DEVALUATION AND THE REAL EXCHANGE RATE

by

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IMF and the World Bank

J. Saul Lizondo
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April 1986

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Abstract

This paper examines the short-term and long-term effects of a nominal devaluation on the real exchange rate. It is shown that in the absence of supporting policies that limit increases in prices and factor costs, devaluation will exert only a transitory influence on the real exchange rate. The effects can only be sustained if measures to reduce the fiscal deficit are adopted. Furthermore, the magnitude of the change in the real exchange rate depends not only on the size of the devaluation and the degree of fiscal adjustment, but also on the means by which the fiscal deficit is reduced. In other words, the change in the nominal exchange rate necessary to hit the real exchange rate target will depend on whether the fiscal deficit is eliminated by increasing taxes, or by reducing government expenditures on traded and nontraded goods. Broadly speaking, the required depreciation of the domestic currency will be larger for the same target real exchange rate if the fiscal deficit is reduced by increasing taxes than by lowering government expenditures, and it would be smaller if the cuts in expenditure fell on traded goods rather than nontraded goods. This result implies that the authorities have to ensure consistency between exchange rate action and policies to reduce fiscal imbalances in order to achieve a unique value of the real exchange rate.
Devaluation and the Real Exchange Rate *

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1. Introduction

It is a well-accepted proposition that in the absence of supporting policies that limit the increase in domestic prices, a nominal devaluation will only have a transitory effect on the real exchange rate. In the long run domestic prices will rise by the full amount of the devaluation and the real exchange rate will return to its original level. As a change in the real exchange rate is often the centerpiece of stabilization programs designed to improve international competitiveness and shift resources towards the production of traded goods, it is obviously critical for policymakers to have some idea of the magnitude and time path of the likely responses of domestic prices to exchange rate action. Only then would they be in a position to implement policies that would assist a nominal devaluation in altering the real exchange rate on a permanent or sustained basis.

Generally speaking, the effects of a devaluation on the real exchange rate can be decomposed into two separate effects. First, there is the short-

* The authors are grateful to Mario Blejer, Nadeem U. Haque, Ricardo Martin, and Peter Montiel, for helpful comments on an earlier version of this paper. The views expressed here are the sole responsibility of the authors.
run response that reflects the initial increase in the domestic price level. This "first-order" effect has been shown to depend on the share of traded goods in total expenditure, and the relative price elasticities of the demand and supply of nontraded goods. As a first approximation, assuming that the price of nontraded goods is constant in the short run, the impact of a devaluation on domestic prices can be estimated as simply the product of the exchange rate change and the share of traded goods in total expenditure. The depreciation in the real exchange rate would, therefore, be equal to the nominal devaluation adjusted for the increase in domestic prices. Second, there is the longer-run response of the real exchange rate which would depend on how prices of nontraded goods respond to shifts in resources away from the nontraded sector towards the traded goods sector. The more rapid is the increase in nontraded goods prices, other things equal, the more quickly would the effects of a devaluation on the real exchange rate be dissipated.

This two-stage response of the real exchange rate to devaluation has been discussed in a number of theoretical studies.\footnote{See, for example, Dornbusch (1974), Krueger (1974), Connolly and Taylor (1976), Rodriguez (1978), and Blejer (1979).} At the empirical level, however, there is still some dispute. There are as yet few studies that provide strong empirical support for the theoretical result that devaluation has no longer-run effects on the real exchange rate. In a recent survey, Goldstein and Khan (1985) argue that while an exchange rate change has a sizable effect on the domestic price level in industrial countries -- a 10 percent devaluation leads eventually to a change in domestic prices of anywhere from 1.5 to 4 percent for a "representative" industrial country -- it is far from the one-for-one effect predicted by the theory. The study by
Bruno (1978) for a pooled cross-section time-series sample of 16 OECD countries over the period 1972-1976, also yielded the result that each 10 percent change in the exchange rate was associated with about a 2 percent change in consumer prices.\(^1\) This would in turn translate into a change in the real exchange rate of around 8 percent. Consequently, it would appear from these studies that the real exchange rate could be changed permanently by devaluation. For developing countries the picture is equally unclear. Diaz-Alejandro (1984) found that nominal devaluations affected the real exchange rates in a number of high-debt Latin American countries. Ghanem and Kharas (1985) in a study of 30 developing countries over the period 1972-1980 come closest to supporting the theoretical hypothesis. These authors conclude on the basis of their tests that a nominal devaluation of 10 percent leads to a real depreciation of between 1-2 percent in the first year.\(^2\)

This apparent inconsistency between the theory and empirical estimates reflects two possible factors. First, that the empirical studies do not properly measure the long-term effects, and thus the estimates available tend to correspond only to the so-called first-order effects. Second, and more importantly, the estimates do not take into account the policies typically enacted to support devaluation. Any sustainable real exchange rate change requires policies to restrain aggregate demand and factor costs, and the extent to which a devaluation will affect the real exchange rate, as well as the length of time over which the effects persist, are a direct function of the supporting policies that are put in place. It can thus be argued that

\(^1\) Similar estimates for industrial countries are obtained by Dornbusch and Krugman (1976) and Artus and McGuirk (1981).

