

Does devaluation cause stagflation?

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Abstract. The traditional view that devaluation tends to increase domestic real income and output has been challenged in recent years on the grounds that trade flows, including factor imports, are relatively insensitive to exchange rate changes, especially in developing countries. This paper presents a simple macro-economic model in which devaluation influences real income and output both through the cost of imported inputs on the supply side of the economy and through exports, imports, and expenditures on the demand side. Statistical estimates of the structural parameters of the model for a group of ten industrial and developing countries are used to show that the demand effects dominate the cost effects in most cases, thus supporting the traditional view that devaluation has positive real effects in these countries in the short to medium run.

Est-ce que la dévaluation engendre la stagflation? Le point de vue conventionnel veut que la dévaluation tende à accroître le niveau du revenu et de la production domestiques. C'est un point de vue qui a été remis en question ces dernières années parce que, dit-on, les flux de commerce international, y compris les flux d'importation de facteurs de production, semblent relativement insensibles aux changements dans le taux de change. Ce mémoire développe un modèle macro-économique simple dans lequel la dévaluation influence le niveau de revenu et de production en termes réels via le coût des facteurs de production importés du côté de l'offre, et via les exportations, les importations et les niveaux de dépenses du côté de la demande. Les auteurs utilisent la calibration statistique des paramètres structurels du modèle pour un groupe de dix pays industrialisés et en voie de développement pour montrer que les effets du côté de la demande dominent les effets de coûts dans la plupart des cas. Voilà qui supporte le point de vue traditionnel qui veut que la dévaluation ait un impact positif réel dans les pays dévaluateurs à court et à moyen terme.

INTRODUCTION

The spectacular increase in the price of oil and other raw materials in the 1970s opened the eyes of economists and policy-makers to the importance of the aggregate

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supply side of the economic system of both industrial and developing countries. In response to these developments, macro-economic theory and policy have undergone rapid changes in recent years. Old truths have been questioned or discredited.

Among the widely accepted views that have been called in question is the traditional proposition of Keynesian open-economy macro-economics that devaluation tends to increase domestic real income and output in the short run as well as net exports and the price level. The grounds on which this proposition, originally emanating from Meade (1951), has been challenged differ among authors. Most of the arguments advanced have rested on aggregate supply and cost considerations as well as on 'elasticity pessimism.' Accordingly, proponents of the new view that devaluation may have adverse real effects have been concerned mainly with semi-industrialized countries, on the presumption that trade flows are relatively insensitive to price and exchange rate changes in these countries (Cooper, 1971a, 1971b; Krugman and Taylor, 1978). Other authors have emphasized the possibility of negative real effects of devaluation in oil-importing industrial countries, provided that price elasticities of exports and imports are sufficiently low (Dornbusch, 1981, chap. 5; Schmid, 1982). Meanwhile, of course, monetarists have objected to the Keynesian approach to devaluation analysis and maintained that exchange rate changes influence real magnitudes mainly through the real balance effect in the short run but leave all real variables unchanged in the long run.

Following in the footsteps of Hirschman (1949), Diaz-Alejandro (1963), and Cooper (1971a, 1971b), Krugman and Taylor (1978) have recently called attention to three types of circumstances under which devaluation can lead to a reduction in output, namely, when (1) imports initially exceed exports, (2) the propensity to save out of capital income is higher than out of labour income, and (3) government revenue is increased by devaluation. They argue that 'all three circumstances prevail in many countries, especially the less developed ones. In these countries a deflationary impact from devaluation is more than a remote possibility; it is close to a presumption' (Krugman and Taylor, 1978, 446–7). From this they conclude that 'devaluation should in many cases be accompanied by measures to *increase* demand' (455). It needs to be pointed out, however, that these conclusions are derived from a model in which both exports and imports are completely insensitive to relative price changes, and all imports are used as inputs into production and are directly proportional to output. Thus, with the volume of exports assumed fixed, the only channel by which devaluation can improve the trade balance in foreign currency in Krugman and Taylor's model is through a negative effect on output, resulting in less need for imported inputs. Subsequently, Taylor (1981) has placed renewed emphasis on the role of imported raw materials (as well as of working capital) as factors of production in semi-industrialized countries, and argued that devaluations (as well as interest rate increases) tend to increase costs and reduce output on the supply side of the economy. Taylor's analysis has led him to conclude that 'it is quite likely that both devaluation and monetary contraction will cause stagflation under semi-industrialized macroconstraints' (501).

This paper presents a simple, macro-economic model in which devaluation

influences real income and output both through the cost of imported oil and other inputs into production on the supply side of the economy, as stressed by the proponents of the new view, and through exports, imports, and expenditures on the demand side. The second section shows how the direction of the real effects of devaluation depends on the relative strength of the supply and demand factors. In the third section statistical estimates of the structural parameters of the model for a group of ten industrial and developing countries are used to make an empirical assessment of the relative importance of these effects. The results show that positive demand effects dominate the supply effects in the short to medium run in all of these countries, except possibly the United Kingdom and Brazil, thus supporting the conventional view that devaluations generally have positive real effects in this time perspective, also in less developed countries. The fourth section briefly discusses the policy implications of these results.

