DEVALUATION IN DEVELOPING COUNTRIES

by

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The purpose of this paper is to study the effects of a devaluation on the economic variables of major concern in a non-oil producing developing country. The question of whether a devaluation can be expected to produce effects similar to those experienced in industrial countries is of considerable practical interest. For example, the International Monetary Fund has frequently been critized for recommending devaluation in developing countries faced with non-transitory current account deficits. Opponents of devaluation point to the rudimentary economic structure of these countries and take the empirical fact that terms of trade are usually exogenous to these countries (with few exceptions) as an indication of the impotence of devaluation to redress the current account. The only clear-cut effect of devaluation would then be a rise in domestic prices. In this paper I argue that, even when the terms of trade remain unaffected, devaluation can have strong effects on the domestic relative price structure and thus on the sectoral allocation of resources, on development of the economy, and on the current account.

The structure of this paper is as follows. The distinguishing features of relevance for the analysis, common to many developing countries, are described in Section I. On the basis of these particular characteristics exchange rate policy in those countries is analyzed in Section II. For this purpose a simple general equilibrium model for medium-term growth and incorporating the major structural conditions prevalent in these countries is proposed. This model is then used for simulation of devaluation under various circumstances with respect to economic structure and policy menus. The main results are summarized in the conclusion.

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I. Characteristics of Developing Countries Relevant for Exchange Rate Policy

The class of developing countries with which this paper is concerned is defined by the following features which are of importance for the subsequent analysis of currency devaluation.

1. Production and Trade

In these economies, the manufacturing sector usually is small and little diversified. The major part of gross national product is generated by the agricultural sector and by services. Large parts of agricultural production are destined exclusively to the home market (these goods may be considered as nontradeables) while only few products are exported ; in some countries, mining products represent the major source of foreign exchange earnings. In any case, product diversification of exports is generally low, and prices for exports (agricultural products, minerals, standardized manufacturing products) lie outside of the control of any individual country and are determined on world markets.(1) Hence, fluctuations in world demand for a commodity representing a high share of total exports translate in strong fluctuations in export receipts. On the other hand, price-taking implies that exports are usually constrained by domestic supply and less so by foreign demand which may be considered as infinitely elastic for all practical purposes.

Imports into these countries provide a large share of equipment for domestic investment and often of raw materials and intermediate products for local production.(2) Therefore, for a given target of domestic production and investment it is extremely difficult in the short run to reduce imports of these three categories of goods through price incentives or otherwise. In some cases, food imports are necessary for the subsistance of the local

(1) Notable exceptions are, e.g., coffee for Brazil, bauxit for Jamaica, crude oil for members of OPEC ; these cases are excluded from the analysis in this paper.

(2) In more advanced developing countries imports of consumer goods, including luxury goods, become more important.

population so that total imports may not be depressible in the short-run.[1] With respect to price incentives this means that domestic demand for imports is inelastic in the short run. In general, however, substitution of imported or import-intensive consumer goods and of intermediary goods is always feasible in the medium run for which import demand may safely be considered as elastic.

Clearly, most developing countries are price-takers for all imported commodities (i.e., the supply elasticity of imports is infinite) so that, combined with the same phenomenon on the export side, a devaluation of the currency is unlikely to affect the terms of trade. A devaluation is therefore not an appropriate policy for stimulating export demand nor a necessary one for that matter. Moreover, if domestic production and investment are not to be lowered, the extent to which import demand can be discouraged in the short-run is necessarily limited. However, as will be shown later, one should not jump to the conclusion that, in the short run, a devaluation will have no or only negligeable effects on the balance of payments. But any positive effect beyond, possibly, the reduction of inessential imports, must be generated by a short-run increase in the supply of exports. In the medium run the effects of devaluation will be exerted through both import substitution and increased export supply.

2. Investment and Financial Conditions

Investment in developing countries typically relies on imported capital goods. One constraint on domestic investment is therefore the availability of foreign exchange. Although this constraint is a severe one, there are at least three more with which these countries have to cope : a low savings rate of the private sector, lack of entrepreneurship, and low return and high risk on private investment. Governments therefore regularly attempt to reduce the savings gap through forced savings. Due to the administrative difficulty of direct and indirect taxation (other than tariffs and taxes on foreign trade) in these economies, forced savings often take the form of an inflation tax : government deficits are financed by increases in the domestic money supply and the excess supply of money, in turn, sets

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[1] But in most of these cases it can be verified that imports of staple foods are only necessary because domestic disincentives depress local production of food.

an inflationary process into motion which then poses thorny problems for maintaining external equilibrium. With a fixed exchange rate, internal inflation leads to a loss of competitivity of domestic products compared to imports, while the production of exportables becomes unprofitable. The need to contain the balance of payments deficit within manageable bounds then compels the government to resort to administrative import restrictions and to ad hoc support programs for exporters. To reduce the producers' risk in the open sector of the economy, and also to augment returns on investment, a variety of stimulations are usually employed. These range from import restrictions in the form of tariffs, licenses and quotas, tax rebates, free government services and other subsidies to market regulation through governmental marketing control boards.

Due to a multiplicity of constraints, and the fact that each one may be binding on its own, investments tend to respond much more sluggishly to a relaxation of any single constraint. For example, an increase in savings will not lead to new investments if either foreign exchange is unavailable for the purchase of imported equipment, or if profitability is too low for investment demand to exist. Only such policies (or policy packages) that relax all constraints simultaneously have a chance of stimulating investment. More time and effort is therefore required to bring about conditions that actually lead to new investment and time frames tend to be longer than in developed countries for devaluation, combined with appropriate support policies, to have an impact on investment. But this fact does not imply that production and exports can only be increased in the long run, as these countries typically are not in full employment equilibrium. When unemployed factors of production, be it labor, land, or capital equipment exist, an increase in profitability can be expected to lead to higher utilization rates.(1)

A final feature of importance for the analysis of devaluation is represented by the financial conditions in these countries. Financial markets are still rudimentary in most developing countries, forcing private investors to depend either on their own savings, without significant financial intermediation, or on loans from the government. The latter in turn, confronted with the difficulties of raising tax revenues, relies on the banking system and thereby quite frequently on money creation.

(1) For example, the long period from plantation to harvesting (particularly for tree crops) is often cited as a reason for very slow supply responses in agriculture. Frequently, however, the price structure discourages cultivation and harvesting of existing plantations.