\(^2\) See also Edwards (1985).
existing empirical studies tend to capture the combined effects of devaluation and supporting policies rather than just devaluation.

The purpose of this paper is twofold: first, we attempt to reconcile the theory underlying the relationship between nominal and real exchange rates with the empirical results that have been obtained in the literature. This is done by formulating a relatively simple model that takes into explicit account the role of demand-management policies. With this theoretical model it is possible to demonstrate that the real exchange rate response to a devaluation depends not only on the substitutability between traded and nontraded goods in consumption and production, and the share of traded goods in final expenditure, but also on the types of policies that accompany devaluation. In general, the real exchange rate outcome following a devaluation will vary according to the stance of demand-oriented policies, and in particular, policies implemented to reduce the fiscal deficit. Second, we use this model to show that an overall reduction in the fiscal deficit is in itself not sufficient to obtain a particular real exchange rate objective or target. The effects of a nominal devaluation on the real exchange rate will depend on how the fiscal deficit is reduced, namely whether through increases in taxes or reductions in expenditures. This result, which has a certain intuitive appeal, is very important from a policy perspective, since it demonstrates clearly the need for close coordination between exchange rate and fiscal policies in an attempt to alter the real exchange rate in a predictable fashion.

In the following section we describe the model and use it to determine the effects of devaluation on the real exchange rate with and without supporting policies. The concluding section discusses some of the policy implications of the exercise.
2. Framework of Analysis

In this section we start by formulating a simple theoretical model that has come to be used extensively in the study of open-economy macroeconomic issues.\textsuperscript{1} This model, which belongs to the class of dependent economy models, is a very useful device for the purpose at hand. The second part of this section traces out the effects of a devaluation in isolation on the real exchange rate and the domestic price level. Here we are essentially interested in reproducing the main theoretical results obtained in previous work on the subject. The final part extends the analysis to incorporate the role of other policies that are considered necessary supplements to exchange rate policy.

a. Theoretical model

Consider a small economy that produces and consumes traded and nontraded goods. The domestic currency price of traded goods, $P_T$, is equal to the foreign currency price of these goods in the world market, $P_W^T$, times the nominal exchange rate, $E$, defined as the domestic currency price of foreign currency. Since the economy is assumed to be small, it does not affect world market prices. Assuming that world prices are constant, units can be chosen so that $P_W^T = 1$. Thus, the domestic currency price of traded goods is equal to the nominal exchange rate $E$. The domestic currency price of nontraded goods, $P_N$, on the other hand, is endogenously determined by the condition of equilibrium in the nontraded goods market. The relative price between traded and nontraded goods, $E/P_N$, will be referred to as the "real exchange rate" and denoted by $e$. An increase in $e$ represents a real depreciation, and vice versa.

\textsuperscript{1} See, for example, Dornbusch (1974), Rodriguez (1978) and Liviatan (1979).
It is assumed that the stock of factors of production is constant, and that factor prices are flexible, so that production of traded and nontraded goods, $Y_T$ and $Y_N$ respectively, depends only on the real exchange rate $e$.

(1) $Y_T = Y_T(e)$ \quad $Y_N = Y_N(e)$ \quad $\frac{dY_T}{de} > 0$ ; $\frac{dY_N}{de} < 0$

Private sector consumption of traded and nontraded goods, $C_T$ and $C_N$ respectively, depends on the real exchange rate and on the real stock of wealth, $a$, which is measured in terms of traded goods.

(2) $C_T = C_T(e, a)$ \quad $C_N = C_N(e, a)$

with $\frac{3C_T}{3e} < 0$ ; $\frac{3C_T}{3a} > 0$ ; $\frac{3C_N}{3e} > 0$ ; $\frac{3C_N}{3a} > 0$.

Public sector total expenditure, $g$, and taxes, $t$, are also defined in terms of traded goods. Total government expenditure is allocated to traded goods, $g_T$, and to nontraded goods, $g_N$, where

(3) $g_T + g_N = g$

There are two assets in the economy, namely domestic money, $M$, and foreign money, $f$. The real stock of domestic money in terms of traded goods, $M/E$, will be denoted by $m$. Therefore, total real wealth is given by:
(4) \( a = m + f \)

The private sector allocates its portfolio between the two assets depending on the expected rate of depreciation of the nominal exchange rate, which is assumed to be exogenous and denoted by \( \hat{E}^* \). The symbol "\( \hat{\cdot} \)" over a variable signifies a percentage change, \( \hat{x} \equiv \Delta x / x \).

(5) \( m = \lambda (\hat{E}^*) a \)

with \( 0 < \lambda (\hat{E}^*) < 1 \), and \( \frac{d\lambda}{d\hat{E}^*} < 0 \).

