} + \varepsilon_{t-1}\{p_M d[\bar{d}(m_a X_a + m_b X_b)] + [Mdp_M + p_M(M + dM)]\frac{d\varepsilon}{\varepsilon}$$

$$+ M_C\{[\psi_b \frac{dp_b}{p_b} - \psi_C(\frac{dp_a}{dp_a} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}) + \gamma(\frac{dM_a}{M_a} - \frac{dX_{aa}}{X_{aa}}) + \pi\frac{dY}{Y}]]\}$$

Exports

In any policy model designed for a Caribbean economy, one must note that such an economy cannot export as much as it pleases. In the short run much depends on price shocks and in the long run much depends on how export demand elasticities are shaped in the economies of the dominant trading partners as well as the comparative rate of development of the technologies embodied in the exports. We concern ourselves with the long run and, in contrast to the IMF tradition as exhibited in the models from Polak (1956) to Mikkelsen (1998), return to the early traditions of Caribbean economists from Prebisch to Seers to write explicit export functions for the growth of exports. Here again disaggregation is necessary, so two distinct specifications are needed as in James (2002). Exports from sector a, E_a, are really competing with suppliers abroad. But pricing is driven by innovation and taste formation which allows a rising price relative to that of substitutes even as the amount the foreigners buy rises. E_a also vary directly with the relative levels of domestic innovative capacity and imported innovative capacity, due for example to favourable effects on taste formation processes and p_a .Specifically,

$$42.\ M_{Y^*_a} = E_a = \beta_a(\frac{p_a}{\varepsilon p_M})^{\mu_a}(\frac{X_{aa}}{M_a})^{\gamma^a_d}\,Y^{*\in_a}$$

where β_a is a constant, $\mu_a > 0$ is the relative price (terms of trade) elasticity of demand for E_a, which takes a positive value because of the influence of innovation on taste and price formation, $\in_a > 0$ is the income elasticity of demand for E_a, and $\gamma^a > 0$ is the technology elasticity of demand for E_a.

In the case of E_b, exports are produced by intensive use of imported inputs. The higher the price of these inputs relative to the price of the exports, the lower the profitability of production and hence the lower the rate of exports. At the same time, increasing relative use of innovative imported productive inputs raise profitability and the level of E_b even though this must be complemented by increasing investment in domestic capital. Thus, using $\frac{\varepsilon p_M}{p_b}$ as the cost/price ratio, write

$$43.\ M_{Y_b^*} = E_b = \beta_b(\frac{\varepsilon p_M}{\varepsilon p_b})^{\mu_b}(\frac{X_{ab}}{M_b})^{\gamma_a^b} Y^{*\in_a}$$

where β_b is a constant, $\mu_b < 0$ is the price elasticity of demand for E_b, $\gamma^b > 0$ is the technology elasticity of demand exports, and $\in_b > 0$ is the income elasticity of demand for E_b. The price elasticities are influenced by technological progress to be very small since product diversification tends to make them irrelevant and since prices are mostly invariant (in the output time scale) when (domestic) capital-intensive industrial activity is involved. It is assumed that $\in_a \geq \pi$ to reflect the proposition of Best (1980) that tastes are also shaped by the evolution of capital-intensive activity in the residentiary sector and that $\in_b < \pi$ to reflecting the ideas of Prebisch and Seers.

Equation (42) implies that the growth of the capital-intensive exports is given by

$$44.\ \frac{dM_{Y_a^*}}{M_{Y_a^*}} = \frac{dE_a}{E_a} = \mu_a^*[\frac{dp_a}{dp_a} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}] + Y_a^*(\frac{dX_{aa}}{X_{aa}} - \frac{dM_a}{M_a}) + \in_a^* \frac{dY^*}{Y^*}$$

which indicates a favourable influence of domestic price-making and domestic technological development and associated normal foreign income elasticity on exports of E_a. Assuming $\lambda > 0$, the term $(\frac{dX_{aa}}{X_{aa}} - \frac{dM^*}{M^*})$ is the crucial non-price competition factor of the economy. From (43), the growth of import-intensive exports is given by,

$$45.\ \frac{dM_{Y_b^*}}{M_{Y_b^*}} = \frac{dE_b}{E_b} = \gamma_b^*[\frac{dX_b}{X_b} - \frac{dX_{ab}}{X_{ab}}] + \mu_b^*[\frac{dp_b}{p_b} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}] + \in_b^* \frac{dY^*}{Y^*}$$