With high rates of domestic price inflation, the rate of interest in these countries rarely reflects the opportunity cost of capital. Real interest rates are frequently negative so that the demand for loans is either rationed with the effect of lowering the private discount rate below the social discount rate, or the supply of loans is allowed to increase at a rate accelerating domestic inflation. Furthermore, the low cost of credit combined with an overvalued exchange rate distorts factor prices in favor of capital and motivates the choice of a capital-labor ratio that is excessive in light of the abundance of unskilled labor in these countries. Thus, while it is quite possible that low real interest rates fail to stimulate overall investment, they will certainly affect the choice of technology, i.e., more capital-intensive production methods, and the choice of projects, i.e., in favor of real estate development and commodity stockpiling and to the detriment of productive investment.

Financial disequilibrium in developing countries usually enhances risks of a change in the political system, of sudden legislative changes with regard to tax payments and currency convertibility, and of abrupt exchange rate adjustments.[1] The rate of interest should, therefore, contain a risk premium to compensate for these factors. In most countries interest rate are, however, not high enough to attract private foreign financial capital or to prevent capital outflows. Foreign capital inflows either take the form of foreign direct investment or of loans to the government at rates determined in international capital markets and denominated in foreign currency. The risk premium requested for foreign direct investments, as compared to financial investments, may be even more important due to a longer run commitment. Only few sectors, mainly mining, can offer rates of return, net of risk premia, that are comparable to those in industrial countries. In order to attract foreign investment at all, additional incentives, usually in the form of tax advantages and tariff protection have to be provided so that the social cost of the goods produced by foreign investments could be substantially above world market prices.

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[1] Leipziger (1976) documents that the variance of the exchange rate is significantly higher in countries with protracted disequilibria compared to those where the exchange rate is adjusted frequently.

The most effective way to attract foreign investment at a lower cost would be to reduce the risks faced by investors. The virtue of a well-balanced economy is that ad hoc measures are less likely to be taken and that the future of the economy is more easily predictable. Thus, a long-run stabilization program including the return to, and stabilization, of an equilibrium real exchange rate[1] tends to diminish the political and economic risks inherent in transacting with this country, and thus the country's cost of borrowing abroad. This consideration will be built into the simulation model of Section II.

[1] "Equilibrium" exchange rate is, of course, an idealized concept. In practical terms it is short-hand for a "real" exchange rate that is compatible with external equilibrium over the medium run, in the absence of trade restrictions and given a desired level of growth for the domestic economy. If domestic inflation is equal to "world" inflation, the qualification "real" can be omitted.

II. Devaluation

1. Preliminaries

Given the general characteristics of the class of countries of concern, the question becomes : what can a devaluation of the currency achieve ? To provide an answer one has to focus on a situation typical for devaluation to become a practical issue. Such a situation is encountered when the balance of payments deficit cannot be financed anymore so that an increase in import controls becomes mandatory. This situation is usually characterized by open or suppressed domestic inflation and by the existance of markets for foreign exchange and for goods with officially controlled prices, such as import and export goods.

For the exchange rate to matter, in the sense of affecting relative prices and hence the real variables in the economy, some rigidity or distortion must exist somewhere in the economy. In fact, as has already been pointed out, such rigidities and distortions are quite common in developing countries : inflationary monetary policy ; officially fixed prices ; rigidity of wages and interest rates ; slow speeds of adjustment in the various markets of the economy, etc. To attribute to the exchange rate its proper role, the main rigidities in a given economy need therefore to be identified.

Clearly, in all countries exchange rate policy is only contemplated when the economy's external sector is in disequilibrium. What exchange rate policy can achieve depends, however, crucially on what created the disequilibrium in the first place. For example, if export receipts from a particular commodity drop because world demand and hence the world price of that commodity have fallen, it is unlikely that devaluation will be able to restore the initial receipts from exporting that commodity. Devaluation provides, however, incentives for exporting other goods. As a second example, if exports decrease because internal inflation decreases profits in the export sector, and therefore quantities produced and exported fall, devaluation is apt to reestablish the initial price, production, and trade structure.

The first example illustrates a real shock and the need for a devaluation of the real exchange rate. The second example represents a financial shock and the objective of devaluation is to bring the real exchange back to its original level. Of course external disequilibrium is only one facet of the overall economic situation and is intimately linked with domestic aggregate employment, inflation, income distribution and with sectoral disequilibrium. Hence the analysis of the balance of payments is necessarily part of the macroeconomic analysis of the economy, and exchange rate policy is then most usefully seen as part of a policy package, instead of being viewed as an isolated choice.

2. Financial Shocks

The case of a financial shock does not raise much controversy. The most typical form of a financial shock originates with government policies.

The public sector runs a budget deficit, often at a rate which increases over time, and to a large extent financed by monetary expansion, with the goal of supporting investment and social expenditures. As a consequence of desired absorption in excess of available domestic supply, inflation accelerates. With a fixed exchange rate the inflationary process is, however, confined to nontraded goods and this increase in the relative price of nontraded goods stimulates demand for imports.

While prices of importables and exportables are fixed, costs of inputs produced by the domestic nontradeables sector increase and so do wages as they adjust, at least partially, to the higher average price level. As a result, profits in the tradeables sector fall, albeit not uniformly, depending on the cost structure of production. Producers of goods with a high content of imported inputs suffer less ; those with high inputs of domestic nontradeables most. If the disequilibrium situation persists, producers are induced to substitute lower-priced imported inputs for domestically produced inputs, or even imported capital equipment for domestic labor. The capital-labor ratio is likely to increase even when installed capital is fixed since adverse profit developments in the open sector make a downward adjustment of employment necessary. Clearly this is a highly undesirable distortion in countries that are poor in capital and foreign exchange.

To make this situation even worse, decreased profits in the open sector endanger ongoing and future investment projects as investments are to a large extend financed out of retained earnings and as actual profits are a determinant of forecasts for future profits. To absorb higher costs producers are forced to cut back production, laying off not only workers, as noted above, but also leaving marginal land, equipment, or plant capacity unused, because production functions seldom exhibit the high elasticity of factor substitution required for keeping the factors in fixed supply fully employed. In the absence of restrictive measures applied to private demand, the increase in relative prices of nontradeables tends to boost import demand, reinforced by the increase in domestic demand derived from the postulated initial expansion of the money supply and/or of government expenditures. Reduced production in the export and import-substitution sectors, as a consequence of lower relative prices of tradeables, gives rise to a lower volume of exports and to a higher volume of imports and the current account is bound to deteriorate.(1)

In such a case devaluation reestablishes the initial relative price structure and hence initial production and demand levels. Of course, the average price level is now higher but not essentially due to devaluation but due to transitory inflationary government finance. Moreover if the government continues to pursue an inflationary course then it would become necessary to continue the adjustment of the exchange rate.