The sign restrictions imply that the higher the expected rate of depreciation of the domestic currency, the smaller will be the fraction of wealth that is held in the form of domestic money. Since it is assumed that the nominal exchange rate is fixed by the central bank, changes in the expected rate of depreciation of the domestic currency cause the private sector to exchange foreign money for domestic money, and vice versa. The transactions takes place with the central bank at the fixed exchange rate, thereby affecting the composition but not the level of private sector real wealth (a).

The short-run position of the economy is determined by the condition of equilibrium in the nontraded goods market.

(6) \( Y_N (e) = C_N (e, a) + e g_N \)

---

1/ Models with endogenous expected rates of depreciation are examined in the literature on balance of payments crises. See, for example, Flood and Garber (1984), and Blanco and Garber (1986).
Equation (6) is represented by curve NN in Figure 1. The higher the level of real wealth, the greater is the private sector demand for nontraded goods, and thus the lower must be the real exchange rate in order to reduce demand and increase supply of nontraded goods so as to maintain equilibrium.

The economy is always on curve NN. In the short run, the level of real wealth is predetermined and curve NN indicates the resulting real exchange rate. In the long run, however, the level of real wealth is endogenous. Hence, it is necessary to examine the evolution of real wealth in order to determine the long-run equilibrium. From equation (4),

\[
\dot{a} = \dot{m} + \dot{f}
\]

where a dot over a variable indicates its derivative with respect to time. As long as there is no change in the nominal exchange rate, we have

\[
\dot{m} = \frac{M}{E}
\]

From the balance sheet of the banking system the change in the nominal stock of domestic money will be

\[
\dot{M} = \dot{R} + \dot{D}
\]

where \(\dot{R}\) is the change in the stock of international reserves, measured in terms of domestic currency, and \(\dot{D}\) is domestic credit creation. The change in the stock of international reserves is thus described by

\[
\dot{R} = E [Y_T(e) - C_T(e, a) - g_T] - E \dot{f}
\]
Figure 1.
where the first term on the right hand side is the current account of the
balance of payments, and the second term is the capital account. If we assume
that domestic credit creation is used to exclusively finance the public sector
budget deficit, then

\[ (11) \quad \dot{D} = E (g_N + g_T - t) \]

Using equations (10) and (11) to replace \( \dot{R} \) and \( \dot{D} \) in equation (9), and then
using the resulting expression and equation (8) to substitute for \( \dot{m} \) in
equation (7), we obtain

\[ (12) \quad \dot{a} = Y_T (e) - C_T (e, a) + g_N - t \]

Equation (12) describes the evolution of real wealth. For the economy to be
in equilibrium, the level of wealth must be constant, which requires that

\[ (13) \quad Y_T (e) - C_T (e, a) = t - g_N \]

Equation (13) is represented by \( \dot{a} = 0 \) in Figure 1. To the left of this
curve \( \dot{a} > 0 \), and thus real wealth increases, and to the right of this
curve \( \dot{a} < 0 \), so real wealth declines. Therefore, for any given initial level
of real wealth, the economy moves along curve NN as indicated by the arrows
until it reaches the intersection with \( \dot{a} = 0 \) curve at point A, where
equilibrium would be achieved.

The point A in Figure 1 represents a short-run (quasi) equilibrium of
the economy. Whether this position is sustainable or not depends on the size

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1/ This amounts to assuming that the government cannot finance its deficit
through any other means, such as borrowing from the nonbank public or from
abroad, and further that there is no demand for credit by the private
sector.
of the country's reserve holdings, as it is losing reserves at this point, and obviously there is a limit to the amount of reserves a country can in fact lose. In equilibrium, the capital account of the balance of payments is in balance since a constant level of real wealth implies a constant desired stock of foreign money, unless there is a change in the expected rate of depreciation. In other words, once the level of real wealth is constant, persistent capital outflows require an ever increasing expected rate of depreciation, while persistent capital inflows require an ever increasing expected rate of appreciation. This would induce the private sector to continuously shift its portfolio composition in one direction or the other. Since we are interested in identifying sustainable long-run equilibrium positions, we assume that in those positions the expected rate of depreciation is equal to zero. Therefore, we need to focus only in the current account of the balance of payments, denoted by CA:

(14) \[ CA = Y_T(e) - C_T(e, a) - g_T \]

Equilibrium in the current account requires

(15) \[ Y_T(e) - C_T(e, a) = g_T \]

Equation (15) is represented by curve \( CA = 0 \) in Figure 1. To the left of this curve there is a current account surplus, and to the right of this curve there is a current account deficit. Comparing equations (13) and (15), it is clear that the position of the curve \( CA = 0 \) with respect to the curve \( \delta = 0 \) depends on whether \( g_T \) is higher or lower than \( (t-g_N) \), that is, on
whether there is a government budget deficit or surplus. In Figure 1 it is assumed that the budget is in deficit to start with, and therefore the curve CA = 0 is to the left of curve á = 0. Hence, at point A the current account, and therefore the overall balance of payments, is in deficit. Using equation (13), which holds at point A, to replace \((Y_T - C_T)\) in (14), it follows that

\[(16) \quad CA = t - g_N - g_T\]