REAL EFFECTS OF DEVALUATION

On the supply side of the economy, gross domestic output q is assumed to be produced from two inputs, labour and other domestic factors l and imported oil and other foreign factors n . For convenience, the linearly homogeneous production function $q = q(l, n)$ may be expressed in terms of proportional rates of change: $\hat{q} = (1 - \theta)\hat{l} + \theta\hat{n}$, where $1 - \theta$ and θ are the shares of the domestic and foreign factors, respectively, in output ($0 < \theta < 1$). The elasticity of substitution between the two factors is defined as $\sigma = -(\hat{n} - \hat{l})/(\hat{E} - \hat{W}) > 0$, where E is the exchange rate (which is exogenous and equals, by assumption, the domestic currency price of imported inputs) and W is the exogenously determined price of the domestic factor. The derived demand for the foreign factor may then be expressed in rates of change as follows:

$$\hat{n} = \hat{q} - (1 - \theta)\sigma(\hat{E} - \hat{W}). \quad (1)$$

Real national income y differs from output by the amount of real factor imports: $y = q - (E/P)n$, where P is the price of domestic output, or $\hat{y} = [1/(1 - \theta)]\hat{q} - [\theta/(1 - \theta)](\hat{E} - \hat{P} + \hat{n})$. This relationship and equation (1), assuming marginal cost pricing so that $\hat{P} = (1 - \theta)\hat{W} + \theta\hat{E}$, imply

$$\hat{y} = \hat{q} - \theta(1 - \sigma)(\hat{E} - \hat{W}). \quad (2)$$

Thus, with limited substitutability in production between domestic and imported inputs ($\sigma < 1$), devaluation (or, say, an oil price increase) lowers real income obtained from any given level of domestic output and factor prices.¹

1 If, as in Schmid (1981), a fixed capital stock is explicitly included in the model as a third factor, the nested CES production function $q = q(v, k, n)$, where v is domestic value added and k is capital, exhibits decreasing returns to scale. Accordingly, gross output may then be expressed as a decreasing function of the real prices of l and n : $\hat{q} = -\epsilon_l(\hat{W} - \hat{P}) - \epsilon_n(\hat{E} - \hat{P})$, where the factor price elasticities $\epsilon_l > 0$ and $\epsilon_n > 0$ (absolute values) are complicated functions of the shares of the three factors in gross output and of the elasticities of substitution between v and n and between l and k . The above output equation can be rewritten as $\hat{P} = (\epsilon_l/\epsilon_p)\hat{W} + (\epsilon_n/\epsilon_p)\hat{E} + (1/\epsilon_p)\hat{q}$, where $\epsilon_p = \epsilon_l + \epsilon_n > 0$, so that the supply schedule corresponding to this price equation is upward sloping in (P, q) .

On the demand side of the economy, gross national income y equals the sum of real domestic expenditure e and exports x less imports of final goods z and factors $(E/P)n$, all measured in units of domestic output. Assuming for convenience that the overall trade balance is initially in equilibrium,² the income-expenditure relationship $y = e + x - z - (E/P)n$ may be expressed in rates of change as follows:

$$\hat{y} = \hat{e} + [\lambda + \theta/(1 - \theta)]\{\hat{x} - (1 - \beta)\hat{z} - \beta(\hat{E} - \hat{P} + \hat{n})\}, \quad (3)$$

where λ and $\theta/(1 - \theta)$ are the shares of final goods imports and intermediate imports, respectively, in national income ($0 < \lambda < 1$) and $\beta = \theta/[\lambda(1 - \theta) + \theta]$ and $1 - \beta$ are the shares of inputs and final goods, respectively, in total imports ($0 < \beta < 1$). Domestic expenditure is expressed as a linearly homogeneous function of real income and real balances,

$$\hat{e} = \alpha\hat{y} + (1 - \alpha)(\hat{M} - \hat{P}), \quad (4)$$

where α is the short-run elasticity of expenditure with respect to income ($0 < \alpha < 1$) and M is the nominal money supply.³ Exports are assumed to be a function solely of the terms of trade,

$$\hat{x} = \eta(\hat{E} - \hat{P}), \quad (5)$$

where $\eta > 0$ is the absolute value of the price elasticity of export demand. Final goods imports (measured in domestic output units) are assumed to depend on expenditures, with a unitary elasticity for simplicity, and on the terms of trade,

$$\hat{z} = \hat{e} + (1 - \delta)(\hat{E} - \hat{P}), \quad (6)$$

where $\delta > 0$ is the absolute value of the price elasticity of the demand for final goods imports. Finally, the demand for imported inputs (in domestic output units) can be expressed as a function of income and the factor price ratio using equations (1) and (2) and the price equation $\hat{P} = (1 - \theta)\hat{W} + \theta\hat{E}$:

$$\hat{E} - \hat{P} + \hat{n} = \hat{y} + (1 - \sigma)(\hat{E} - \hat{W}). \quad (7)$$

