Seminar Paper No. 314

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Abstract

The focus of this study is on the short-to-medium-term effects of devaluation in the least developed countries where a large part of the population barely survives on a subsistence wage. A general macroeconomic framework for devaluation analysis in LDCs is developed. Empirical evidence is presented to demonstrate that devaluation can be an efficient means of reducing current account deficits in the least developed countries, provided that it is accompanied by domestic monetary restraint as well as by an infusion of foreign concessional finance, to avert or at least reduce the detrimental side effects on living standards that would otherwise occur during the period of adjustment to the new exchange rate.

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I. Introduction

Devaluation is a controversial instrument of economic policy, especially in developing countries. Even in cases where currency overvaluation is a major cause of an acute balance of payments crisis, the governments of developing countries are frequently reluctant to devalue, because (i) they believe that export production, import demand, and domestic expenditure are not very responsive to a change in the exchange rate; (ii) they fear the potentially disruptive side effects of devaluation on inflation, employment, and output growth as well as on real wages and income distribution; (iii) they want to avoid the political risk of devaluation; Cooper (1971) has documented several instances where developing country governments were toppled because they decided to devalue.

The focus of the present study is on the effects of devaluation in the deficit-prone least developed countries where a large proportion of the population barely survives on a subsistence wage. To be wholly successful, devaluation generally requires a reduction of real wages that encourages the expansion of exports and of import substitution. This raises our lead question: Is devaluation an appropriate instrument of economic stabilization in the least developed countries where a fall of real wages or earnings could result in severe hardship or even starvation?

More specifically, the aim of our study is to investigate the short- and medium-term effects of devaluation on macroeconomic performance in the least developed countries, subject to the constraint that real wages or earnings or GNP cannot be permitted to

fall, and to explore whether or how this constraint can be satisfied by temporary concessional capital inflows from abroad without jeopardizing the devaluation-induced adjustment of the current account.

Our approach is both theoretical and empirical. In the theoretical part we formulate a fairly general macroeconomic framework appropriate for less developed countries. Within this framework, we show how devaluation influences the current account and real GNP through exports, imports, and expenditures on the demand side of the economy, as well as through the cost of imported inputs (e.g., oil) on the supply side. We also introduce financial considerations to demonstrate the implications of foreign and domestic credit for external and internal balance during the period of adjustment following devaluation.

In our attempt to quantify the theoretical analysis we follow Gylfason and Schmid (1983) and Gylfason and Risager (1984) in using estimates of the structural parameters of the macromodel to assess the effects of devaluation on current account, GNP, employment, and profits in the countries under study. Our focus on the least developed countries inevitably creates severe data problems because statistical estimates of the relevant macroeconomic variables and relationships for the countries studied are unavailable in many cases, and the ones that have been published are often of inferior quality. The extent of guesswork needed to carry out our task is therefore considerable. Subject to this caveat, our empirical strategy permits us to quantify the macroeconomic impact of, say, a ten percent devaluation with fixed and variable real wages,

respectively, in each of the countries under study. Our approach also enables us to estimate the injection of foreign concessional finance that is needed to compensate for the main detrimental side effects of devaluation.

II. Macroeconomic framework

Our analysis is focused on the short to medium term of 1-3 years. We have in mind the small open economy of a developing country that exports commodities for final consumption (e.g., cotton, jute, tea) and imports final goods and intermediate inputs (e.g., oil). On the supply side of the economy, output is produced by three factors of production: labor, imported inputs, and capital. Workers are either self-employed in agriculture or wage-earners on farms or in cities. The capital stock is held fixed during the limited time period under consideration. This permits us to disregard investment. The other two inputs are employed to the point where real factor cost equals marginal product. On the demand side we emphasize the real side of economic transactions (i.e., the market for goods and services) rather than the monetary side. While money influences expenditure in the model, we abstract from other domestic financial assets so that consideration of money markets can be suppressed (see Taylor 1981). For simplicity we also exclude interest rates from the analysis. Our focus on the least developed countries where rigid controls of capital transactions are often in force, makes it reasonable to assume that financial capital movements are exogenously determined. In the light of evidence for a number of LDCs (see, e.g., Khan 1974), we assume aggregate imports

as well as exports to be responsive to relative price changes, pervasive import restrictions in many of these countries notwithstanding. We abstract from foreign debt outstanding and from associated interest and amortization payments (see Gylfason and Risager 1984). After all, these payments constitute a minuscule proportion of merchandise exports in a majority of the least developing countries under consideration (UNCTAD 1983). Hence we make no distinction between the current account and the trade balance in this paper.

The simplifying assumptions listed above enable us to focus sharply on the main channels through which devaluation influences the external position and growth performance of the least developed countries.

Supply and demand effects of devaluation

We begin by defining the current account of the balance of payments in the usual way as the difference between domestic GNP and expenditure:

(1) $B = Y - E(YP/V, M/V)$

Here we express expenditure as a function of real GNP and of real money balances, both measured in terms of the domestic consumer price index $V = P^{1-b}e^{b}$ where P is the implicit GNP deflator, b is the share of final goods imports in expenditure, and e is the import price index which equals the exchange rate, by definition. M is money supply.