Therefore, at point A, the current account deficit, and thus the overall balance of payments deficit, is equal to the deficit in the government budget.\(^1\) The long-run stationary equilibrium of the economy would be reached when the two curves á = 0 and CA = 0 collapse into one curve, which implies complete balance of payments equilibrium.

b. Effects of a devaluation

The effects of a devaluation can be examined with the aid of Figure 1. A nominal devaluation reduces the real stock of domestic money, and thus the level of real wealth. This causes a decline in the demand for nontraded goods, which in turn requires a depreciation of the real exchange rate to increase the demand and reduce the supply of nontraded goods so as to maintain equilibrium. For example, starting from point A, a devaluation would reduce the level of real wealth from \(a_0\) to \(a_1\), causing a depreciation of the real exchange rate from \(e_0\) to \(e_1\). After this impact effect, however, real wealth

\(^1\) If the exchange rate were crawling, instead of being fixed, the long run rate of inflation would be positive and equal to the rate of crawl. As a result, the current account (and thus the overall balance of payments) deficit at the stationary equilibrium would be equal to the public sector budget deficit minus the inflation tax. This also implies that changes in the expected rate of devaluation would affect the balance of payment not only in the short run due to the immediate change in portfolio composition, but also in the long run due to the change in the inflation tax.
increases until it returns to $a_0$, while the real exchange rate appreciates steadily until it comes back to $e_0$.

The impact effect of a devaluation on the real exchange rate can be obtained from equations (5) and (6). Since the nominal stock of domestic money is predetermined at the time of the devaluation, the real stock of domestic money declines by the amount of the devaluation. Therefore, as a fraction $\lambda(E^*)$ of wealth is held in the form of domestic money, the change in real wealth is given by:

\begin{equation}
(17) \quad \hat{a} = -\lambda(E^*) \hat{e}
\end{equation}

where $\hat{e}$ is the actual rate of devaluation. In terms of Figure 1, equation (17) indicates the decline in real wealth from $a_0$ to $a_1$. In order to determine the magnitude of the depreciation of the real exchange rate, in other words from $e_0$ to $e_1$, we have to use equation (6), which defines the curve NN. Differentiating equation (6) and using equation (17) to substitute for $\hat{a}$, we obtain

\begin{equation}
(18) \quad \hat{e} = \lambda(E^*) \frac{\beta \eta^a_N}{\varepsilon_N + \beta \varepsilon^e_N + (1 - \beta)} \hat{e}
\end{equation}

where $\eta^a_N = \text{nontraded goods demand elasticity with respect to real wealth (positive)}$;

$\varepsilon^e_N = \text{nontraded goods demand elasticity with respect to the real exchange rate (positive)}$;

$\varepsilon^e_N = \text{nontraded goods supply elasticity with respect to the real exchange rate, defined to be positive; and}$

$\beta = \text{share of the private sector in total consumption of non-traded goods, } (C_N/Y_N)$. 
Therefore, there are several factors that affect the initial depreciation of the real exchange rate. Other things being equal, the higher the share of domestic money in real wealth, the larger is the decline in real wealth, and therefore the larger must be the real depreciation that is necessary in order to maintain equilibrium in the nontraded goods market. Similarly, the larger the demand elasticity of nontraded goods with respect to wealth, the larger is the decline in the demand for nontraded goods brought about by the decline in real wealth, and thus the greater is the real depreciation that is required to maintain equilibrium. On the other hand, the higher the supply elasticity and the relative price demand elasticity of nontraded goods, the smaller is the real depreciation that is needed to maintain equilibrium.

As mentioned above, after the initial effect the real exchange rate appreciates steadily until it returns to its original level. The long-run neutrality of the real exchange rate with respect to a nominal devaluation follows from equations (6) and (13), which determine the long-run stationary equilibrium. Since both equations are independent of the level of the nominal exchange rate, the long-run real exchange rate does not change as a result of a devaluation. The evolution of the real exchange rate \((e)\) through time after a devaluation is described in Figure 2, and most of the models in the literature imply a path for the real exchange similar to one described here.\(^{1/}\)

There are some studies, however, that yield different results regarding the impact effect of devaluation described by equation (18). For example, Jones and Corden (1976) show that in a Heckscher-Ohlin model with

---

\(^{1/}\) See, for example, Dornbusch (1974), Krueger (1974), Boyer (1977), Rodriguez (1978), Blejer (1979), Liviatan (1979), and Montiel (1985).
Figure 2.