(1) Monetary expansion and fiscal expansion clearly have additive effects on the balance of payments. The magnitude of the balance of payments effect depends therefore on the extent to which the deficit is financed by money creation (resulting in an increase in prices of nontradeables) and depends on the sectoral allocation of government demand. If government consumes tradeables, the increase of government expenditures spills immediately into imports. If government consumes nontradeables the result depends on whether there exists excess supply of nontradeables. If there exists excess supply no further change in relative prices is necessary and the only spill-over to imports results from increased domestic income. Otherwise, increased government demand results in higher relative prices of nontradeables (in addition to the effect of the increase in the money supply), and the resulting substitution of demand on to imports increases the balance of payments deficit.

3. Real Shocks

Another, and usually more painful, need for stabilization policy arises when an economy suffers from real shocks such as a durable deterioration of the external terms of trade, loss of some export markets, reduction of protective measures, etc.

The stylized situation I now wish to analyze is as follows. Consider the present disequilibrium of non-oil developing countries brought about to some extent, but certainly not exclusively, by external factors. What could a devaluation contribute to the reestablishment of external equilibrium ? To simplify I limit the discussion to a shock that occurs once and for all, it being understood that the analysis applies to each element of a sequence of shocks. In line with conditions prevailing in developing countries, unskilled labor is in excess supply. The time horizon for the analysis is now of a longer term, since it is reasonable to expect substantial time lags for the realization of most real effects.

A. Elasticity Theory

To establish a common background I first wish to show that traditional elasticity theory does not yield the result that with exogenous terms of trade devaluation will be ineffective. Consider the generalized Marshall-Lerner condition, known as the Bickerdike-Metzler-Robinson condition :

$$(1) \qquad \frac{dB}{de} = \frac{\eta_m \eta_x(1 + \varepsilon_m + \varepsilon_x) + \varepsilon_m \varepsilon_x(\eta_m + \eta_x - 1)}{(\eta_x + \varepsilon_x)(\eta_m + \varepsilon_m)}$$

where dB/de is the change in the current account provoked by devaluation ; η_m, η_x are demand elasticities for imports and exports, resp. ; ε_m, ε_x are supply elasticities of imports and exports, resp. ; all elasticities are defined as non-negative numbers. If $\varepsilon_m \to \infty$, $\eta_x \to \infty$, as implied by the assumption of exogeneity of world market prices for the developing country, expression (1) becomes ;

$$(2) \qquad \frac{dB}{de} = \eta_m + \varepsilon_x \geq 0.$$

This shows that the effect of devaluation depends solely on the elasticity of import demand and the elasticity of export supply, and is always non-negative. If $\eta_m = 0$ then the only effect on the current account derives from a non-zero elasticity of export supply. It is also useful to recall that η_m and ε_x are derived from domestic excess demand functions so that the elasticities of import demand and of export supply are necessarily larger than the elasticities of total domestic demand for importables and of total domestic supply of exportables.

For illustrative purposes the following, very rough, calculation of the average effect of devaluation may be made. Consider a devaluation by 10 per cent (say), keeping nominal wages fixed. On the import side we may accept the results of Khan (1974) that import price elasticities are roughly unitary. On the export side, with infinite elasticities of world demand, the change in the value of exports is obtained from the change in domestic excess supply, that is, the change resulting from the increase in production and the decrease of domestic demand for exportables. Retaining a unit elasticy for domestic demand for exportables leads to a constant value of domestic demand. From the econometric evidence a short run supply elasticity of 0.2 seems a reasonable assumption.(1) Hence the value of the production of exportables increases by 12.2 per cent, and the value of exports by 12.2 per cent times the inverse of the export share in exportables.(2) For example, if half of the production is exported the value of exports would increase by 24.4 per cent (during the first year). Combined with an unchanged value of imports this represents a sizeable improvement of the current account.

B. Wage Flexibility

In the above calculation the nominal wage rate was kept fixed implying that the real wage rate decreases as a consequence of the devaluation induced shift in the domestic price level. Since real wages are already extremely low in many developing countries it may not be desirable

(1) See Askari-Cummings (1976) for supply elasticities in agriculture and Feltenstein et al.(1979) for mining, both in developing countries.

(2) The volume of production increases by 2 per cent and price by 10 per cent. Hence the value of domestic production increases by 12.2 per cent. The proportional change in exports is $(12.2 \cdot \frac{Q}{X})$ where $\frac{Q}{X}$ is the inverse of the share of domestic production exported. This can be derived as follows. Let Q, X, E denote the values of production, export and domestic demand for exportables, resp. Hence $Q = E + X$. Then

$$\frac{dQ}{Q} = \frac{dE}{E}\,\frac{E}{Q} + \frac{dX}{X}\,\frac{X}{Q}\,.$$

to decrease real wages. I would, however, argue that a decrease in real wages is not a necessary condition for devaluation to have real effects although the magnitudes of these effects will be reduced if real wages remain constant. To demonstrate this argument I look at total employment L as the sum of employment in the nontradeables sector (L_N) and of employment in the tradeables sector (L_T). In each sector employment is a function of sectoral real wage costs.

$$(3) \qquad L = L_N(\omega_N) + L_T(\omega_N) \; ; \; \frac{\partial L_N}{\partial \omega_N} \, , \, \frac{\partial L_T}{\partial \omega_T} < 0$$

where $\omega_N = \frac{w_N}{P_N}$, $\omega_T = \frac{w_T}{P_T}$

Differentiation of (3) yields :

$$(4) \qquad \hat{L} = \eta_N \, l_N \, \hat{\omega}_N + \eta_T \, (1-l_N) \; \hat{\omega}_T \; ; \; \eta_N, \; \eta_T < 0$$

where a hat denotes a proportional change, η_N, η_T are the sectoral labor demand elasticities, $l_N = L_N/L$, i.e., the share of employment in the N sector.