Equation (1) shows that devaluation influences the current account through three distinct but overlapping channels:

(i) through real GNP (Y);

(ii) through the terms of trade (e/P), because $P/V = (e/P)^{-b}$;

(iii) through real balances (M/V), because $V = P^{1-b}e^{b}$.

Thus, in order to determine the effects of devaluation on the current account, we must first find its effects on GNP and the price level. For this purpose we use a simple aggregate supply and demand model of income and price determination.

On the supply side, we assume output Q to be produced by two variable factors of production, domestic labor L whose nominal wage W is to begin with held fixed by contract or custom, and imported inputs N the domestic currency price of which equals e:

$$(2) \quad Q = Q(L, N)$$

This production function Q has standard properties (Q_L, $Q_N > 0$; Q_{LL}, $Q_{NN} < 0$; etc.), and exhibits decreasing returns to scale. By first deriving the input demand functions

$$(3) \quad L = L(W/P, e/P)$$

$$(4) \quad N = N(W/P, e/P)$$

from the first-order conditions for maximum profit, we can express output as a decreasing function of the real prices of the two inputs:

$$(5) \quad Q = Q(W/P, e/P)$$

The next step is to exploit the definition of real GNP as the difference between gross domestic output Q and the amount of real factor imports

$$(6) \quad Y = Q - (e/P)N$$

Combining equations (4), (5), and (6) and solving for the price level gives the aggregate supply equation

$$(7) \quad P = P(\overset{+}{Y}, \overset{+}{e}, \overset{+}{W})$$

This equation can be represented by a positively sloped aggregate supply schedule under decreasing returns to scale. (The plus sign above Y indicates that the partial derivative P_Y is positive, and so on.) Under plausible parameter assumptions, an increase in foreign or domestic factor cost raises the price level at any given level of GNP.

On the demand side, we express GNP in the usual way as expenditure E plus exports X minus payments for final imports Z and for factor imports (e/P)N, all in real terms:

$$(8) \quad Y = E + X - Z - (e/P)N$$

Expenditure is given by

$$(9) \quad E = E(YP/V, M/V)$$

as in equation (1). We take exports to be an increasing function solely of the terms of trade:

$$(10) \quad X = X(e/P)$$

and final imports to vary directly with expenditure in domestic output units and inversely with the terms of trade:

$$(11) \quad Z = Z(EV/P,\ e/P)$$

Finally, factor imports are given by equation (4). Substituting equations (9), (10), (11), and (4) into (8) gives the aggregate demand equation

$$(12) \quad Y = Y(\underset{-}{P},\ \underset{?}{e},\ \underset{?}{W},\ \underset{+}{M})$$

This equation describes a downward-sloping aggregate demand schedule that shifts in response to changes in the exchange rate, the nominal wage, and the money supply.

Figure 1 illustrates the effects of devaluation on aggregate supply and demand. The initial equilibrium solution for GNP and the price level is given by point A. On the supply side, devaluation raises the cost of imported inputs so that the price level rises for any given level of GNP. Therefore, devaluation shifts the supply schedule to the left. On the other hand, the effect of devaluation on aggregate demand is ambiguous in principle, and depends on whether the expenditure-switching effects through the price elasticities of exports and imports are sufficiently strong to outweigh the expenditure-reducing effects of devaluation through reduced real balances (M/V) as well as the reduced purchasing power of GNP (YP/V). In the figure we assume that the expenditure-switching effects prevail so that devaluation shifts the demand schedule to the right. A new post-devaluation equilibrium is thus reached at point C in the figure.

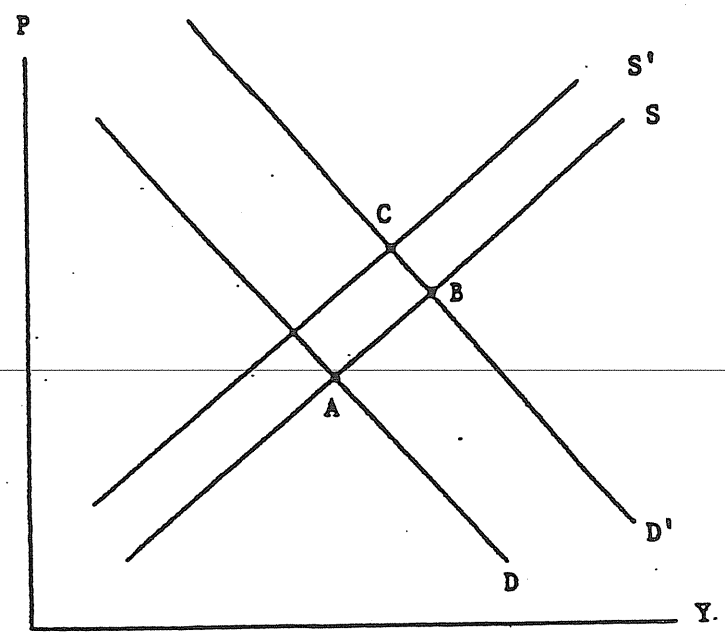

Figure 1. Demand and supply effects of devaluation

Since the effect of devaluation on GNP is indeterminate, its effect on the current account must also be ambiguous, compare equation (1).