Substitution from equations (4)–(7) into (3) yields the following expression for the effect of devaluation on real national income (in units of domestic output) for given money supply and domestic factor prices:⁴

$$\hat{y}/\hat{E} = \{[\lambda(1 - \theta) + \theta]\Omega - \theta\Gamma\}/\Delta. \quad (8)$$

space. The three-factor model described above subsumes the two-factor model presented in the text as a special case in which either the share of capital in gross output is zero or the elasticity of substitution between k and l is infinitely large. In either case, the coefficients of the above price equation converge on $1 - \theta$, θ , and 0 , respectively, which gives the price equation that is used in the text. For further detail, see Schmid (1981). See also Bruno (1981) whose model of the supply side of an oil-importing economy includes a variable capital stock as a third factor of production.

2 We relax this assumption in the empirical discussion in the third section.

3 For a rigorous foundation of this type of expenditure function in a model of intertemporal optimization, see, for example, Dornbusch and Mussa (1975).

4 Below we discuss the effects of devaluation on output, and relax the assumption that M and W are held fixed.

Here $\Omega = \eta + (1 - \beta)\delta + \beta\sigma - 1$ represents an extension of the traditional Marshall-Lerner expression to an input-importing economy; $\Gamma/\Delta = \{\lambda(1 - \theta)(\eta + \delta - 1) + \theta\eta + (1 - \theta)(1 - \lambda)(1 - \alpha)\}/\Delta$ is the absolute value of the elasticity of y with respect to P in the income-expenditure equation (3); and $\Delta = 1 - (1 - \theta)(1 - \lambda)\alpha$ is the reciprocal of the multiplier of the model ($0 < \Delta < 1$).⁵ For the moment we abstract from the effect of devaluation on domestic factor prices and assume that W is fixed, but we shall relax this assumption later on. Thus, for given W (and M), $\hat{y}/\hat{E} > 0$ as long as $\Omega > \beta\Gamma$. Equation (8) decomposes the effect of devaluation on real income into (1) a demand effect that is positive as long as the extended Marshall-Lerner condition is met ($\Omega > 0$), and (2) a cost or supply effect that is negative as long as the traditional Marshall-Lerner condition is met ($\eta + \delta > 1$). To see this result more clearly, equation (8) may also be written as

$$\hat{y}/\hat{E} = \hat{y}/\hat{E}|_P + (\hat{y}/\hat{P})(\hat{P}/\hat{E})$$

where

$$\hat{y}/\hat{E}|_P = [\lambda(1 - \theta) + \theta]\Omega/\Delta, \quad \hat{y}/\hat{P} = -\Gamma/\Delta,$$

and $\hat{P}/\hat{E} = \theta$. Figure 1 illustrates the point. The D schedules are based on equations (3)–(7) and the S schedules on the price equation $\hat{P} = (1 - \theta)\hat{W} + \theta\hat{E}$.⁶ In the figure the effect of the demand shift is shown by the distance AB , while BC indicates the income effect of the cost increase. As equation (8) and figure 1 show clearly, the direction of the effect of devaluation on real income cannot be determined a priori but depends on the relative magnitudes of these shifts and hence of the structural parameters of the model. Accordingly, the analysis to follow is facilitated by rewriting equation (8) in terms of these parameters as follows:

$$\hat{y}/\hat{E} = \{(1 - \theta)[(1 - \theta)\lambda(\eta + \delta - 1) + \theta\eta - \theta(1 - \lambda)(1 - \alpha)] - \theta(1 - \sigma)\}/\Delta. \quad (9)$$

The term $\theta(1 - \sigma)$ reflects the factor substitution effect of devaluation, while the remaining terms represent the traditional effects of devaluation through the export and import price elasticities η and δ and the real balance effect $1 - \alpha$.

Equation (9) implies the following propositions. First, the higher the elasticity of substitution σ between domestic and imported inputs, the more likely is a devaluation to increase real income, *ceteris paribus*. The reason is that high values of σ enable firms to reduce their dependence on foreign oil and other factor imports when their prices rise, leaving a bigger share of gross domestic output for domestic residents. Second, the higher the price elasticities of demand for exports and final goods imports, η and δ , the more likely is a devaluation to increase real income, other things being equal. It is precisely pessimism about the degree of substitutability in production as well as on the demand side of the economy as reflected by low values of

5 Note that the value of the multiplier $1/\Delta$ varies inversely with θ , the share of imported inputs in gross production. When $\theta = 0$, the multiplier takes the standard form $1/(s + m)$ where $s = 1 - \alpha$ and $m = \lambda\alpha$.