The average price level P is a weighted average of prices in the N and T sectors :

$$(5) \qquad P = \alpha P_N + (1-\alpha) P_T .$$

Now consider a devaluation together with a monetary policy that fixes P. Then one gets from (5), and the fact that $\hat{P}_T = e$ where e is the rate of devaluation :

$$(6) \qquad \hat{P}_N = - \frac{(1-\alpha)}{\alpha} \; \hat{P}_T = - \frac{(1-\alpha)}{\alpha} \, e .$$

With P constant, real wage earnings $(\frac{w_N}{P} \, , \, \frac{w_T}{P})$ remain unchanged if nominal wages remain constant. With $dw_N = dw_T = 0$ one obtains

$$(7) \qquad \hat{\omega}_N = - \hat{P}_N = \frac{1-\alpha}{\alpha} \, e$$

$$\hat{\omega}_T = -e .$$

Substitution of (7) into (4) yields :

$$(8) \qquad \hat{L} = \left[\eta_N l_N \frac{1-\alpha}{\alpha} - \eta_T (1-l_N)\right] e.$$

Several empirically interesting situations may now be considered. If $\eta_N = \eta_T = \eta$; then

$$(9) \qquad \hat{L} = \eta\left[l_N \frac{1-\alpha}{\alpha} - (1-l_N)\right] e = \eta \frac{1}{\alpha} (l_N - \alpha) e.$$

The term in parenthesis has an ambiguous sign. Higher labor intensity in the N-sector would make $l_N > \alpha$ while a trade deficit may reverse this relationship. If, as a first approximation, $l_N \tilde{=} \alpha$, i.e., the share of the labor force employed by the N-sector corresponds to the share of N-goods in total expenditure, then $\hat{L} = 0$, i.e., devaluation has no employment effects.

In a developing country $\eta_T > \eta_N$ and I consider the limiting, but highly relevant case where $\eta_N \tilde{=} 0$. Then

$$(10) \qquad \hat{L} = - \eta_T (1-l_N) e > 0.$$

Thus the increase in total employment is seen to be given by the product of the share of employment in the T-sector, the elasticity of demand for labor in the T-sector and the rate of devaluation. For example, if $1-l_N = 0.3$, $\eta_T = 1.0$, then a 10 per cent devaluation results in a 3 per cent increase in total employment.

To compare these results with the case where real wage earnings decrease, keep w_N, w_T constant and allow first P and P_N to increase by the rate of devaluation (i.e. relative prices remain constant). Then

$$(11) \qquad \hat{L} = - \left[\eta_N l_N + \eta_T (1-l_N)\right] e.$$

With $\eta_N = \eta_T = \eta$ this becomes

$$\hat{L} = -\eta e > 0, \tag{12}$$

so that with a reduction in real wages employment increases unambiguously. Furthermore, as l_N is usually close to α the increase in employment obtained from (12) exceeds the one obtained from (9), where real wages remain constant.

Finally, if P_N is fixed but P is allowed to rise by $(1-\alpha)$ e then one gets $\hat{\omega}_N = 0$ and

$$\hat{L} = -\eta_T(1-l_N)e > 0 \tag{13}$$

which is identical to (10).

C. A General Equilibrium Model

With this background it appears worthwhile to explore further the effects of devaluation in a general equilibrium model. My favorite model takes into account the most salient structures of the type of economy under consideration. To focus on essentials I adopt an abstraction of a growing economy, but not of a steady-state type which would be less appropriate for my purpose.

However, asset equilibrium and the feedback of government budget finance and of the balance of payments deficit to the accumulation or decumulation of financial assets, are central ingredients for this stylized developing economy. Since financial markets are rudimentary in these countries only the money market is retained and a simple form of the quantity theory of money is postulated.

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(1) It may be of interest to point out that the wage elasticity of demand for labor (η) is always superior to the elasticity of substitution (ε), because with capital constant an increase in labor inputs moves production to a higher isoquant. For example, if production is approximated by a Cobb-Douglas function $Q = L^{\alpha} K^{1-\alpha}$ then $|\eta| = \frac{1}{1-\alpha}$ and $\varepsilon = 1$, so $|\eta| > \varepsilon$. For example, if $\alpha = 2/3$ in the open sector then $\eta = 3$. This implies, of course, that a reduction of the real wage by 10 per cent increases in the long run employment in the open sector by 30 per cent and thus the total wage bill in this sector by 20 per cent.

Several key assumptions underlie the specification of the model. First I assume the existence of excess labor supply so that potential production is only constrained by the availability of capital stock. Second, the economy is modelled to produce none of its capital stock so that all investment goods must be imported. Third, the major constraint on investment is assumed to be domestic savings and foreign exchange availability. Fourth, the economy produces predominantly nontraded goods and is a price-taker for all traded goods, whether exported or imported. Finally, in order to show that devaluation is compatible with price stability, it is assumed that the authorities expand the money supply at a rate consistent with price stability. This assumption is not constringent : if the inflation rate in the rest of the world differs from zero, the domestic money supply would have to expand at a rate consistent with the world inflation rate. Money, in this model, is inessential : it neither inflicts resource costs, because the inflation rate is constrained to zero, nor is its role as a factor of production or as a consumption good taken into account. In concordance with the situation prevailing in developing economies, the rate of interest is assumed not to be an important factor for consumption and production.

The model will be used to simulate the effects of devaluation under various circumstances. Although the dynamic structure of the model is simple, simulation has been given preference over an analytic approach, to be able to compute explicitly the time paths of the variables of interest.

The Model [1]

(1) $Y_t = E_t + (I_t + B_t)/\bar{P}_t = E_t + \tilde{B}_t/\bar{P}_t$

(2) $ET_t = (\bar{P}_t E_t - PN_t EN_t)/PT_t$

(3) $E_t = \beta(Q)EN_t = \beta_0 Q_t^{\beta_1} EN_t$

(4) $Q_t = PT_t/PN_t$

(5) $XN_t = x_1(Q_t, KN) = x_1 KN_{t-1}$

[1] All variables are listed and defined in the Appendix.

(6) $XT_t = x_2(Q_t, KT) = x_2 KT_{t-1}$

(7) $XN_t = EN_t$

(8) $\tilde{B}_t = PT_t(XT_t - ET_t) - r^* F_t R_t$

(9) $PT_t = PT^*.R_t$

(10) $PN_t = \frac{1}{\alpha} \bar{P}_t - \frac{1-\alpha}{\alpha} PT_t$

(11) $M_t = M_{t-1} + (Y_t - Y_{t-1})$

(12) $B_t = M_t - M_{t-1} - (F_t - F_{t-1})R_t - (R_t - R_{t-1})F_{t-1}$

(13) $F_t = \tilde{B}/R_t + (1-\Pi)F_{t-1}$

(14) $I_t = (\tilde{B}_t - B_t) / PT_t$

(15) $K_t = I_t + (1 - \delta)K_{t-1}$

(16) $KN_t = K_t - KT_t$

(17) $KT_t = k(Q_t)K_t = k\ ^{Q}_{t}\ K_t$

Initial values for the endogenous variables (at t = 0) :

KN	KT	Y	E	EN	ET	XN	XT	Q	PT	PN	M	F	I	$\tilde{B}$
40	40	90	90	80	20	80	20	2	2	1	90	0	0	0

Values of parameters :

PT^*	R	$\bar{P}$	α	β_0	β_1	δ	k	Π	r^*	x_1	x_2
2	1	1.34	0.67	1.5	-0.415	0	0.25	0	0.10	2	0.5

Equation (1) defines the real value of aggregate demand (Y), equal to output, as the sum of consumption (C) by the private and public sectors, investment(I) of both sectors, and the current account surplus (B). Since all investment goods are imported, investment can be eliminate from (1) by defining $\tilde{B}$ as the current account surplus net of imports of

investment goods. The reason for this procedure will become apparent later.