Wage adjustment and foreign credit

Thus far we have held nominal wages fixed. As far as the least developed countries are concerned, this implies that devaluation lowers real wages below the subsistence level. In order to maintain real wages constant, nominal wages must be adjusted fully to any change in the costs of living by the formula

$$(13) \quad W = (P^{1-b} e^{b})^{a}$$

where the adjustment parameter a must be set equal to 1 to ensure full compensation. With full adjustment of wages, the supply schedule will shift further to the left than is shown in Figure 1 with the result that GNP is unambiguously reduced by devaluation (for a given supply of money). In other words, as demonstrated by Gylfason and Risager (1984, Table 3), if real wages are not permitted to fall and monetary and financial policies are not adjusted, devaluation will cause stagflation.

Can such an outcome be averted? We attempt to answer that question by introducing monetary and financial considerations into the above analysis so as to make room for domestic credit policy and financial capital flows. Since domestic (as well as foreign) credit is issued primarily to the public sector in the least developed countries, we do not distinguish between credit and fiscal policy.

We begin this extension by defining the overall balance of payments as the sum of the current account balance and net inflow of foreign loans ΔF where F is the stock of foreign debt outstanding and Δ is the first difference operator:

(14) $\Delta R = PY - VE + \Delta F$

Here R represents the net foreign assets of the banking system which are related to money supply and domestic credit D by the identity

(15) $M = R + D$

These equations indicate the crucial difference between domestic and foreign credit. Increased capital inflow from abroad simultaneously strengthens the external position and economic activity in the short run, whereas domestic credit expansion stimulates economic activity only at the cost of a greater deficit in the balance of payments through the induced changes in expenditure, GNP, and the price level.

Now we can view the implications of credit for the analysis of devaluation. By itself, devaluation reduces either real wages or GNP or both as we have seen, but improves the current account as intended if exports, imports, and expenditures are sufficiently responsive to relative price changes. For GNP to remain unchanged or increase while the current account improves, real wages must fall so as to stimulate employment, but then real wage earnings will fall if employment is not sufficiently elastic. Here foreign credit enters the picture. A reduction of either GNP or real wage earnings can be prevented by an appropriate injection of foreign capital, which at the same time reinforces the positive effects of the

devaluation and domestic credit restraint on the overall balance of payments. To what extent the devaluation-induced improvement of the current account can be preserved in this process is an empirical matter to which we now tun, among others.

III. Empirical analysis

For empirical purposes it is necessary to develop a quantitative version of the above model (Appendix). To this end, the model has been reformulated as linear relationships between rates of change, so that all parameters can be expressed in terms of the following shares and elasticities, all of which can be quantified:

- β, share of inputs in total imports;
- λ, share of final goods imports in GNP;
- θ_N, share of imported inputs in domestic output;
- θ_L, share of labor in domestic output;
- ω, initial ratio of current account deficit to exports;
- v, income velocity of money;
- σ, elasticity of substitution between labor and imported inputs;
- η, price elasticity of exports (absolute value);
- δ, price elasticity of imports (absolute value); and
- α, income elasticity of expenditure.

This section begins with a brief discussion of our statistical method. We next display our estimates and guesstimates of the values of the above parameters for a selected group of least developed countries. We then present the results of our empirical simulations, and discuss their policy implications.

Method

Under ideal conditions, statistical analysis of the effects of devaluation should be based on fully specified dynamic econometric models of national economies. However, the limited quantity and poor quality of economic data for virtually all the countries included in our sample render econometric methods infeasible here.

The method that we employ instead involves substitution of estimates of the above shares and elasticities into expressions for the effects of devalution on the current account, GNP, etc., along the lines of Gylfason and Schmid (1983) and Gylfason and Risager (1984). The shares can readily be obtained from international trade and national income accounts statistics published by the UN, World Bank, and IMF. The elasticities are more difficult to deal with because no estimates are available for the least developed countries. For the latter parameters, therefore, we try to make informed guesses based on estimates available for other LDCs, but we also consider broad ranges of reasonable values in order to assess the sensitivity of our results to particular parameter assumptions.

Data

Out of the 37 countries listed by UNCTAD (1983) as 'least developed', we have selected twelve to be included in our sample (Table 1). The following have been left out: (i) The very small countries (less than 500,000 inhabitants); (ii) the Franc zone countries in Africa which have agreed to subordinate their monetary policy to the Banque de France; (iii) countries where data have been disrupted or are otherwise unavailable, for political or other reasons.

Table 1. Devaluation record of selected least developed countries, 1961-81

	Devaluation year and percentage change of the US dollar price of domestic currency
Afghanistan	1963:125
Bangladesh	1975:83
Botswana	1975:26
Burundi	1965:75; 1976:14
Ethiopia	None
Haiti	None
Malawi	1967:17
Nepal	1967:33, 1975:18
Rwanda	1966:100
Somalia	None
Sudan	1978:13, 1979:25, 1981:41
Tanzania	1975:16

Sources: UNCTAD (1983) and IMF (1983).

Only seven of the parameters required for our purposes have been amenable to estimation from available statistics. To the remaining four we have had to apply guesswork. In view of the deficient quality of the available data, it is by no means certain that the estimtes provide a closer mirror image of reality than do the guesstimates.

The definitions and sources of the structural parameters that we have estimated are given below (column numbers refer to Table 2).