6 The S schedules are horizontal, because we assume constant returns to scale in production. If a fixed stock of capital were explicitly included as a third factor of production, the S schedules would slope up (see fn. 1).

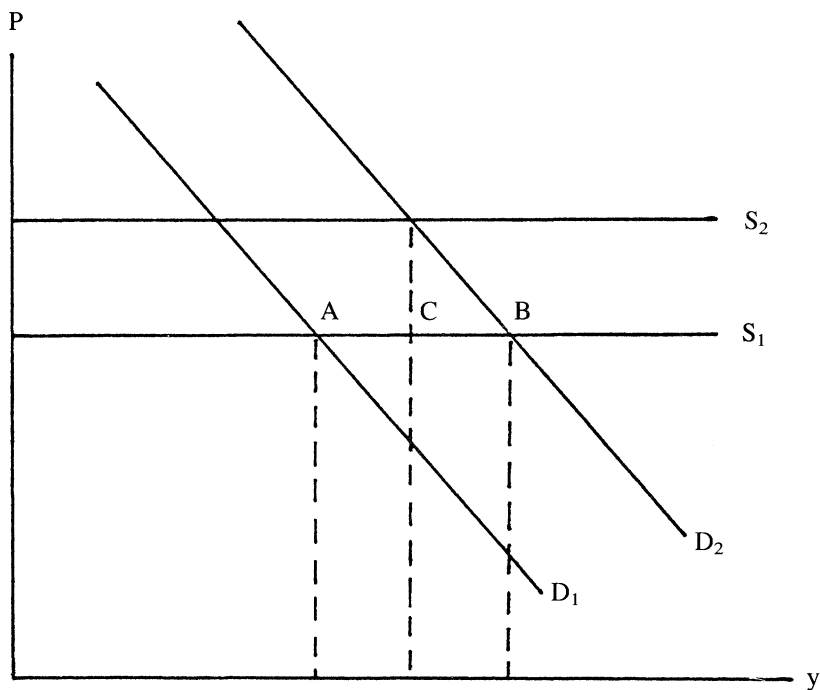


FIGURE 1 Real effects of devaluation

the elasticities σ , η , and δ that underlies the belief of Krugman and Taylor (1978), Taylor (1981), and others in the contractionary effects of devaluation. Third, for given values of these elasticities and the shares θ and λ a positive real effect of devaluation is more likely the smaller is the real balance effect as reflected by $1 - \alpha$. Fourth, an increase in the share λ of final goods imports in national income also tends to reduce the prospects for contractionary effects, through its interaction with both the real balance effect and the price elasticities in the numerator of equation (9), provided that the traditional Marshall-Lerner condition $\eta + \delta > 1$ is met. However, a rise in λ also reduces the multiplier $1/\Delta$, rendering the net effect on \hat{y}/\hat{E} ambiguous. The special case where $\lambda = 0$ and $\beta = 1$ (i.e., only inputs are imported) is dealt with in Schmid (1982). Finally, a rise in θ – the share of factor imports in gross output and, equivalently, the weight of the exchange rate in the domestic price index – has a more complicated effect. By increasing both the import cost effect (provided $\sigma < 1$) and the real balance effect of devaluation and by also lowering the multiplier, a rise in θ tends to increase the likelihood of contractionary effects. At the same time, however, the interaction of θ with η and δ has an ambiguous effect on \hat{y}/\hat{E} . In the special textbook case where $\theta = 0$ and $\beta = 0$ (i.e., no inputs are imported), equation (9) simplifies to $\hat{y}/\hat{E} = \lambda(\eta + \delta - 1)/[1 - (1 - \lambda)\alpha]$, in which case devaluation raises real income as long as the traditional Marshall-Lerner condition is met. In sum, these propositions imply that (1) the smaller the dependence of the economy on imported inputs (as

reflected by a high σ) and (2) the greater its capacity for expenditure switching and reduction (as reflected by high values of η , δ , and α), the weaker is the case for contractionary effects of devaluation.

As exchange rate changes drive a wedge between gross output and real income, it is also of interest to evaluate the effect of devaluation on output. This may be done by solving equations (3)–(7) for given M and W as before, to give

$$\hat{q}/\hat{E} = \{(1 - \theta)[(1 - \theta)\lambda(\eta + \delta - 1) + \theta\eta - \theta(1 - \lambda)(1 - \alpha)] - \theta(1 - \sigma)(1 - \Delta)\}/\Delta, \quad (10)$$

which is identical to the expression for \hat{y}/\hat{E} in (9) except for the term $1 - \Delta$ in the numerator. Comparison of equations (9) and (10) shows that, since $\Delta < 1$, devaluation will raise output more (or lower it less) than real income as long as $\sigma < 1$, that is, as long as the real import bill for intermediate goods cannot be reduced proportionately in response to devaluation, owing to limited substitutability between domestic and foreign factors of production.