Domestic Price Level and Real Exchange Rate

P₀, P₁, P₂, e₀, e₁, p, e

time
wages kept constant, a devaluation may produce a real appreciation if traded goods are labor intensive. They also show that this result cannot arise in a capital-specific model, and then argue that a capital-specific model is better suited for the analysis of a devaluation. Lapan and Enders (1978), using a two-country model, show that a devaluation in the home country may appreciate its real exchange rate if the share of home country wealth held in home currency is lower than the share of the foreign country wealth held in the home country currency. Under these conditions, a devaluation of the home currency would redistribute wealth in the "wrong" direction, namely from the foreign country to the home country, leading to an appreciation of the real exchange rate in the home country.¹/ Kyle (1978), using a model with money and bonds in the utility function, shows that it is possible for a nominal devaluation to produce a short-run real appreciation due to substitution effects between bonds, goods and money in the utility function. Finally, Stockman (1983), using an equilibrium two-period model, shows that a devaluation has no effect on the real exchange rate since the reduction in real wealth arising from the "tax" on domestic money is compensated by the increase in the interest-bearing reserves of the government, which are internalized by the private sector. Generally speaking, however, the results obtained here are consistent with those obtained by the majority of papers on the subject.

The effect of the devaluation on the price level can also be easily derived from our previous results. Assume that the price level is defined as:

\[(19) \quad P = E_T P_N^{\alpha_T} P_N^{\alpha_N}\]

¹/ This result is valid only in the case of a large economy.
where $\alpha_T$ and $\alpha_N$ are the respective shares of traded and nontraded goods in total expenditures, $\alpha_T + \alpha_N = 1$. Therefore,

$$\hat{P} = \alpha_T \hat{E} + \alpha_N \hat{P}_N$$

but, we know that

$$\hat{e} = \hat{E} - \hat{P}_N$$

In order to obtain the impact effect of a devaluation on the price level, we use (21) to substitute for $\hat{P}_N$ in (20) and then use (18) to substitute for $\hat{e}$ in the resulting expression and obtain

$$\hat{P} = \left( \alpha_T + \alpha_N \left[ 1 - \lambda(\hat{e}^*) \frac{\beta \eta^a_N}{\varepsilon_N + \beta \eta^e_N + (1-\beta)} \right] \right) \hat{E}$$

If the expression in square brackets is less than one, the price level initially increases proportionally less than the exchange rate. This implies that the nominal price of nontraded goods either increases proportionally less than the rate of devaluation, or declines.  

$^1/$ From equation (22) the impact effect on the price level is larger, the higher are the share of traded goods in the price index, the nontraded goods supply elasticity, and the nontraded goods demand elasticity with respect to the real exchange rate; and the lower

$^1/$ The nominal price of nontraded goods declines if the expression in brackets in equation (22) is negative. Models that allow for this possibility include Krueger (1974), Connolly and Taylor (1976), Boyer (1977) and Blejer (1979). An initial decline in the nominal price of nontraded goods could theoretically result in an initial decline in the price level. However, this case is not plausible since it would require extreme values of the various parameters.
are the nontraded goods demand elasticity with respect to wealth and the share of domestic money in real wealth.

After the impact effect, as real wealth rises, domestic prices increase steadily until they reach a new long-run level which is higher than the initial one by the same proportion as the nominal devaluation. Formally, the long-run effect on the price level can be obtained by using (21) to replace $P_N$ in (20), and then setting $\varepsilon = 0$, a condition that was shown to hold in the long run. As a result, we obtain $\hat{P} = \hat{E}$, and the price level rises in the same proportion as the nominal exchange rate. Figure 2 shows the evolution of the price level following a devaluation.

Clearly the time path of the price level does not accord with the idea that a devaluation produces a once-and-for-all increase in the price level equal to the share of traded goods in the price index times the rate of devaluation. This would be the impact effect only if the price of nontraded goods does not change with a devaluation, which is equivalent to assuming that the expression in brackets in equation (22) is equal to zero. Furthermore, as shown in Figure 2, following the initial jump the price level keeps rising for a period of time before it reaches a new stationary level.

Another implication of this model is that the effectiveness of a devaluation in producing a (transitory) real depreciation, and thus a (transitory) improvement in the current account of the balance of payments, depends on the extent to which the devaluation was anticipated. The higher the expected rate of depreciation, the lower the share of wealth held in domestic money, and thus the smaller the reduction in real wealth brought about by the devaluation. In the limit, if the private sector holds its entire portfolio in foreign currency, a devaluation would be immediately reflected in a proportional increase in all prices without any effect on the
real exchange rate. These results can be obtained formally by setting 
\( \lambda(\hat{E}^*) \) equal to zero in (18) and (22), i.e., 1/

\[
(18a) \quad \hat{e} = 0 \\
(22a) \quad \hat{p} = \{\alpha_T + \alpha_N\} \hat{E} = \hat{E}
\]

c. Devaluation and supporting deficit-reducing policies

Since a devaluation by itself produces only a transitory depreciation
of the real exchange rate and a transitory improvement in the balance of
payments, additional policies are needed in order to make these effects
permanent. As was shown above, under the assumption of this model the long-
run balance of payments deficit is equal to the public sector budget
deficit. Therefore, a permanent improvement in the balance of payments
necessarily requires a reduction in the public sector deficit, and in
particular, long-run balance of payments equilibrium requires government
budget equilibrium.