β, the share of inputs in total imports (column 1), was obtained from UNCTAD (1983). Imported inputs are defined as agricultural raw materials, fuels, ores, metals, chemicals, and machinery and equipment (SITC 2-22+3+5+67+68+7).

λ, the share of final goods imports in GNP (column 2), was obtained from UNCTAD (1983) and the World Bank Atlas. Final goods imports are defined as total imports minus imported inputs.

θ_N, The share of imported inputs in domestic output (column 3), defined as (MI/GNP)/(1+MI/GNP) where MI stands for imported inputs, was obtained from UNCTAD (1983) and the World Bank Atlas.

θ_L, the share of labor in domestic output (column 4), is defined as $(1-\theta_N)s_L$ where s_L is the ratio of employment income to NNP. The labor share s_L was derived from UN (1980) for 7 of the countries under study. For the remaining five, s_L has been set equal to 0.27, the unweighted average value of s_L in the 7 countries for which estimates were obtainable.

θ, (column 5), represents the sum total of columns 3 and 4.

ω, the ratio of current account deficit to exports (column 6), was derived from UNCTAD (1983).

v, the income velocity of money (column 7), is the ratio of nominal GNP to money supply broadly defined as reported by the IMF (1983).

Most of our estimates for the above parameters pertain to 1980 (Table 2). Where statistics for 1980 were unobtainable, we have employed the most recent figures given in the sources quoted. The figures indicate some distinctive features of the economies of the least developed countries: substantial dependence on imported inputs; moderate extent of openness (total imports are 26 % of GNP on average); low share of labor in GNP (28 % on average), reflecting large-scale self-employment; huge current account deficits; and finally a low degree of monetization.

The four behavioral parameters which we have been unable to estimate, are listed below. The assigned numbers represent medium-run elasticity values supposed to result from adjustment processes stretching over 1-3 years. In each case we provide a brief justification for the value chosen.

σ, the elasticity of substitution between labor and imported inputs = 0.3. We are unaware of any estimates of this elasticity, either for developing or industrial countries. Bruno's (1984) assessment of the elasticity of substitution between labor and raw materials in industrial countries provides a range of values between 0.35 and 0.93, while Pindyck's (1979) estimates of the elasticity of substitution between labor and energy, again in industrial countries, range between 0.93 and

1.94. Our guesstimate may thus apper conservatively low. The rationale for choosing a low figure is the widespread belief that factor substitutability in the least developed countries is severely constrained by undeveloped markets, institutions, and infrastructure. A higher value for σ is tried in the sensitivity analyses that follow the first simulations.

η, the price elasticity of exports = 1.2;

δ, the prisce elasticity of imports = 1.4.

These numbers are the average values of regression estimates for a group of developing countries (none of them in the least developed group), as reported in Gylfason and Risager (1984). In view of the widely held opinion that the economic structures of the least developed countries are inflexible, we also try lower values for η and δ in the sensitivity analyses.

α, the income elasticity of expenditure = 0.7. This value is inferred from Gylfason's (1981) estimate for the US.

Results

Armed with the above parameter values, we are now in a position to evaluate the consequences for the current account and GNP as well as for wages, employment, and profits of a 10 % devaluation (Table 3). With nominal wages held constant, a 10 % devaluation leads invariably to an improvement of the current account, ranging from 0.7 (Nepal) to 2.8 % (Botswana) of GNP. The unweighted average improvement is equivalent to 1.5 % of GNP for the sample as a whole, and constitutes the sum of a real balance effect (+1.0 % of GNP), a terms of trade effect (+0.6 %), and an income effect (-0.1 %). Thus, devaluation improves the current account in our model

Table 3 Effects of 10 % devaluation on current account, GNP, real wages, employment, and profits.

	Constant nominal wages					Constant real wages[1]			
	Effect on current account[2]	Effect on GNP[3]	Effect on real wages[3]	Effect on employ-ment[3]	Effect on real profits[3]	Effect on current account[2]	Effect on GNP[3]	Effect on employ-ment[3]	Effect on real profit[3]
Afghanistan	2.1	0.8	-4.6	4.0	4.1	1.9	-0.6	-1.4	-1.6
Bangladesh	0.9	-0.9	-2.2	-0.5	-0.8	1.0	-1.5	-2.8	-3.2
Botswana	2.8	1.4	-9.1	6.4	11.5	1.2	-0.4	-0.6	-1.2
Burundi	1.7	-0.4	-4.3	1.3	0.5	1.8	-0.9	-2.4	-1.7
Ethiopia	0.9	-1.0	-2.9	0.0	-0.4	1.1	-1.6	-2.8	-3.4
Haiti	1.6	-0.4	-4.0	1.1	0.6	1.7	-1.0	-2.5	-2.0
Malawi	1.9	-1.4	-5.0	0.4	-0.2	2.2	-1.9	-3.2	-3.8
Nepal	0.7	-0.7	-1.8	-0.2	-0.4	0.7	-1.2	-2.2	-2.6
Rwanda	1.1	-1.3	-2.9	-1.5	-1.3	1.2	-1.5	-3.7	-2.6
Somalia	2.1	-0.9	-4.1	0.5	0.1	2.3	-1.7	-3.2	-3.8
Sudan	1.5	-0.1	-3.2	1.7	3.9	1.6	-2.0	-2.7	-6.9
Tanzania	1.1	-1.5	-3.2	-0.9	-1.4	1.4	-2.0	-3.5	-4.1
Unweighted average	1.5	-0.5	-3.9	1.0	1.4	1.5	-1.4	-2.6	-3.1

Source: Authors' computations.