It needs to be emphasized that the expressions for \hat{y}/\hat{E} and \hat{q}/\hat{E} presented above tend to overstate the real effects of devaluation because the price level is assumed to be cost determined in the model (see fn. 1). It is therefore of interest to study the implications for the real effects of devaluation of full adjustment of domestic factor prices (e.g., through wage indexation) and of money supply to exchange rate changes. Recalculation of these effects on the assumption that $\hat{W} = \hat{M} = \hat{E}$ yields $\hat{y}/\hat{E} = \hat{q}/\hat{E} = 0$, thus confirming the standard result that devaluation becomes impotent as an instrument for economic stabilization if it fails to lower real factor prices and the real money supply. While this possibility has to be reckoned with in long-run analysis of the real effects of devaluation, some degree of wage stickiness (and of monetary non-accommodation) may be assumed in the short and medium run (due, for example, to overlapping long-term labour contracts, rational expectations notwithstanding, cf. Fischer, 1977). Finally, if domestic factor prices are adjusted to the cost of living by the formula $\hat{W} = \gamma[(1 - \lambda)\hat{P} + \lambda\hat{E}]$, where $0 < \gamma \leq 1$ so that $0 < \hat{W}/\hat{E} \leq 1$, then equation (8) becomes

$$\hat{y}/\hat{E} = \{[\lambda(1 - \theta) + \theta]\Omega - \theta\Gamma\}/\Delta + \{[\theta(1 - \sigma) - (1 - \theta)\Gamma]/\Delta\}(\hat{W}/\hat{E}) \quad (11)$$

for given M . It may be shown that the second expression in braces in equation (11) is negative and bigger in absolute value than the preceding expression which is identical to the right-hand side of equation (8). Therefore, if W adjusts fully to E so that $\hat{W} = \hat{E}$ but M is held fixed, then $\hat{y}/\hat{E} < 0$.

The effect of devaluation on the balance of trade is closely related to the real effects discussed above. Defining the trade balance in real terms as $b = y - e$ and using equation (4) for \hat{e} , a change in b may be written as $db = (1 - \alpha)y(\hat{y} + \hat{P})$, assuming M is fixed. As $\hat{P}/\hat{E} = \theta$ for given W , the effect of devaluation on the trade balance may then be expressed as⁷

$$db/\hat{E} = (1 - \alpha)y(\hat{y}/\hat{E} + \theta). \quad (12)$$

7 A corresponding expression for the effect of devaluation on the balance of trade in foreign currency is obtained simply by dividing both sides of equation (12) by E .

Thus, a positive effect of devaluation on real income ensures that the trade balance improves. For the trade balance to deteriorate as a result of devaluation, its effect on real income must not only be negative but also sufficiently strong to outweigh the unambiguously positive effect through θ (which reflects the expenditure-reducing effect of devaluation through real balances). Equation (12) also shows that in the special case where $\theta = 0$ (i.e., all imports are final goods) the direction of the effect of devaluation on the trade balance and on real income is always the same (provided $\alpha < 1$); as was shown before, this effect is positive as long as the traditional Marshall-Lerner condition $\eta + \delta > 1$ is satisfied.

EMPIRICAL EVIDENCE

In view of the a priori indeterminacy of the direction of the real effects of devaluation, it is necessary to appeal to empirical evidence in order to be able to make a quantitative assessment of the likelihood of contractionary effects. To this end, statistical estimates of the structural parameters of the model presented above were collected from various sources for five industrial and five developing countries and then substituted into the reduced-form expressions for \hat{y}/\hat{E} and \hat{q}/\hat{E} developed in the preceding section.

It needs to be emphasized from the outset that the response of quantities and prices to devaluation – stagflation or not – is essentially a dynamic phenomenon because the substitution between domestic and foreign goods and factors following a change in relative prices, and frequently the relative price change itself, takes time. Ideally, empirical analysis of the adjustment process following devaluation should therefore be based on complete econometric models with fully specified dynamics. Unfortunately, however, such models are not available for a majority of the ten countries in the present sample, including all the LCDs. Our empirical strategy is accordingly indirect. We substitute estimates of σ , η , δ , etc., most of which are based on dynamic single-equation econometric models and reflect adjustment periods of up to about two to three years, into equations (9) and (10) to obtain estimates of \hat{y}/\hat{E} and \hat{q}/\hat{E} . Given this time perspective, the generally positive real effects of devaluation that we report below do not preclude the possibility that stagflationary tendencies can arise immediately following devaluation and are subsequently reversed.