The two production sectors of the economy are denoted N for nontradeables and T for tradeables. Equations (2) and (3) determine domestic demands for tradeables (ET) and overall domestic consumption demand (E), for given relative prices and given demand for nontradeables (EN). Equation (2) defines domestic demand for tradeables (ET) in real terms as the difference between total domestic demand (E) and demand for nontradeables (EN). Equation (3) determines overall domestic demand. Through (3) the allocation of overall demand between tradeables and nontradeables becomes a function of the relative price Q_t, which is defined in (4). Domestic production of both types of goods is also a function of relative prices and of installed capacity, as expressed in (5) and (6). It may be argued that a change in relative prices in favor of the tradeable sector is likely to stimulate production there at given capital capacity through an increase in labor intensity. In order not to prejudge the issue in favor of devaluation this possibility is assumed away here. A rigid capital/labor ratio is postulated so that output can only be increased through additional investment. The capital/labor ratio implied by (5) and (6) is 1 for nontradeables and 2 for tradeables, first to characterize the greater labor intensity in all sectors of production in developing countries compared to industrial countries, and second, to mark the use of more advanced technology in the open sector of developing countries. Equality of supply and demand in the market for nontradeables is imposed by (7) which determineds EN. Equation (8) defines the current account surplus ($\tilde{B}$) net of imports of capital goods, as the excess supply of tradeables minus interest payments on foreign debt (F), expressed in domestic currency.

The assumption that the country is a price-taker for tradeables led already to (8) and is again the basis for (9) : the domestic currency price of tradeables (PT) is determined by the world market price (PT^*) and the exchange rate (R) which is set by the monetary authority. The general price level ($\bar{P}$) is a weighted average of the price for tradeables, which is determined by (9), and the price for nontradeables (PN). The weight α corresponds to the share of nontradeables in domestic expenditure.

The value $\alpha = 0.67$ reflects the fact that in developing countries the nontradeable sector is still accounting for a more important part of economic activity than the tradeable sector. Because monetary policy is specified so as to be consistant with a constant overall price level, (10) is solved for the price of nontradeables. Underlying (11) is a simple form of the quantity theory of money with constant velocity, normalized at 1.34 : if money grows at the same rate as income, the price level remains constant. Given the growth rate of the money supply, the current account surplus compatible with it is specified in (12). Since capital flows will be determined later, (12) is solved for the current account surplus. Note that (12) implies a balanced budget for the public sector. This is again not an essential feature of the model and had the assumption of a positive inflation rate been adopted a corresponding budget deficit would have been obtained. It is also to be noted that in the present formulation it is immaterial whether investment is carried out by the private or the public sector, because there is perfect crowding out. The managerial or organisational constraint on investment is, of course, neglected in this framework.

Equations (13) and (14) are very special and designed to capture the constraints on investment in a developing country. (13) says that capital inflows are related to the performance of the current account, net of imports of investment goods. It is postulated that international bankers consider net exports of consumption goods minus foreign interest payments (which is, of course, equal to domestic savings) if used for productive investment, as positive indicators for creditworthiness. Thus, the higher domestic saving, the higher will be the availability of foreign credit. Since this is a pure flow consideration, the accumulation of foreign debt can be taken into account by requiring repayment of the foreign debt at the constant rate Π (for simplicity). I now assume in (14) that the country invests at the maximum feasible rate, which is equal to the amount of domestic savings (i.e., the current account surplus net of imports of investment goods) plus the amount of foreign loans.

Equations (15) and (17) determine the overall and sectoral capital stocks. At time t the stock of capital (K_t) is equal to the stock at time t-1, minus the rate of depreciation δ, plus investment at t. (16) says that the capital stock in the sector for nontradeables (KN) is

equal to the overall stock minus capital allocated to the tradeable sector (KT). How much is allocated to tradeables is a function of the relative price as in (17). To conclude this part note that sectoral production, which seemed to be uninfluenced by changes in relative prices from (5) and (6), are dependent on the relative price through (16) and (17), i.e., an increase in the relative price of tradeables leads to a reallocation of capital to the tradeable sector and hence allows an increase in production there.

D. Simulation Results

Model 1

In Table 1 the simulated results of devaluation of the domestic currency by 10 per cent are shown. Because most variables evolve monotonically (a notable exception being domestic consumption which may decrease initially) only the final values after 25 periods (years) are shown. Of course, the relevant time horizon for a devaluation is not 25 years but much less. However, the dynamic specification of the model does not make any claim on realism so that only the qualitative nature of the results matters, not the quantitative precision nor distribution over time.

In the initial stationary equilibrium net investment, foreign debt, and the balance of payments deficit are all equal to zero. Now the exchange rate is devalued by 10 per cent and nothing else is modified (Simulation I). Through (9) the price of tradeables increases by 10 per cent and through (10) the price of nontradeables must decrease by 10 per cent. Hence, the relative price Q increases by 20 per cent. This increase in the relative price of tradeables discourages consumption of tradeables and, as the demand functions are specified, this decrease in consumption of tradeables is not compensated by an increase in consumption of nontradeables so that overall domestic consumption falls. This imperfect substitutability between tradeables and nontradeables

describes well the situation in developing countries.[1] Furthermore, the change in relative prices causes a shift of productive resources into the tradeable sector. Thus, production of nontradeables falls and since consumption cannot exceed production, consumption of nontradeables actually declines. As a consequence of both, an increase in production and a decrease in consumption of tradeables, domestic saving, or equivalently, the current account surplus increases. This allows the country to borrow abroad and to invest the sum of domestic savings and foreign credits. Of course, growth would eventually be curbed when one or several of the underlying assumptions will cease to hold: For example, at some time full employment will be approached.