This result can be illustrated by using Figure 1. Recall that the
stationary equilibrium of the economy is determined by the intersection of
curves NN and \( \hat{a} = 0 \), and that long-run balance of payments equilibrium only
holds for points on the CA = 0 curve. Therefore, unless NN and \( \hat{a} = 0 \)
intersect at some point on the CA = 0 curve, the stationary equilibrium will
be inconsistent with balance of payments equilibrium. Now curve \( \hat{a} = 0 \) is

1/ Since most of the early models included only domestic money, the expected
rate of depreciation played no role. See, for example, Dornbusch (1974)
stress the need to take into account the anticipatory actions of the
private sector and diversification of portfolios. Models that do
incorporate foreign assets include, among others, Boyer (1977), and Lapan
and Enders (1978).
defined by equation (13), while curve CA = 0 is defined by equation (15). If the public sector deficit is eliminated, the right hand side in both equations will be the same, and curves \( \hat{a} = 0 \) and CA = 0 will collapse into one curve. Under this condition, the intersection of curves \( \hat{a} = 0 \) and NN will necessarily be at a point on the curve CA = 0.

Although the objective of long-run balance of payments equilibrium is attained with the elimination of the fiscal deficit, irrespective of the specific fiscal policies used, the mix of fiscal policies is important for the determination of the long-run real exchange rate. In other words, different combinations of increases in taxes and reductions in public sector expenditure on traded and nontraded goods, all of which imply long-run balance payments equilibrium, will imply different values for the long-run real exchange rate. This can be shown in the framework of Figure 3, which reproduces the original curves NN, \( \hat{a} = 0 \), and CA = 0.

Let us assume first that the fiscal deficit is eliminated entirely by increasing taxes. From equations (6) and (15) it is clear that curves NN and CA = 0 do not shift, while equation (13) indicates that curve \( \hat{a} = 0 \) shifts to the left. From our previous results we know that curve \( \hat{a} = 0 \) will collapse into the curve CA = 0. Thus, the new long-run equilibrium will be at a point such as B, where the NN and the new \( \hat{a} = 0 \) curves intersect. Therefore, if the fiscal deficit is eliminated by increasing taxes real wealth will decline from \( a_A \) to \( a_B \), and the real exchange rate will depreciate from \( e_A \) to \( e_B \).

Alternatively, let us assume that the fiscal deficit is eliminated entirely by reducing public sector expenditure on traded goods. From equations (6) and (13), curves NN and \( \hat{a} = 0 \) do not shift, while from equation (15) it follows that curve CA = 0 shifts to the right until it collapses into
Figure 3.
curve $\dot{a} = 0$. Thus, the new long-run equilibrium will be at point $A$, which is the same as the previous equilibrium. Therefore, the elimination of the fiscal deficit by reducing public sector expenditure in traded goods does not require either a reduction of wealth, or a depreciation of the real exchange rate.

Finally, let us assume that the fiscal deficit is eliminated by reducing public sector expenditure on nontraded goods. Equation (15) indicates that curve $CA = 0$ does not shift, while equations (6) and (13) indicate that curve $NN$ shift upwards to $N'N'$ and curve $\dot{a} = 0$ shifts upwards until it collapses into curve $CA = 0$. Since curve $\dot{a} = 0$ shifts more than curve $NN$, the new intersection point $C$ must be to the northwest of point $A$.\(^{1/}\)

Therefore, the elimination of the public sector deficit by reducing public sector expenditure on nontraded goods implies a decline in real wealth from $a_A$ to $a_C$, and a depreciation of the real exchange rate from $e_A$ to $e_C$.

The various ways of eliminating the fiscal deficit have different implications regarding the level of wealth and the real exchange rate for the following simple reason. In each case the current account (and balance of payments) deficit is eliminated, which can be done either directly through a reduction in public sector expenditure on traded goods, or indirectly through

\[\frac{dy_T}{de} \left[ -\frac{de}{dg_N} \right]^{-1} \]

Following the same procedure with equation (6), the upward shift is curve $NN$ is
\[\frac{dy_N}{de} = \left[ -\frac{3C_N}{3e} \frac{1}{e} - \frac{dy_T}{de} \frac{1}{e} + \frac{dN}{de} \right]^{-1} \]

producers profit maximization implies $\frac{dy_N}{de} = -e \frac{dy_T}{de}$, and consumers utility maximization implies $\frac{dC_N}{de} = -e (\frac{dC_T}{de})$, it follows that curve $\dot{a} = 0$ shifts up by more than curve $NN$.\(^{1/}\)

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\(^{1/}\) The upward shift in curve $\dot{a} = 0$ is obtained by differentiating equation (13) with respect to $g_N$, while keeping a constant. The result is

\[\frac{dy_T}{de} \left[ -\frac{de}{dg_N} \right]^{-1} \]