Estimates of parameters

Before presenting the results of the computations, a few comments on the parameter estimates presented in table 1 are in order. As proxies for the elasticity of substitution σ between domestic and imported factors in the United States, the United Kingdom, Germany, and Japan we use Bruno's (1981, table 3) estimates of the elasticity of substitution between labour and raw materials, which he obtained by estimating the approximate equivalent, in his three-factor model, of equation (1) above. Based on annual time series for the United States (1959–72), United Kingdom (1957–78), Germany (1961–77), and Japan (1961–77), Bruno's estimates of σ range from 0.35 for the United Kingdom to 0.93 for Japan. Since his estimating equations are static, they do not permit a distinction to be made between the degree of substitutability

TABLE 1
Parameter estimates

	σ	η	δ	α	θ	λ	β
United States	0.57	1.41	1.92	0.70	0.05	0.05	0.49
United Kingdom	0.35	0.48	0.43	0.7	0.13	0.15	0.49
Canada	0.96	0.79	0.85	0.7	0.14	0.09	0.65
Germany	0.81	1.11	0.90	0.7	0.11	0.13	0.48
Japan	0.93	1.25	1.45	0.7	0.05	0.06	0.49
Brazil	0.3	0.1	1.7*	0.7	0.06	0.03	0.69
India	0.3	0.5	2.2*	0.7	0.03	0.03	0.53
Pakistan	0.3	1.8*	0.8*	0.7	0.09	0.06	0.63
Philippines	0.3	0.9	2.7*	0.7	0.13	0.09	0.62
Turkey	0.3	1.4*	2.7	0.7	0.10	0.03	0.79

NOTES

σ = elasticity of substitution between domestic and imported inputs. Source: Bruno (1981) for United States, United Kingdom, Germany, and Japan, Pindyck (1979) for Canada, and authors' guesstimates for LCDS

η = price elasticity of exports (absolute value). Source: Stern, Francis, and Schumacher (1976) for industrial countries and Khan (1974) for LCDS

δ = price elasticity of final goods (i.e., manufacturing) imports (absolute value). Source: Deppler and Ripley (1978) for industrial countries and Khan (1974) for LCDS

α = income elasticity of consumption (= one less real balance elasticity). Source: Gylfason for the United States and authors' guesstimates for the rest

θ = share of imported inputs in domestic output. Source: authors' calculations based on import statistics for 1977 (1976 for India and the Philippines) as reported by UNCTAD, *Handbook of International Trade and Development Statistics*, 1979, and on national accounts for the same year as reported by IMF, *International Financial Statistics*, 1981 *Yearbook*

λ = share of final goods imports in national income. Source: same as for θ above

β = share of inputs in total imports. Source: same as for θ above

between factors in the short and long run. We take Bruno's estimates of σ to be commensurate with the other elasticity coefficients, η , δ , and α , which refer to adjustment processes that are completed within one to three years (see below). If, in the light of this, Bruno's estimates may seem rather low, it may be mentioned that Pindyck's (1979, table 5.8) estimates of σ between labour and energy are somewhat higher: 0.93 for the United States, 0.97 for the United Kingdom, 0.96 for Canada (cf. table 1), 1.94 for Germany, and 0.96 for Japan, based on a factor-share model of ten industrial countries applied to pooled time-series cross-section data on an annual basis for 1959–74. Pindyck interprets these as 'long-run' estimates. As no estimates of σ are available for the five developing countries listed in table 1, it is conservatively assumed that σ equals 0.3 in these countries. While this is admittedly an arbitrary choice, we show in the next subsection that our conclusions are not very sensitive to variations in the values chosen for σ .

The estimates of the export price elasticity η in the five industrial countries in the sample are taken from the list of 'best' elasticity estimates compiled by Stern, Francis, and Schumacher (1976, table 2.2); they are based on the approximate median when several estimates are available. As proxies for the price elasticity of final goods imports δ in the five industrial countries we use Deppler and Ripley's

(1978, table 13) estimates of the price elasticities of manufacturing imports, based on a world trade model for fourteen industrial countries applied to semi-annual data for 1965–76. These estimates of η and δ are generally quite high, except for the United Kingdom, where $\eta = 0.48$ and $\delta = 0.43$, and reflect adjustment periods of up to about three years. The corresponding estimates of η and δ for the five developing countries in the table are obtained from Khan's (1974) study of aggregate export and import demand in fifteen developing countries, based on annual data for 1951–69. Khan found that no significant distinction could be made between short-run and long-run effects (except in the case of Pakistani exports for which the short-run (i.e., first-year) price elasticity is 0.5 compared with 1.5 to 1.8 in the long run). Those of his estimates marked by asterisks are statistically significant at the 0.05 level, while the others are not significantly different from zero.

The estimate of the income elasticity of consumption α and hence of the real balance (or wealth) elasticity $1 - \alpha$ for the United States is taken from Gylfason (1981). It is based on a life-cycle model of consumption applied to quarterly data for 1952–78, and refers to a period of about two years. For want of comparable estimates of α for the other nine countries in the sample, the same value of α , 0.7, is used for these countries as well. Again, our results are not very sensitive to variations in this parameter.