Several features of the simulation invite comment. First an initial increase in excess supply of tradeables through both a decrease in domestic consumption by the private or public sector and an increase in production, made possible by a reallocation of capital, starts the whole process off in this model. Although overall consumption falls initially (for three years in the simulation) this is not strictly necessary. After some initial period the reallocation of capital and positive investment lead to higher levels of production making it possible to increase both savings and consumption.

While the numerical results of the simulation are of no particular interest some patterns are enlightening. First, real income grows steadily in spite of steadily accumulating foreign debt. This is a direct consequence of the specification of the production functions with constant capital-output ratios. One unit of capital costs 0.1 units of traded goods per year, and creates 0.5 units of traded goods. Second, the price level remains constant all the time because the money supply is forced to grow at the same rate as income. The country runs an overall

[1] This result would be reinforced if the wealth effect were taken into account. It is also to be noted that the decrease in prices of nontradeables is the direct consequence of holding the money supply at a level consistant with constant aggregate prices.

balance of payments surplus, equal to the increase in the money supply, but a current account deficit.

To test the sensitivity of these results to the particular specification of the model a number of key parameters and functional specifications are now changed, one by one.

In Simulation II the rate of interest on foreign loanes is raised from $r = 0.10$ to $r = 0.11$.[1] Now the economy expands somewhat less but all the qualitative results of Simulation I are verified.

Next, in Simulation III, the rate of depreciation of physical capital is raised from $\delta = 0$ to $\delta = 0.10$. In addition, loans are now assumed to be reimbursable uniformly over 10 years, whereas before loans were assumed to be perpetuities. The implication of this change is that the country can only borrow up to the trade surplus (not counting imported investment goods) less service and repayment of foreign debt whereas before the borrowing capacity was unaffected by repayment requirements. The quantitative expansion of the economy is now much lower than with Simulation I, but the qualitative results still carry over.

As mentionned before the specification of the domestic demand function for tradeables plays an important role. In Simulation IV the price elasticity of domestic demand for tradeables is raised from 0.415 to 1. The change in relative prices now has a much stronger impact than in Simulation I. Again, total domestic consumption is reduced initially for three periods and then rises above the original level. All the qualitative results of Simulation I are again preserved.

In Simulation V the price elasticity of domestic consumption of tradeables is reduced to zero. Qualitatively, the expansion of the economy is now reduced compared to Simulation I, that is, the impact of the change in relative prices is much less. Qualitatively all results are preserved with one exception. Because domestic demand for tradeables is completely price-inelastic there is no initial reduction in total domestic consumption anymore and domestic consumption rises immediately.

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[1] In fact, a rate of interest of 10 per cent in the absence of inflation is already a very high rate, but a low one compared to the implied marginal productivity values of capital.

In Simulation I the allocation of productive capital depends on relative prices. While this feature is perfectly natural it may be objected that, in the short run, capital is sector-specific. Simulation VI incorporates therefore the extreme assumption that the sectoral allocation of capital is completely price-inelastic at all times. This assumption has the obvious effect that, even over time, the increase in relative prices does not lead to a reallocation of investment in the tradeables sector. Expansion of the economy is therefore again reduced in comparison to Simulation I.

So far the price of non-tradeables has been treated as being flexible. This may not be a reasonable assumption and simulation VII is based on the opposite assumption of a fixed price P_N. The domestic price level now becomes endogenous and is given by

$$(10') \qquad P = \alpha P_N + (1-\alpha)P_T.$$

The increase in the price level after devaluation must be financed by a shift in the money supply and therefore (11) is replaced by[1]

$$(11') \qquad M_t = M_{t-1} + (Y_t - Y_{t-1}) + \frac{Y}{V}(P_t - P_{t-1})$$

where $1/V = 0.75$ and V is the velocity of circulation. The price level jumps from 1.34 to 1.40, and relative prices increase from 2.00 to 2.20. The impact of devaluation is much less than with simulation I because relative prices change only by 10 per cent instead of 20 per cent, but the direction of the results is identical.

Finally, in simulation VIII, the currency is devalued in response to a deterioration of the terms of trade, that is, the price of imported capital goods increases by 10 per cent. The impact is a reduction of domestic real income and expenditures for the first 2 periods, before the economy starts to grow.

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[1] (11') is obtained by differentiating the quantity equation $MV = PY$, yielding $dM = \frac{P}{V} dY + \frac{Y}{V} dP$ and setting $P = V = 4/3$.

Table I

Model 1 : Simulation of a devaluation by 10 per cent

(Values of simulated variables after 25 periods)

0. Initial stationary equilibrium values (reproduced from p. 16)

90	90	80	40	40	80	20	20	0	0

I. With the original parameters of the model

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
1063	937	1275	495	779	905	355	197	167	1637

II. With a rate of interest on foreign loans r = 0.11

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
928	826	1115	433	681	798	313	174	135	1416

III. With capital depreciation δ = 0.10 and rate of foreign credit repayment Π = 0.10

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
266	231	282	109	172	223	87	48	46	359

IV. With the demand function $E_t = 2.25\ EN_t\ Q_t^{-1}$

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
4389	3487	5680	2209	3471	3788	1488	563	1203	7555

V. With the demand function $E_t = \frac{9}{8} EN_t$

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
389	365	438	170	267	324	127	88	31	494

VI. With sectoral capital allocation $KT_t = 0.5\ K_t$

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
132	131	128	64	64	127	31	27	1.5	67

VII. With fixed prices $PN_t = 1$ and $\bar{P}_t = \alpha PN_t + (1-\alpha) PT_t$

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
222	216	228	102	125	200	61	46	8	210

VIII. Import prices for investment goods increase by 10 per cent

Y	E	K	KN	KT	XN	XT	ET	$\tilde{B}$	F
846	750	1010	393	617	724	284	158	128	1367

Model 2

Although I believe that Model 1 captures well conditions in developing countries it may still seem desirable to experiment more with the specification of production conditions. For example, the labor market is not incorporated explicitly in Model 1, and factor productivity is constant. What I call Model 2 differs from Model 1 in three respects :

i) the fixed-coefficient technology of Model 1 is replaced by a Cobb-Douglas technology ;

ii) sectoral employment is endogenized via constant labor shares, but the assumption of infinitely elastic supply of labor services is maintained ;

iii) the assumption of maximal investment, equal to the supply of foreign exchange, is relaxed.