1) Real wages are defined as nominal wages deflated by the CPI.

2) In percent of GNP.

3) In percent.

primarily by lowering expenditure through reduced real balances and, to a lesser extent, through reduced purchasing power of GNP; the negative income effect amounts to only a minor offset.

Devaluation is not costless in these countries. Given constant nominal wages, real wages fall throughout, by 3.9 % on average, but since employment rises by 1.0 %, the average reduction in real wage earnings is limited to 2.9 %. Profits also rise, by 1.4 %, but GNP is nonetheless reduced by an average of 0.5 %.

The case of constant nominal wages displayed in Table 3 is juxtaposed with that of full wage adjustment, all other parameters remaining unchanged. While the positive effect of devaluation on current account remains, by and large, unchanged, the unweighted average fall of GNP is increased by 0.9 percentage points to 1.4 %. With real wages held constant, employment (and hence real wage income) as well as profits fall everywhere, or by 2.6 % and 3.1 % on average, respectively.

A comparison of the two cases shows that wage indexation only marginally reduces the fall of labor income resulting from devaluation, but above all concentrates this reduction on the unfortunate few who lose their jobs. Full adjustment of wages also implies a substantially greater reduction of GNP through lower employment and profits, and hence also, presumably, less investment activity and worse prospects for output growth over the medium term.

In Table 4 we vary the assumed values of some of the parameters that we have been unable to estimate, so as to test the sensitivity of the results to our assumptions. We report only the case of constant nominal wages.

Table 4 Effects of 10 % devaluation on current account and GNP with constant nominal wages: Further results (In percent of GNP)

	Reference case from Table 3		Variation 1: Elasticity of substitution higher (σ=0.7)		Variation 2: Elasticity of imports and exports lower (δ=0.7; η=0.6)		Variation 3: Initial current account deficit larger (ω=3.0)	
	Effect on current account	Effect on GNP	Effect on current account	Effect on GNP	Effect on current account	Effect on GNP	Effect on current account	Effect on GNP
Afghanistan	2.1	0.8	2.2	1.0	1.4	-0.2	1.5	-0.1
Bangladesh	0.9	-0.9	1.1	-0.4	0.4	-1.5	0.7	-1.1
Botswana	2.8	1.4	3.4	2.3	1.9	-0.3	4.1	-0.8
Burundi	1.7	-0.4	1.9	-0.1	1.1	-1.0	1.4	-2.2
Ethiopia	0.9	-1.0	1.2	-0.4	0.4	-1.7	0.6	-1.6
Haiti	1.6	-0.4	1.8	-0.1	1.0	-1.1	1.3	-0.9
Malawi	1.9	-1.4	2.1	-0.6	1.4	-2.4	1.8	-2.3
Nepal	0.7	-0.7	0.8	-0.3	0.3	-1.1	0.5	-0.8
Rwanda	1.1	-1.3	1.3	-0.8	0.6	-1.8	1.0	-1.4
Somalia	2.1	-0.9	2.3	-0.3	1.5	-2.1	2.1	-1.1
Sudan	1.5	-0.1	1.7	-0.6	0.8	-1.6	1.1	-1.2
Tanzania	1.1	-1.5	1.4	-0.8	0.6	-2.3	0.9	-1.9
Unweighted average	1.5	-0.5	1.8	0.0	1.0	-1.4	1.4	-1.3

Source: Authors' computations.

The first variation involves an increase in the elasticity of substitution between domestic and foreign inputs, σ, from 0.3 to 0.7. Unsurprisingly, the greater flexibility in factor substitution enhances the external adjustment somewhat, while the cost in terms of lost output is reduced to zero.

The second variation concerns a lowering of the price elasticities of imports and exports to one half of the values used in the base case. Setting $\delta = 0.7$ and $\eta = 0.6$ leads, as might be expected, to less favorable current account and GNP effects of devaluation. When foreign trade is less responsive to price changes, devaluation will obviously have a smaller impact on the current account throughout as well as on aggregate demand, and hence also on GNP. Clearly, the price elasticities would have to be even lower than assumed in this variation, for the uniformly positive current account effect of devaluation to be nullified. We have also tested for the consequences of lowering only one of the price elasticities at a time (not shown in table). This exercise demonstrates that the price elasticities of exports and imports, respectively, play about equally important quantitative roles in this context.

The third and final variation involves postulating substantial current account deficits to begin with ($\omega = 3.0$) instead of using the estimated values of Table 2. The rationale is that devaluation will be considered indispensable only when there is a heavy current account deficit and that we want to explore the consequences of devaluation for all the countries under study in that particular circumstance. The outcome indicates that the current account improvement is somewhat reduced everywhere except in Botswana (which

had a sizable initial surplus in the base case calculation), or by 0.2 % of GNP on average, excluding Botswana. Meanwhile, the contraction of GNP following devaluation increases significantly, or by 0.8 % of GNP on average. Without this negative income effect, the current account effect would, of course, have been larger.