The shares of imported inputs in domestic output, θ , and of final goods imports in national income, λ , were computed from national accounts data and import statistics as reported by the IMF and UNCTAD.⁸ The latter share was calculated from the formula $\lambda = (\text{total imports}/\text{GNP})(1 - \beta)$, where β is as before the share of inputs in total imports (measured here as the ratio of imported agricultural raw materials; fuels (for industrial use), ores, and metals; chemicals; and machinery and equipment to total imports in 1977).⁹ The former share was computed from the formula $\theta = \beta\lambda/[1 - \beta(1 - \lambda)]$, which follows from the definition of β (see above p. 511).

Results

We are now in a position to evaluate the effects of devaluation on real income, output, and the trade balance in the ten countries under study by substituting the parameter estimates presented in table 1 into the expressions for \hat{y}/\hat{E} , \hat{q}/\hat{E} , and db/\hat{E} developed in the preceding section. The results, presented in table 2, show that devaluation has positive real effects in all these countries except two, the United Kingdom and Brazil. Neither exception is surprising; the extended Marshall-Lerner condition is not satisfied for either country.¹⁰ Even so, the resulting deterioration in the trade balance

8 See IMF, *International Financial Statistics, 1981 Yearbook* (relevant country pages), and UNCTAD, *Handbook of International Trade and Development Statistics, 1979* (table 4.2).

9 In calculating β , we assumed on the basis of available evidence for the mid-1970s that 30 per cent of total oil imports is used for production in the United States and Canada, 40 per cent in the European countries and Japan, and 50 per cent in the LCDs.

10 It is noteworthy, however, that devaluation *increases* both real income and output in the United Kingdom by 0.2 per cent if Pindyck's (1979) estimate of σ ($= 0.97$) is used instead of Bruno's (1981) estimate ($= 0.35$), notwithstanding the low values of η and δ . Concerning Brazil, it may be noted that if Khan's (1974) low and insignificant estimate of η ($= 0.10$) is replaced by Houthakker and Magee's (1969) significant estimate ($= 0.39$), the effects of 10 per cent devaluation on Brazil's real income and output become quite small, or -0.2 and 0.2 per cent, respectively.

TABLE 2

Effects of 10 per cent devaluation on real income, output, and the balance of trade

	Effect on real income	Effect on real output	Effect on trade balance
	(Changes in per cent)		(In per cent of GNP)
United States	3.7	3.9	1.2
United Kingdom	-1.4	-0.6	-0.0
Canada	2.2	2.3	1.1
Germany	3.6	3.8	1.4
Japan	3.6	3.7	1.3
Brazil	-0.9	-0.5	-0.1
India	0.9	1.1	0.4
Pakistan	3.5	4.2	1.3
Philippines	3.6	4.5	1.5
Turkey	2.7	3.4	1.1

SOURCE: Equations (9), (10), and (12) and table 1

of the United Kingdom and Brazil is negligible, thanks to the expenditure-reducing effect operating via real balances (cf. equation (12)). A further reason for the sluggish real effects of exchange rate changes in Brazil (and also in India) is that λ , the share of final goods imports in GNP, is unusually low, thus reducing the expenditure-switching effect that devaluation would otherwise have through the high price elasticity of imports, δ .

In the other eight countries devaluation has positive real effects. Increases in real income and output in response to 10 per cent devaluation range from 0.9–1.1 per cent in India to 3.6–4.5 per cent in the Philippines, and the improvement in the trade balance ranges from the equivalent of 0.4 per cent of GNP in India to 1.5 per cent of GNP in the Philippines. The income effects are smaller than the output effects because Bruno's (1981) estimates of σ as well as those assumed for the LCDs are all less than 1. If Pindyck's (1979) estimates of σ , which are close to 1 in most cases, were used instead, the income and output effects would be identical for each country, and larger than shown in table 2, ranging from 0.3 per cent for the United Kingdom and Brazil to 5.6 per cent for the Philippines.¹¹ On the other hand, of course, lower estimates of the price elasticities of exports and final imports, η and δ , than those we have obtained from the above-mentioned sources would reduce the positive real effects of devaluation.

As was stressed in the preceding section, the benefits of devaluation are also exaggerated insofar as the assumption that domestic factor prices and money supplies do not adjust is unwarranted. In particular, if domestic factor prices are adjusted to the cost of living by the formula $\hat{W} = \gamma[(1 - \lambda)\hat{P} + \lambda\hat{E}]$ where $0 < \gamma \leq 1$, the critical value of the adjustment coefficient γ that nullifies the positive effect of devaluation on

11 Even if σ were assumed to be zero throughout, the United Kingdom and Brazil would remain the only countries in the sample where the real effects of devaluation are negative.

real GNP for given M is about 0.7 for Canada and India and about 0.8 elsewhere; with full indexation (i.e., $\gamma = 1$ so that $\hat{W} = \hat{E} = \hat{P}$) and no accommodation in monetary policy, the real effects of devaluation become negative throughout.