Here, the first term in (45) describes the critical role of technology adoption in increasing exports of the import-intensive sector E_b, a hypothesis that is explicit in Best (1980). The second term describes the favourable influence of changing (improving) terms of trade, if any, on $\frac{dE_b}{E_b}$. The last term introduces the foreign income elasticity of exports on the hypothesis that the income elasticity of demand for traditional exports shows some characteristics of inferior goods. Rising foreign incomes slows demand for traditional exports. Since p_b is given by the price-taking characteristics of sector b, it could be treated as given exogenously, but in a trade model it is endogenous to the trading partner and explicitly accounted for.

If we then adopt a strategy similar to (41), we can write

$$46.\ E^* = E^*_{t-1} + p_a E_a \frac{dE_a}{E_a} + E_a \frac{dp_a}{p_a} + p_b E_b \frac{dE_b}{E_b} + E_b \frac{dp_b}{p_b}$$

Then, using (44) and (45), we get

$$47.\ E^* = E^*_{t-1} + p_a E_a \{\mu^*_a [\frac{dp_a}{dp_a} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}] + Y^*_a (\frac{dX_{aa}}{X_{aa}} - \frac{dM_a}{M_a}) + \in^*_a \frac{dY^*}{Y^*}\} + E_a \frac{dp_a}{p_a}$$

$$+ p_b E_b \{\gamma^*_b [\frac{dM_b}{M_b} - \frac{dX_{ab}}{X_{ab}}] - \mu^*_b [\frac{dp_b}{p_b} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}] + \in^*_b \frac{dY^*}{Y^*}\} + E_b \frac{dp_b}{p_b}$$

This equation will prove significant in the design of strategic policy interventions to pursue key targets of growth of foreign reserves.

5. The Budget Constraints

Two key sets of budget constraints are represented here: government and the private sector, featuring that for enterprises and that for consumers.

Government Budget Constraint

It is assumed that the government budget balance is governed by its ability to adjust borrowing in the local market (dL_g) and the foreign market (dF_g). That is,

$$48.\ G - T = dL_g + dF_g$$

Private Sector Budget Constraints

The private sector is also assumed to be constrained by the ability of each productive sector to raise domestic operating capital (dL_a and dL_b) as well as by the development of the domestic demand for money as determined by the overall flow of income and by its ability to attract foreign direct capital flows, whether or not as credit. That is

$$49.\ (Y - C_p - T) - I = dU_d - dL_b - dL_a - dF_p$$

Household consumption is treated as a function of the disposable income and any significant choices households make about their saving rate. So,

$$50.\ C_p = (1-s)(Q-T)$$

6. The Reduced Policy Model

Reduction of the model is designed to retain focus on the target variables of growing reserves dZ, inflation dP and output growth dQ. However, this can be done by targeting growth of dZ, dX_a *and* dp_a/p_a since in a dual Caribbean economy one can treat the output of dX_b and dp_b/p_b as essentially exogenous in a policy model. Using policy instruments, dL_g and dL_a, $d\varepsilon$, G and T, the targeted variables could be influenced subject to the behaviour of a set of endogenous variables dY, dL_b, dU, dP, dE_a, dE_b dM and $G\text{-}T$. In addition to dX_b, the exogenous variables are foreign inflows dF, change of exports of import-intensive output dE_b and all the technology variables, dX_{aa}/X_{aa}, dX_{ab}/X_{ab}, dM_a/M_a and dM_b/M_b.