We conclude that the results reported in Table 3 for constant nominal wages are generally quite robust even to substantial variations in the parameter values that could not be estimated. Our results for the case of constant real wages (not reported here) are similarly robust. Throughout, devaluation improves the current account at the cost of either a significant reduction of real wages or a substantial loss of output and employment if real wages are not permitted to fall. Real wage earnings must fall in either case.

As demonstrated in Section II, such losses can be avoided through foreign borrowing. For this to bse possible, real wages must be permitted to fall. The reason is that with full wage indexation, a policy of foreign capital infusion aimed at keeping GNP or real wage earnings constant after a 10 % devaluation would simply raise money supply, prices, and wages by 10 %, and thus restore all real variables, including the current account, to their pre-devaluation levels.

When real wages are permitted to fall, the average foreign capital inflow that is needed to maintain GNP unchanged amounts to 0.8 % of GNP. Because real balances do not need to be restored to their initial level in this case, real wage earnings as well as expenditure are lower than initially, and the current account improves throughout as before (Table 5). To restore real wage earnings to their pre-devaluation level, a much greater influx of

Table 5 Foreign capital inflow requirements and current account effects when GNP or real wage earnings are kept constant after a 10 % devaluation with constant nominal wages (In percent of GNP)

	Constant GNP		Constant real wage earnings	
	Capital inflow requirements (1)	Effect on current account (2)	Capital inflow requirements (3)	Effect on current account (4)
Afghanistan	-1.0	2.8	0.6	1.6
Bangladesh	0.7	0.5	1.7	-0.1
Botswana	-7.9	5.3	10.8	-0.6
Burundi	0.3	1.3	1.8	-0.8
Ethiopia	1.0	0.4	2.7	-0.4
Haiti	0.6	1.3	3.3	-0.4
Malawi	1.1	0.7	3.1	-1.8
Nepal	0.6	0.4	1.6	0.1
Rwanda	0.9	0.3	2.5	-1.3
Somalia	0.7	1.4	2.2	-0.2
Sudan	0.1	1.4	0.8	0.9
Tanzania	2.4	0.3	5.7	-1.0
Unweighted average	0.8[1]	1.3	3.1[2]	-0.3

Source: Authors' computations.

1) Does not include Afghanistan and Botswana.
2) 2.4 if Botswana is not included.

capital is needed, equivalent to 3.1 % of GNP on average. In this case, GNP must rise everywhere, but the current account improves only in three of the countries, and deteriorates by the equivalent of 0.3 % of GNP on average in the sample as a whole.

The amounts of foreign finance needed to prevent a contraction of GNP or of real wage earnings after a 10 % devaluation are not substantial when compared with the actual influx of foreign aid to the countries under study. Between 1979 and 1981, the latter amounted to an unweighted annual average of about 12 % of these countries' GNP (UNCTAD, 1983 A). But even though the amounts are manageable, it appears that while external adjustment through devaluation does not require a contraction of GNP, the foreign capital inflow needed to keep real wage earnings constant is generally not compatible with a current account improvement after devaluation.

IV. Summary

Our analysis has shown that devaluation can be an effective tool for rectifying current account deficits in the least developed countries. According to our simulations, a 10 % devaluation improves the current account by 0.7 to 2.8 % of GNP in the short to medium term in the 12-country sample studied.

The simulations also demonstrated the detrimental side effects of devaluation that often occur. With nominal wages held fixed, a 10 % devaluation was shown to lower GNP by 0.5 % and real wage earnings by 2.9 %, on average.

Full indexation of wages was seen to lead to a much greater reduction of GNP (1.4 % on average) as well as a substantial

contraction of profits. Simultaneously, employment and hence real wage earnings declined by an average of 2.6 %. Thus, the relatively small but evenly distributed loss of income resulting from a reduction of real wage levels after devaluation was seen to be replaced by much more severe losses confined to those few who were thrown out of work under a policy of wage indexation.

Our analysis also showed how increased inflows of foreign finance can avert the post-devaluation fall of GNP or of real wage earnings that would otherwise take place. With real wages held fixed, a foreign capital infusion to neutralize these losses would be futile since the improvement of the current account is nullified in the process. When real wages were permitted to fall, the average capital inflow required to restore GNP was quite small, or equivalent to 0.8 % of GNP on average, and the current account improved throughout. Restoration of real wage earnings, however, required a much higher capital inflow (3.1 % of GNP on average). More importantly, a majority of the countries in our sample experienced a current account deterioration following devaluation supplemented by the foreign capital inflows needed to keep real wage earnings constant.

We conclude that devaluation can be an efficient and appropriate method for reducing current account deficits in the least developed countries, provided (i) that it is accompanied by domestic monetary restraint; (ii) that real wages are permitted to fall at least enough to prevent employment from declining; (iii) that at least sufficient foreign capital is procured (preferably on concessional terms) to avert a reduction of GNP. In general, however, the empirical magnitudes involved in our analysis indicate

that there is no way to avoid a small reduction of real wage earnings in favor of profits during a transition period, if devaluation is to have its intended positive effect on the current account. Specifically, if the three conditions listed above are met, the detrimental side effects of 10 % devaluation could be limited to a 2-3 % average reduction of real wage earnings in the 12 countries under study. We conjecture that comparably effective alternative adjustment strategies such as import restrictions and exchange controls would prove more costly in economic and social terms.