Two further qualifications are in order. First, it should be noted that our estimates of the real effects of devaluation may be biased, because we have excluded interest rates from the analysis. The direction of this potential bias cannot be determined a priori, however. On the demand side, the link between devaluation and *nominal* interest rates through prices and real money balances may tend to reduce the positive real effects of devaluation for a given state of inflation expectations, while the link between devaluation and *real* interest rates via inflation expectations is likely to amplify such effects. On the supply side, interest rates may feed back on prices by raising the cost of production, and this may act to increase the likelihood of stagflationary effects of devaluation. Second, we have used price elasticity estimates for merchandise trade as though they were estimates for the current account. While this distinction is relatively unimportant as far as the United States, the United Kingdom, Germany, and Japan are concerned, it is potentially very important for Canada and the LDCs in the sample that have substantial overseas debts denominated in foreign currency, because amortization and interest payments on the outstanding stock of such debts increase proportionately with the price of foreign exchange, thus reducing the favourable effect of devaluation on the current account and real income.

Before concluding this discussion, we return to the three types of circumstances on which Krugman and Taylor (1978) based their argument for contractionary effects of devaluation in LCDs. First, if, following Hirschman (1949), the trade balance is initially assumed to be in deficit equivalent to a multiple μ of exports (i.e., $x - z - (E/P)n = -\mu x$), very high values of μ are required for the positive effect of devaluation on real income to disappear. Other things being equal, the critical value of μ for which a positive real effect of devaluation is reduced to zero is lowest in the case of Pakistan, or 1.4, rises to 1.8 for Canada and Turkey, and so on. Trade deficits of this magnitude are far beyond the range of experience of all these countries (except possibly Pakistan where the value of imports has consistently been almost twice as high as the value of exports since 1975). Second, if redistribution of income from workers to capitalists is represented in the present model by a reduction in the spending propensity α , assuming as Diaz-Alejandro (1963) did that capitalists have a higher propensity to save than workers, it turns out that the critical value of α for which a positive \hat{y}/\hat{E} is reduced to zero is negative in all cases. According to our model, no redistribution of income would thus be large enough to nullify the expansionary effects of devaluation in these countries. We conclude from these results that neither the first nor the second type of circumstance emphasized by Krugman and Taylor (1978) can be considered likely to lead to contractionary effects of devaluation in the LCDs included in the present sample, nor in other countries where exports and final goods imports are as responsive to price changes as in the present group (cf. table 1). Concerning the effect of devaluation on government revenue, the third possibility that Krugman and Taylor discuss, this potentially contractionary channel of influence can, of course, be partly or wholly offset by discretionary

changes in government spending on domestic goods. Since our model does not include a government sector, we do not attempt to assess the quantitative importance of this effect.

In sum, under the conditions that we have analysed and subject to the qualifications that we have noted, the new view that devaluations cause stagflation is not supported by the empirical evidence presented above, at least not for the present group of countries. On the contrary, the estimates we have collected from various sources indicate a sufficiently large degree of flexibility in factor and commodity substitution over a period of, say, one to three years for devaluation to have, subject to these conditions and qualifications, the intended expansionary effect on real GNP in all these countries except possibly the United Kingdom and Brazil.¹²

CONCLUSION

Although the evidence presented here indicates that devaluations have the intended effects on trade and growth performance in most of the ten countries in the sample, notwithstanding the low values deliberately assumed for the elasticity of factor substitution in production in the LCDs, it remains true that no conclusive evidence of the effects of exchange rate changes on trade flows exists for a number of developing countries. It must also be acknowledged that the extent to which failure to produce such evidence in the past can be blamed on inadequate data is open to question. Nevertheless, the examples given here should suffice to demonstrate that there does exist a number of countries, less developed as well as industrialized, in which the available empirical evidence seems to support the traditional view that devaluations tend to improve the trade balance and stimulate growth as intended, at least in the short to medium term. Criticism of national governments that devalue their currency for balance-of-payments reasons or of international agencies such as the IMF for recommending such action on the basis that 'By leaving the possibility of an output reduction out of their models, financial programmers cannot deal with this natural consequence of the policies they commend' (Taylor, 1981, 501), therefore seems misguided, at least as far as the countries included in the present paper are concerned.

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12 The case of the United Kingdom merits special mention because of the devaluation of the pound sterling by 14 per cent in November 1967. As Artus (1975) has argued, the trade balance of the United Kingdom deteriorated initially, owing to the adverse terms-of-trade effects of the devaluation, and did not begin to improve until 1969; the improvement was sustained until 1972 when the U.K. trade balance again swung into deficit. It seems likely that this prominently J-shaped pattern is responsible for the preponderance of low or sometimes even perverse estimates of export and import price elasticities for the United Kingdom in the literature, including those used in this paper. For further discussion of the 1967 devaluation of the pound as well as of the devaluation of the Phillipine peso in 1970 and the Pakistani rupee in 1972, see Gylfason and Schmid (1982, 19-21). More detailed discussion of the effects of devaluations in developing countries is provided by Bhagwat and Onitsuka (1974) and Donovan (1981).

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