Following the same procedure with equation (6), the upward shift is curve $NN$ is

\[\frac{dy_N}{de} = \left[ -\frac{3C_N}{3e} \frac{1}{e} - \frac{dy_T}{de} \frac{1}{e} + \frac{dN}{de} \right]^{-1} \]

producers profit maximization implies $\frac{dy_N}{de} = -e \frac{dy_T}{de}$, and consumers utility maximization implies $\frac{dC_N}{de} = -e (\frac{dC_T}{de})$, it follows that curve $\dot{a} = 0$ shifts up by more than curve $NN$.\(^{1/}\)
a reduction in wealth and a depreciation of the real exchange rate which would reduce private sector demand and increase supply of traded goods. If the deficit is eliminated directly through a reduction in public sector expenditure on traded goods, there is no need for changes in relative prices and wealth that would change the behavior of the private sector. However, if the deficit is eliminated in some other way a combination of reduction in real wealth and depreciation of the real exchange rate is required. The elimination of the deficit through a reduction in public sector expenditure on nontraded goods leads to a larger real depreciation (and a lower reduction in real wealth) than an increase in taxes because in the former case the exogenous reduction in demand falls entirely on nontraded goods, requiring a larger decline in its relative price.\footnote{Other authors have also examined the relationship between fiscal policy and the real exchange rate, and reached similar conclusions. For example, Montiel (1985) uses a Keynesian model to derive the same result as here, namely that a switch in government spending from traded to nontraded goods leads in the long run to an appreciation of the real exchange rate. See also, Berglas and Razin (1973), Bruno (1976), and Greenwood (1984). Berglas and Razin (1973), however, note that restrictive fiscal policy may lead to an appreciation of the real exchange rate if nontraded goods are inferior goods. This could also happen in our model, since inferior nontraded goods imply a positively sloped NN curve. However, we do not consider the case of inferior nontraded goods because it also has some fairly implausible implications. For example, a nominal devaluation by itself would cause a transitory real appreciation — see equation (18) with a negative \( n_M \). For the same reason, an exogenous increase in the money supply would cause a real depreciation. Furthermore, if the NN schedule becomes steeper than curve \( \hat{\alpha} = 0 \), the system is divergent; if the economy is not at point A, it will move continuously away from A. Kapur (1981), using a growth model, shows that changes in government expenditure on traded capital goods may affect the steady state real exchange rate since this would change the steady state stock of capital per capita. Capital accumulation is not allowed for in our model. Kimbrough (1985) examines the relationship between fiscal policy and real exchange rates for countries under freely floating exchange rates.}
Obviously, some combinations of the three policies examined above could also be used to eliminate the deficit. For example, a combination of a reduction in public sector expenditure in traded and nontraded goods would imply a new equilibrium along the segment AC in Figure 3. A combination of an increase in taxes and a reduction in public sector expenditure on traded (nontraded) goods would produce a new equilibrium along the segment AB (BC).

Clearly, a combination of the three policies would imply a new equilibrium somewhere within the triangle ABC. In other words, for each combination of the three policies mentioned above there is a corresponding long-run equilibrium position in triangle ABC. This implies that when setting targets for a reduction in the fiscal deficit and a real depreciation in order to attain a given balance of payments improvement, the target for the real exchange rate cannot be set independently from the specific way in which the fiscal deficit is to be reduced.

We have shown that long-run balance of payments equilibrium can be attained by eliminating the fiscal deficit, which generally implies a reduction in real wealth and a depreciation of the real exchange rate. For this reduction in real wealth and depreciation of the real exchange rate to take place it is not necessary to devalue the domestic currency. If the fiscal deficit is eliminated, but the domestic currency is not devalued, there will be an adjustment period that will endogenously bring about the necessary

1/ It is also possible to obtain a long run equilibrium position outside the triangle ABC if the policy package that eliminates the fiscal deficit includes some expansionary policy. For example, if the policy package includes an increase in taxes but also a (smaller) increase in public sector expenditure in traded goods so that the fiscal deficit is eliminated, the long-run equilibrium position would be located on the NN curve to the northwest of point B, outside the triangle ABC. The consideration of this type of policy packages does not affect the main conclusions of the paper.
changes in real wealth and real exchange rate. For example, if the fiscal
deficit is eliminated entirely by increasing taxes, the economy will adjust
from point A to point B along the NN curve, causing a gradual reduction in
real wealth and a gradual depreciation of the real exchange rate. If the
deficit is eliminated entirely by reducing the expenditure on nontraded goods,
the real exchange rate would jump from A to D, and then both the real exchange
rate and real wealth would adjust gradually along the NN curve until point
C. If the deficit is eliminated entirely by a reduction in public sector
expenditure in traded goods, however, there is no need for an adjustment
process and the economy attains a long-run equilibrium position immediately at
the same point A. Combinations of the three types of fiscal policies will
produce an initial jump in the real exchange rate, followed by a gradual
depreciation.