To find the reduced form of the model for the rate of domestic inflation, we first, substitute from (50) into (49), then use (32) and reorganize to get

$$51.\ I + \frac{dY}{V} = Y - (1-s)Q + (1-s)T - T + dL_b + dL_a + dF_p$$

Then, substitute for I from (8), use (7) and substitute for dY. Assume that $sY_{t-1} = Y - (1-s)Q$ and then use (35) and substitute for dF_p. Next, use (48) and substitute for dF_g and then use (29) and substitute for dL_b and again use (7) and reorganize the result to get

$$52.\ dP = \frac{[(V\theta - 1)P_{t-1}) - \kappa_2 V]dQ}{Q_{t-1}(1-V\theta)} - \frac{\kappa_1 V \bar{d}X_a}{Q_{t-1}(1-V\theta)} + \frac{\kappa_3 VM^* + \kappa_4 V - VG_a + V[sY_{t-1} + (1-s)T + dL_a + dF - G + dL_g]}{Q_{t-1}(1-V\theta)}$$

Moreover, use of (12) to isolate the rate of adjustment of the prices of capital-intensive output that favours the growth of the output of the capital-intensive sector gives

$$53.\ \frac{dp_a}{p_a} = \frac{[(V\theta - 1)P_{t-1}) - \kappa_2 V]dQ}{Q_{t-1}(1-V\theta)(\varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2}\lambda_1)} - \frac{\kappa_1 V \bar{d}X_a}{Q_{t-1}(1-V\theta)(\varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2}\lambda_1)}$$

$$+ \frac{\kappa_3 VM^* + \kappa_4 V - VG_a + V[sY_{t-1} + (1-s)T + dL_a + dF - G + dL_g]}{Q_{t-1}(1-V\theta)(\varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2}\lambda_1)}$$

$$-\frac{\varepsilon^{1-\lambda_2} p_a^{1-\lambda_1} \lambda_2}{\lambda_1} \frac{d\varepsilon}{\varepsilon} - \frac{p_b^{\lambda_1+\lambda_2} p_a^{1-\lambda_1} (1-\lambda_1-\lambda_2)}{\lambda_1} \frac{dp_b}{p_b}$$

Similarly, reorganizing (57) and using (12) gives the growth of aggregate output as

$$54.\ dQ = \frac{\kappa_1 V \bar{d} X_a}{(V\theta - 1)P_{t-1} - \kappa_2 V} - \frac{\kappa_3 V M^* + \kappa_4 V - VG_a + V[sY_{t-1} + (1-s)T + dL_a + dF - G + dL_g}{(V\theta - 1)P_{t-1} - \kappa_2 V}$$

$$+ \frac{Q_{t-1}(1-V\theta)}{(V\theta-1)P_{t-1} - \kappa_2 V} [\varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2} \lambda_1 \frac{dp_a}{p_a} + \varepsilon p_a^{\lambda_1} p_b^{1-\lambda_1-\lambda_2} \lambda_2 \frac{d\varepsilon}{\varepsilon} + \frac{p_b p_a^{\lambda_1} \varepsilon^{\lambda_2} (1-\lambda_1-\lambda_2)}{\lambda_1} \frac{dp_b}{p_b}]$$

However, this also gives the growth of the capital-intensive output as

$$55.\ \bar{d} X_a = \frac{[((V\theta - 1)P_{t-1}) - \kappa_2 V] dQ}{\kappa_1 V}$$

$$+ \frac{\kappa_3 V M^* + \kappa_4 V - VG_a + V[sY_{t-1} + (1-s)T + dL_a + dF - G + dL_g]}{\kappa_1 V}$$

$$- \frac{Q_{t-1}(1-V\theta)}{\kappa_1 V} [\varepsilon^{\lambda_2} p_a p_b^{1-\lambda_1-\lambda_2} \lambda_1 \frac{dp_a}{p_a} + \varepsilon p_a^{\lambda_1} p_b^{1-\lambda_1-\lambda_2} \lambda_2 \frac{d\varepsilon}{\varepsilon} + p_b p_a^{\lambda_1} \varepsilon^{\lambda_2} (1-\lambda_1-\lambda_2) \frac{dp_b}{p_b}]$$