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APPENDIX

This appendix develops the quantitative version of the macroeconomic model presented in section II.

Supply side

$$(A.1)\quad \hat{Q} = \theta_L \hat{L} + \theta_N \hat{N}, \quad \theta = \theta_L + \theta_N \leq 1$$

$$(A.2)\quad \sigma = -(\hat{N} - \hat{L})/(\hat{e} - \hat{W})$$

$$(A.3)\quad \hat{N} = (1/\theta)\hat{Q} - (\theta_L \sigma/\theta)(\hat{e} - \hat{W})$$

$$(A.4)\quad \hat{Y} = [1/(1 - \theta_N)]\hat{Q} - [\theta_N/(1 - \theta_N)](\hat{e} - \hat{P} + \hat{N})$$

$$(A.5)\quad \hat{P} = (\theta_L/\theta)\hat{W} + (\theta_N/\theta)\hat{e} + [(1 - \theta)/\theta]\hat{Q}$$

$$(A.6)\quad \hat{Y} = \hat{Q} - \{\theta_N \theta_L (1 - \sigma)/[(1 - \theta_N)\theta]\}(\hat{e} - \hat{W})$$

Eq. (A.1) expresses the production function (2) in the text in terms of proportional rates of change (denoted by hats ("^"); θ_L and θ_N are the shares of labor and imported inputs, respectively, in gross output. Eq. (A.2) defines the elasticity of substitution σ between the two factors. Eq. (A.3) follows from (A.1) and (A.2), and shows the derived demand for the imported factor as a function of output and relative factor prices. Eq. (A.4) converts the definition of GNP as output less factor imports from eq. (6) to proportional rates of change. Eq. (A.5) is the price equation implied by the non-increasing returns to scale production technology assumed in eq. (A.1). Finally, eq. (A.6) is derived from (A.3),(A.4), and (A.5). Based on eqs. (A.5) and (A.6), the supply equation (7) in the text can be reexpressed as

(A.7) $\hat{P} = b_1\hat{Y} + b_2\hat{e} + b_3\hat{W}$

where

$$b_1 = (1 - \theta)/\theta$$

$$b_2 = \{\theta_N/\theta + (1 - \theta)\theta_L\theta_N(1 - \sigma)/[(1 - \theta_N)\theta^2]\}$$

$$b_3 = \{\theta_L/\theta - (1 - \theta)\theta_L\theta_N(1 - \sigma)/[(1 - \theta_N)\theta^2]\}$$

Thus the supply schedule has a positive slope b_1 as long as the production technology is characterised by decreasing returns to scale ($\theta < 1$). With constant returns to scale ($\theta = 1$), the supply schedule becomes horizontal as in Gylfason and Schmid (1983). Observe that b_2 and b_3 are positive at least as long as $0 \leq \sigma \leq 1$, and $b_2 + b_3 = 1$.

Demand side

(A.8) $\hat{Y} = \rho\hat{E} + \Gamma\{[1/(1 + \omega)]\hat{X} - (1 - \beta)\hat{Z} - \beta(\hat{e} - \hat{P} + \hat{N})\}$

(A.9) $\hat{E} = \alpha(\hat{Y} + \hat{P} - \hat{V}) + (1 - \alpha)(\hat{M} - \hat{V})$

(A.10) $\hat{X} = \eta(\hat{e} - \hat{P})$

(A.11) $\hat{Z} = \hat{E} - (\delta - b)(\hat{e} - \hat{P})$

(A.12) $\hat{N} = (1/\theta)\hat{Y} - \Lambda(\hat{e} - \hat{W})$

Eq. (A.8) converts the income-expenditure equation (8) in the text to proportional rates of change, assuming that the current account is in deficit initially so that $E = \rho Y$ where $\rho = 1 + \omega\Gamma/(1 + \omega)$ and ω is the initial current account deficit expressed as a fraction of

exports. Observe that $\Gamma = \lambda + \theta_N/(1 - \theta_N)$ is the share of final plus intermediate imports in GNP, while $1 - \beta$ and β are the shares of these variables in total imports. Eq. (A.8) converts the expenditure equation (9) in the text to proportional rates of change; α is the short-run income elasticity of expenditure. Similarly, eqs. (A.10) and (A.11) express the export and import equations (10) and (11) in terms of rates of change; η is the price elasticity of exports and δ is the price elasticity of final imports in the original import equation $\hat{Z} = \hat{E} + \hat{V} - \hat{P} - \delta(\hat{e} - \hat{P})$ which is converted to (A.11) by using $\hat{V} = (1 - b)\hat{P} + b\hat{e}$ and $b = \lambda/\rho$. We assume a unitary expenditure elasticity of imports for simplicity. Finally, eq. (A.12) is derived from (A.3) and (A.6) to show the demand for the imported factor as a function of GNP and relative factor prices; the relative price elasticity is $\Lambda = \theta_L\sigma/\theta - \{\theta_L\theta_N(1 - \sigma)/[(1 - \theta_N)\theta^2]\}$. By substitution from eqs. (A.9) to (A.12) into (A.8), we can rewrite the demand equation (12) in the text as