Although the new long-run equilibrium can be attained without a
devaluation of the domestic currency, the process of adjustment in which the
real exchange rate depreciates gradually is accompanied by balance of payments
deficits until the economy reaches the new long-run equilibrium. A
devaluation of the domestic currency, however, can make the economy reach the
new long-run equilibrium immediately, thereby preventing the loss of
international reserves during the process of adjustment. 1/ The magnitude of
the devaluation that is required to reach immediately a new long-run
equilibrium depends on the new equilibrium point; that is, it depends on the

1/ In models that assume rigidities in prices and wages, a devaluation also
helps to prevent unemployment, since a real depreciation without a
devaluation would require a decline in the nominal price of nontraded
goods. If nontraded goods prices are sticky, output would decline and
unemployment may result. See, for example, Dornbusch (1974), and Bruno
(1978).
specific policies that are used to eliminate the fiscal deficit. For example, if only an increase in taxes is used, the magnitude of the devaluation must be such that real wealth falls from \( a_A \) to \( a_B \). On the other hand, if only a reduction in public sector expenditure in nontraded goods is used, real wealth must fall from \( a_A \) to \( a_C \), which requires a smaller devaluation. In general, the lower the level of real wealth in the new long-run equilibrium, the higher the rate of devaluation that is needed to attain equilibrium immediately. This implies that the greater the reliance on increasing taxes with respect to reducing public sector expenditures the greater the needed devaluation. Conversely, the larger the reliance in reducing public sector expenditure on traded goods relative to the other policies, the smaller the required devaluation.

A devaluation that moves the economy immediately to equilibrium causes a once-and-for-all effect in the price level. The magnitude of this effect depends on the specific policies that were used to eliminate the fiscal deficit. From equation (20) and the definition of the real exchange rate it follows that

\[
(23) \quad \hat{P} = \hat{E} - \alpha_N \hat{e}
\]

Equation (23) and Figure 3 can be used to compare the effect of the various policies on the price level. For example, the price level increases by more if the deficit is eliminated by increasing taxes than by reducing public sector expenditure in nontraded goods, under the assumption that both policies are accompanied by the devaluation required to attain long-run equilibrium immediately. This follows because to move from A to B requires both a higher devaluation and a lower real depreciation than going from A to C.
3. Conclusion

In analyzing the effects of devaluation on the real exchange rate, it is useful to consider the circumstances in which such a policy is implemented. Typically, the need for a real exchange rate change arises when a country experiences an imbalance between aggregate absorption and aggregate supply, which is reflected in a worsening of its external payments position. While it is true that external factors, such as an exogenous deterioration in the terms of trade or an increase in foreign interest rates, can be responsible for the basic demand-supply imbalances, often these imbalances can be traced back to fiscal deficits that are financed by monetary expansion. If foreign financing is available the aggregate disequilibrium can persist for extended periods, but at the cost of a widening current account deficit, a loss of international competitiveness, an inefficient allocation of resources because of the distortions in relative prices caused by domestic inflation, and a heavier foreign debt burden.

If it is the fiscal stance of the authorities that is responsible for the situation, then the appropriate policy package would clearly include devaluation and measures to eliminate the fiscal deficit. This paper showed that such combination of policies would in fact achieve both the real exchange rate and balance of payments targets. This result is a well-known one. However, what is important in this context is that devaluation by itself would not be sufficient to achieve a real exchange rate objective, except perhaps in the very short term. Devaluation does have an initial effect on the real exchange rate, with the size depending on the substitution elasticities between traded and nontraded goods in consumption and production, and the share of domestic money in real wealth. The effects can only be sustained if supporting policies, such as measures to reduce the fiscal deficit and control of the growth of money, are adopted. The empirical results reported in a
number of studies presumably reflect the combined effects of devaluation and these other supporting policies, and thus are not necessarily inconsistent with the theoretical analyses that indicate that devaluation by itself would have no lasting effect on the real exchange rate.

The analysis in this paper also highlighted a further aspect of the policy combination that is not as well-appreciated in the literature. That is, the effects of devaluation on the real exchange rate depends on both the size of the reduction in the deficit and the means by which this reduction is achieved. In other words, the magnitude of the nominal devaluation necessary to hit the real exchange rate and balance of payments targets will depend on whether the fiscal deficit is reduced by increasing taxes, or by reducing government expenditures on traded and nontraded goods. In broad terms, the required depreciation of the domestic currency will be larger if the fiscal deficit is reduced by increasing taxes than by lowering government expenditures. Furthermore, the required nominal devaluation would be smaller if the cuts in expenditure fall on traded goods rather than nontraded goods.

The results here have an obvious bearing on the design of policy packages that are aimed at improving international competitiveness and the external balance. It is shown that the size of the nominal devaluation and the way the fiscal deficit is reduced cannot be considered as independent policy measures. The authorities have to ensure that consistency is maintained between the two types of policies to achieve a unique value of the real exchange rate. If this is not done then the level of the real exchange rate would be indeterminate, even though the balance of payments deficit is eliminated. Simply proposing that the fiscal deficit should be reduced when devaluing the exchange rate is not enough to achieve a particular real exchange rate target; much more detail is called for on the methods by which the fiscal deficit is to be reduced.
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