Finally for the growth of reserves dZ we use (3), (6), (34) (the foreign exchange constraint), (41) and (47) to get

$$56.\ dZ = dF + E_{t-1}^* - M_{t-1}^*$$

$$+ E_a \frac{dp_a}{p_a} + (E_b - M_C \psi_b) \frac{dp_b}{p_b} - \varepsilon_{t-1} \{p_M d[\bar{d}(m_a X_a + m_b X_b)] + [M dp_M + p_M (M + dM)] \frac{d\varepsilon}{\varepsilon}$$

$$+ (p_a E_a \mu_a^* + M_C \psi_C (\frac{dp_a}{dp_a} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M}) - (p_b E_b \mu_b^* + M_C \psi_C (\frac{dp_b}{dp_b} - \frac{d\varepsilon}{\varepsilon} - \frac{dp_M}{p_M})$$

$$+ (p_a E_a \gamma_a^* + M_C \gamma)(\frac{dX_{aa}}{X_{aa}} - \frac{dM_a}{M_a}) + p_b E_b \gamma_b^* (\frac{dM_b}{M_b} - \frac{dX_{ab}}{X_{ab}})$$

$$+ (p_a E_a \in_a^* + p_b E_b \in_b^*) \frac{dY^*}{Y^*} - M_C \pi \frac{dQ}{Q} - M_C \pi \frac{dP}{P}$$

or

$$57.\ dZ = dF + E_{t-1}^* - M_{t-1}^*$$

$$+E_a\frac{dp_a}{p_a}+(E_b-M_C\psi_b)\frac{dp_b}{p_b}-\varepsilon_{t-1}\{p_M d[\bar{d}(m_aX_a+m_bX_b)]+[Mdp_M+p_M(M+dM)]\frac{d\varepsilon}{\varepsilon}$$

$$+(p_aE_a\mu_a^*+M_C\psi_C(\frac{dp_a}{dp_a}-\frac{d\varepsilon}{\varepsilon}-\frac{dp_M}{p_M})-(p_bE_b\mu_b^*+M_C\psi_C(\frac{dp_b}{dp_b}-\frac{d\varepsilon}{\varepsilon}-\frac{dp_M}{p_M})$$

$$+(p_aE_a\gamma_a^*+M_C\gamma)(\frac{dX_{aa}}{X_{aa}}-\frac{dM_a}{M_a})+p_bE_b\gamma_b^*(\frac{dM_b}{M_b}-\frac{dX_{ab}}{X_{ab}})$$

$$+(p_aE_a\in_a^*+p_bE_b\in_b^*)\frac{dY^*}{Y^*}$$

$$-M_C\pi\frac{[\gamma_a\bar{d}X_a+X_ad\gamma_a+\gamma_b\bar{d}X_b+X_bd\gamma_b]}{\frac{p_a^{1-\lambda_1}}{\varepsilon^{\lambda_2}p_b^{1-\lambda_1-\lambda_2}}X_a+\frac{p_b^{\lambda_1-\lambda_1}}{p_a^{\lambda_1}\varepsilon^{\lambda_2}}}-M_C\pi\frac{dP}{P}$$

This is a fully simultaneous policy model. For targeting the budget balance, capital accumulation, aggregate output and inflation constrained by the balance of payments or capacity to import, equations (52), (55), (57) and (59) represent an alternative to the system (52), (54), (56) and (58) though the latter would still be an improvement on the fully aggregated IFI models. In particular, if one observes that the component dX_b can reasonably also be treated as exogenous in dQ it is entirely reasonable for government to consider using (55) as its output target equation since dX_a is subject to its direct and indirect influence through both fiscal and monetary policy instruments. To achieve the targeted capital-intensive output, supporting price adjustments and reserves, government would still be motivated to use policy instruments such as less borrowing and overall spending in a context of its revenue collection efforts and overall revenues. Government might also be able to calibrate the exchange rate if the technical coefficients allow. Moreover, the aggregate trade patterns are explicit so that the link to wise trade liberalization can be exhibited and considered.

However, as equation (56) shows, the structure of spending can be also be used as a policy instrument to favour the development of the capital-intensive sector in the process of stimulating overall growth. Furthermore in a context of the need to eliminate systematic historical discrimination against the capital producing sector, (56) and (57) indicates that government would be wise to consider reform of the financial sector to break down market discrimination and improve the flow of domestic credit to the capital producing sector. This is usually good policy since the poor are major owners of domestic capital assets. Considering (10) or (11), any targeting of government demand to sector a will create conditions under which the associated contracts can incorporate the insurance of government demand into the risk-taking capacity of sector a and expand its capacity to draw on credit from the financial sector. At the same time, the financial sector can be reformed to better manage the risks of an expanded supply of credit to sector a as its demand for credit grows with economic development.

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