$$\text{(A.13)} \quad \hat{Y} = a_1\hat{P} + a_2\hat{e} + a_3\hat{W} + a_e\hat{M}$$

where

$$a_1 = -\{\Gamma\Omega + \rho(1 - \alpha - b)[1 - \Gamma(1 - \beta)]\}/\Delta$$

$$\Omega = [1/(1 + \omega)]\eta + (1 - \beta)(\delta - b) - \beta$$

$$\Delta = 1 - \{[1 - \Gamma(1 - \beta)]\alpha\rho - \Gamma\beta/\theta]$$

$$a_2 = (\Gamma\Omega + \Gamma\beta\Lambda - \rho b)[1 - \Gamma(1 - \beta)]/\Delta$$

$$a_3 = -\Gamma\beta\Lambda/\Delta$$

$$a_4 = [\rho(1 - \alpha)]/\Delta$$

The slope of the demand schedule a_1 is negative as long as the price elasticities of exports and of final goods imports (i.e., η and δ and hence also Ω) and the real balance elasticity of expenditure (i.e., $1 - \alpha$) are large enough to dominate the terms of trade effect through which an increase in domestic prices tends to stimulate expenditure (as reflected by b in the expression for a_1; see also eq. (1) and the ensuing discussion). It should also be noted that Ω is a linear combination of the price elasticities of the three components of the current account, and plays the role that the familiar sum of elasticities $\eta + \delta$ plays in the Marshall-Lerner condition in simpler models; our explicit distinction between the GNP deflator P and the consumer price index V implies that the price elasticity of imports is $\delta - b$. Observe also that $1/\Delta$ is simply the expenditure multiplier. While the signs of a_2 and a_3 are ambiguous and $a_4 > 0$, the homogeneity of the model ensures that $a_1 + a_2 + a_3 + a_4 = 0$.

Current account

By first rewriting eq. (1) in the text in terms of first differences, then dividing through by Y and substituting eq. (A.9) into the result, we can rewrite the currrent account equation as follows:

$$\text{(A.14)} \quad \Delta B/Y = (1 - \alpha\rho)\hat{Y} + \rho(1 - \alpha - b)\hat{P} + \rho b\hat{e} - \rho(1 - \alpha)\hat{M}$$

Here $\Delta B/Y$ stands for the change in the current account as a fraction of GNP and $(1 - \alpha\rho)\hat{Y}$ reflects the income effect of devalution, $\rho(1 - \alpha)\hat{P}$ reflects the real balance effect, and $\rho b(\hat{e} - \hat{P})$ reflects the terms of trade effect; compare the discussion following eq. (1) in the text.

Employment, profits, and wages

The following employment equation is obtained by combining eqs. (A.2), (A.3), and (A.6):

$$(A.15)\quad \hat{L} = (1/\theta)\{\theta_N\sigma + \theta_N\theta_L(1 - \sigma)/[(1 - \theta_N)\theta]\}(\hat{e} - \hat{W}) + (1/\theta)\hat{Y}$$

The profit equation (A.16) is obtained by rewriting the definition of profits $R = Y - (W/P)L$ in terms of rates of change, observing that the share of labor in GNP, $(W/P)L/Y$, can be expressed as $\theta_L/(1 - \theta_N)$:

$$(A.16)\quad \hat{R} = [(1 - \theta_N)/(1 - \theta)]\hat{Y} - [\theta_L/(1 - \theta)](\hat{W} - \hat{P} + \hat{L})$$

Finally, we rewrite the wage equation (13) in the text as

$$(A.17)\quad \hat{W} = a[(1 - b)\hat{P} + b\hat{e}]$$

Foreign credit

In order to be able to quantify the amount of foreign credit necessary to offset the negative GNP effect of devaluation for constant nominal or real wages, we need to trace through the model the effect of the foreign capital infusion on the balance of payments, money supply, expenditure, and ultimately income. For example, holding nominal wages fixed ($a = 0$), we begin by merging equations (A.7), and (A.13) so as to get

$$(A.18)\quad \hat{Y} = c_1\hat{e} + c_2\hat{M}$$

where

$$c_1 = (a_1b_2 + a_2)/(1 - a_1b_1)$$

$$c_2 = a_4/(1 - a_1b_1) > 0$$

The sign of c_1, which reflects the effect of devaluation on GNP for given money supply and nominal wages, is ambiguous because devaluation lowers both real balances and wages in this case.

Assuming full sterilization of any initial current account deficits or surpluses through offsetting changes in domestic credit, eqs. (14) and (15) in the text imply the following relationship between the rate of monetary expansion and capital inflow:

$$(A.19) \quad \hat{M} = v\Delta F/PY$$

where $v = PY/M$ is the income velocity of money. Combining eqs. (A.18) and (A.19), we can now write the amount of foreign credit (expressed as a proportion of GNP) necessary to keep GNP constant in the wake of devaluation as follows:

$$(A.20) \quad \Delta F/PY = -(c_1/vc_2)\hat{e}$$

The same method was used to compute the amount of foreign credit needed to restore real wage earnings to their initial position.

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