Technically, these three modifications are introduced in the following way. Model 1 is retained except for equations (5), (6) and (15). Equations (5) and (6) are replaced by

(5') $\log XN_t = A + \alpha_1 \log LN_t + \alpha_2 \log KN_t$

(6') $\log XT_t = B + \beta_1 \log LT_t + \beta_2 \log KT_t$

with $A = \log 1.178 \quad \alpha_1 = 0.9 \quad \alpha_2 = 0.1$

$B = \log 0.5977 \quad \beta_1 = 0.8 \quad \beta_2 = 0.2$

where the assumption $\alpha_1 > \beta_1$ reflects the fact that the labor intensity of production of nontradeables exceeds the one of tradeables. For simplicity, constant returns to scale are still assumed for both sectors, although it could be argued that for tradeable goods developing countries may, at their stage of development, benefit from increasing returns to scale which would render devaluation more expansionary.

From factor shares, as implied by the production functions, labor demands are obtained :

(18) $LN_t = \alpha_1 \frac{PN}{WN} XN_t$

(19) $LT_t = \beta_1 \frac{PT}{WT} XT_t$

(20) $$L_t = LN_t + LT_t$$

Actual employment is equal to labor demand as a result of the assumption of infinite supply. The implied elasticity of the demand for labor with respect to real wage costs are

$$\eta_N = -\frac{\partial LN}{\partial (WN/PN)} \frac{WN/PN}{LN} = \frac{1}{1-\alpha_1} = 10$$

$$\eta_T = -\frac{\partial LT}{\partial (WT/PT)} \frac{WT/PT}{LT} = \frac{1}{1-\beta_1} = 5 \ ,$$

which certainly marks a stark contrast to the zero elasticities assumed in Model 1, and is also contrary to what I believe and what I asserted on page 13.

Nominal wages are initially set as WN = WT = 1 and are kept exogenous. The unit in which labor inputs are measured are determined by the (arbitrary) wage unit.

As to investment, equation (14) is still retained. However, it is now assumed that I_t represents imports of (malleable) capital goods not all of which are invested productively. Productive investment is a share k of I_t, $0 \leq k \leq 1$, and the remainder $(1-k)I_t$ is consumed, say, by the public sector for welfare, defense, or whatever purpose. The share k evolves according to

(21) $$k_t = \frac{\gamma_0}{K^{\gamma_1}}$$

with $\gamma_0 = 1.55$, $\gamma_1 = 0.1$.

The rationale for the adjustment process in (21) is that as the stock of capital and hence income grow the need for accumulation of productive capital becomes less urgent and other social goals may be satisfied.

For the first set of simulations, no constraints are imposed on capital returns, that is, it is neither required that they are equalized across sectors nor that they exceed the cost of borrowing. In the initial

stationary state, capital returns in both sectors are rN = rT = 0.20 > r^* = 0.10. This provides, in principle, incentives for investment. However, because investment goods are imported, investment is constrained by foreign exchange availability and, with a balanced currenct account and no foreign credits, investment is constrained to zero. Devaluation, through its initial impact on resource allocation and on domestic consumption relaxes this constraint. Rates of return decrease in both sectors but more rapidly in the nontradeables sector. To maintain investment in both sectors it must be assumed that the government invests in the nontradeable sector in spite of rN < rT, and in spite of rN < r^*, or that capital returns in the tradeables sector are taxed and those in the nontradeables sector subsidized.

In Simulation I k, the part of available foreign exchange used for productive investment, is kept fixed at k = 1. Investment increases rapidly, as does employment at constant productivity equal to real wages, but capital productivity declines strongly. After 25 periods rN = 0.012 < r^* < rT = 0.12. Production increases substantially, but is to a large extent used for investment. Therefore domestic consumption increases much less than domestic real income. It is again necessary here to recall that absolute numbers are rather meaningless in this exercise, what counts are the qualitative results.

In Simulation II the results are qualitatively similar. Since part of available exchange is used for government consumption, which in real terms, equals $(1-k)I\,PT/\bar{P}$ where $(1-k)I$ is the part of imports not used for investment (measured in units of capital goods) investment is much less. Total private and government consumption in period 25 is 377 + 632 = 1009 whereas real income equals 1304. The remainder corresponds to investment less the deficit of the current account.

When a depreciation rate on capital of δ = 0.10 is introduced, so that the cost of capital is $r^* + \delta$ = 0.20, expansion of the economy is much less pronounced than in Simulation II. In spite of a real cost of capital equal to the initial rates of return in each sector devaluation still leads to expansion - but only by accepting returns below cost. Evidently, if a country has no investment projects yielding returns above costs, expansion is necessarily limited. In the present example, it makes however sense

to expand even when rates of return fall below cost since the opportunity cost of labor is zero whereas labor productivity is always strictly positive.[1] In other terms, real income has increased over the simulation horizon from 90 to 418. If capital owners receive a subsidy covering the difference between the cost of capital and their returns labor still benefits since labor income rises from 104 to 533 and the tax to compensate capital owners is equal to 393 (= KN(0.20 - 0.028) + KT(0.20 - 0.192)).

In Simulations I to III the nominal wage rate and hence with a constant price level real wage rates have been kept constant. This implies, of course, that real wage costs increase in the nontradeables sector and decrease in the tradeables sector. To prevent an increase in real wage costs in the nontradeables sector the nominal wage rate in that sector is decreased by 10 per cent in Simulation IV. Production in nontradeables increases now much more than in Simulation II and so does domestic consumption. The rate of return on capital is now much higher in the nontradeables sector than in Simulation II, but still below the one in the tradeables sector.

In Simulation V, nominal wages in both sectors are reduced by 10 per cent which is equivalent to a reduction of real wage earnings by 10 per cent. This simulation demonstrates that a devaluation coupled with a real wage reduction is, of course, much more effective.

In Simulation VI the assumption that rates of return may differ across sectors is dropped. From the constant capital shares implied by the production functions (5') and (6') one obtains :

$$rN = \alpha_2 \, PN.XN/KN \tag{22}$$

$$rT = \beta_2 \, PT.XT/KT \tag{23}$$

Setting (22) equal to (23) yields :

$$\frac{KN}{KT} = \frac{\alpha_2}{\beta_2} \, \frac{PN}{PT} \, \frac{XN}{XT} \tag{24}$$

[1] This is another illustration of the inadequacy of the Cobb-Douglas production function for developing countries. The only way to rationalize less than full labor employment is to assume that real wages are not sufficiently flexible.

Equation (17) is now replaced by :

$$(17') \qquad KT = K/(1 + \frac{KN}{KT})$$

Equalization of rates of returns across sectors leads to a much slower expansion of the nontradeables sector and to a much more rapid expansion of the tradeables sector. Comparison with Simulation II shows the inefficiency of letting returns differ across sectors.

Simulation VII is based on the same model as Simulation VI, but the foreign rate of interest is increased to $r^* = 0.20$. Expansion, notably of the tradeables sector, is much reduced and after 25 periods the rate of return in both sectors falls to 0.126. But capital expansion is still worthwhile. For example, real income increases between periods 24 and 25 by 262, and the stock of capital by 1145. The real cost of this addition to capital exceeds marginal productivity of capital by 0.20 - 0.126 = 0.074 per cent. Multiplied with the level of investment yields 1145 . 0.074 in units of capital goods, equal to 139 in real monetary units.[1] Since the increase in real income exceeds the required subsidy to capital owners, investment is still beneficial.

[1] $139 = 1145 \cdot 0.074 \cdot \frac{PT}{P}$

Table II

Model 2 : Simulation of a devaluation by 10 per cent

(values of simulated variables after 25 periods)

0. Initial stationary equilibrium values (identical to table I)

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
90	90	80	40	40	80	20	20	0	0	0	104	1	0.20	0.20

I. Devaluation with k = 1

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
2108	526	9643	3750	5893	509	1593	111	0	2108	10481	3217	1.00	0.012	0.119

II. Devaluation with $k = \gamma_0/K^{\gamma_1}$

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
1304	377	4928	1916	3011	365	1002	79	582	1236	7296	2066	.66	0.017	0.146

III. Devaluation with $\delta = 0.1$

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
418	157	1248	485	763	152	333	33	118	347	2849	711	.76	0.028	0.192

IV. Devaluation with WN = PN

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
1083	607	2813	1094	1719	581	619	128	254	634	4055	1618	.70	0.048	0.158

V. Devaluation with WN = WT = PN

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
3853	1352	10038	3903	6134	1300	2628	285	1884	3333	16571	6317	.62	0.030	0.189

VI. Devaluation with rN = rT

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
3819	27	13790	21	13768	26	3442	5	2850	5056	22818	6085	.60	0.11	0.11

VII. Devaluation with rN = rT and $r^* = 0.20$

Y	E	K	KN	KT	XN	XT	ET	G	$\tilde{B}$	F	L	k	rN	rT
1598	21	7083	14	7068	20	2038	4	1076	2102	10784	3604	.64	0.126	0.126

III. Conclusion

The major conclusion that emerges from this analysis is that in a non-oil producing, poor developing country, subjected to financial or real shocks, devaluation of the external value of the currency remains a precious policy instrument. The decision to devalue may be taken on two different grounds. One is to make past inflation (the case of a financial shock) compatible with external equilibrium and the desired optimal structure of production. Another ground for devaluation is provided by the need to adjust to durable real shocks, or the need to stimulate export-led growth.

The simulation results support the conclusion that devaluation, combined with restrictive monetary and fiscal policy, can stimulate growth of the economies with which this paper is concerned. In the simulations the heuristic case was retained where world prices are stationary so that domestic long-run financial equilibrium requires a stationary price level. Expansion of the money supply was constrained to equal the expansion of real domestic income (divided by constant velocity). Constraining the government sector to a balanced budget implies that increases in the money supply are achieved through balance of payments surpluses.

All these specifications are not really restrictive from an economic point of vue (but, perhaps, from the political standpoint). World inflation, government deficits and domestic inflation could all be incorporated into the model. This would only change units but not the qualitative results.

There are, however, a number of restrictive albeit not unrealistic assumptions underlying the model. First, and foremost,it was assumed that labor supply is infinitely elastic. While this assumption is very reasonable with regard to unskilled labor, it is much less so for skilled labor which is usually in scarce supply in developing countries. Second, the lack of entrepreneurial capacity was largely neglected except for the fact that an economy based on competitive principles may be a more fertile ground for the development of managerial talents. Third, it was assumed

that foreign loans are obtainable on a commercial basis and that they are used, at least initially, for accumulation of productive capital. In reality, developing countries may not as easily obtain foreign credit as assumed in this paper. Nor may they have as many potential investment projects for which marginal productivity of capital exceeds the cost of capital as assumed in most simulations. Furthermore, their use of foreign exchange is likely to be less efficient than assumed in the paper. Qualitatively, devaluation can be expected the produce the same directional results, but with more modest magnitudes, as in the simulations where account was taken of such imperfections. Fourth, it is not to be expected that governments will ever behave in such a first-best manner as postulated for this model. In paradise lost, where governments are victims to the temptation of protecting or stimulating certain activities to the detriment of others, where private agents always face the uncertainty of the government's favor or wrath, complexities arise for which the model in the paper provides no added understanding.

The simulation exercises illustrates that a devaluation can be compatible with domestic price stability, relative to the rest of the world, external and public sector equilibrium, and still provide the impetus to growth through a relative price structure that is more adequate for the production possibilities of the economy. Needless to say, devaluation offers nothing that could not be achieved through other means, such as for example, high price flexibility. The arguments presented in this paper in favor of devaluation could therefore be rephrased as arguments in favor of an optimal price structure. One way of correcting a suboptimal price structure is provided by exchange rate policy. The immediate effect of a readjustment of the price structure is a relaxation of binding foreign exchange constraints and, over time, of the savings constraint. This allows the country to step up investment and thus growth, at least at long as the labor supply is not exhausted and as long as labor productivity on the marginal unit of capital exceeds the difference between the cost of imported capital and the marginal productivity of capital.

Appendix : List of variables

N, T	: indices for nontradeables and tradeables.
B	: current account surplus (in units of domestic currency)
$\tilde{B}$	: current account surplus net of imported capital goods (in units of domestic currency)
E, EN, ET	: domestic consumption (E at constant prices ; EN, ET in physical units)
F	: the stock of foreign debt (in foreign currency)
G	: government expenditures (at constant prices)
I	: domestic investment(at constant prices)
K, KN, KT	: domestic capital stock(in physical units)
L, LN, LT	: domestic labor employment (number of workers)
M	: domestic money supply (in domestic currency)
PT^*	: world market price (in foreign currency)
Q	: relative price of tradeables
R	: exchange rate of one unit of foreign currency
V	: velocity of domestic money supply
XN, XT	: domestic production (in physical units)
Y	: domestic real income (at constant prices)
k	: share of foreign exchange used for productive investment
r^*	: world market interest rate
rN, rT	: rates of return on domestic capital
WN, WT	: nominal wage rates (in domestic currency)

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