IMF WORKING PAPER

WP/88/51

INTERNATIONAL MONETARY FUND

Research Department

Contractionary Devaluation in Developing Countries: An Analytical Overview

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June 29, 1988

Abstract

This paper evaluates the growing literature on whether devaluation has contractionary effects on output in developing countries. It explores the nature of the links between the exchange rate and real output within a unified, fairly general analytical framework which incorporates a number of the developing-country features cited in this literature. The analysis suggests that many of the arguments on both sides of the contractionary devaluation debate require modification and that a number of potential effects have been ignored. It is concluded that the direction of the impact effects of devaluation on real output is ambiguous on analytical grounds.

JEL Classification Numbers:

131, 431

*We would like to thank Jagdeep Bhandari, Mohsin Khan, Ashok Lahiri, Ichiro Otani, Liliana Rojas-Suarez, and Carmen Reinhart for their comments on an earlier draft. Remaining errors are our responsibility.

Contents

I. Introduction

In spite of the widespread adoption of floating exchange rates among industrial countries after 1973, the vast majority of developing countries have continued to maintain official parities for their currencies. In the face of frequent and severe external shocks, as well as unstable domestic policies, such parities have been subject to frequent devaluations. Yet, although currency devaluations have become quite common in developing countries, they continue to be resisted by the authorities and often are used only as a last resort. Among the reasons that have been adduced for this aversion is the fear that devaluation may have contractionary effects on domestic economic activity while increasing the rate of inflation, and possibly not improving external indicators such as the trade balance or the change in net international reserves.

While the view that a properly-administered devaluation will improve the trade balance is widely accepted, as is the likelihood that some increase in the price level will ensue, much less consensus exists concerning possible effects on output and employment. Diaz Alejandro (1965) and Cooper (1971) were among the first to raise the possibility that devaluation could prove contractionary in developing countries. However until the publication of an influential paper by Krugman and Taylor (1978), the dominant view was that the substitution effects engendered by a real devaluation were likely to prove sufficiently strong so as to assure that the net effect on output and employment would be expansionary, in spite of a countervailing negative real balance effect and problematical income distribution effects. The Krugman-Taylor paper formalized several channels of contractionary influence likely to prove particularly relevant in developing countries, and gave rise to a burgeoning literature exploring these and a variety of other macroeconomic channels through which a nominal devaluation could cause real output to contract. At the very least, the presumption that devaluation is typically expansionary has come under serious challenge in the developing-country context. Our purpose in this paper is to provide a critical analytical overview of this literature. We shall examine and evaluate the various channels that have been proposed through which devaluation may exert contractionary influences on domestic economic activity.

In order to accommodate the large variety of channels through which devaluation has been perceived to affect domestic economic activity, we adopt a fairly general analytical framework. Accordingly, we consider a small open economy producing both traded and nontraded goods using homogenous labor, sector-specific capital, and imported inputs. 1/ Production costs are affected not just by the costs of employing the factors mentioned above, but also by the need to finance working capital. A general wage determination mechanism is analyzed which includes several labor market models that have appeared in the literature as special cases. On the demand side, households are assumed to hold money, capital, and foreign interest-bearing assets, in addition to which they may issue loans to each other. Alternative assumptions about international capital mobility are examined, as are the possible consequences of Ricardian equivalence for household behavior.

Our analysis, however, is subject to the general limitations that characterize the contractionary devaluation literature. To clarify these, note first that where the exchange rate is the only exogenous nominal variable, a nominal devaluation can have no long-run real effects. Thus, devaluation can be neither expansionary nor contractionary in the long run. It follows that the dispute over contractionary devaluation must concern alterations in the path followed by output and employment during the economy's transition to long-run equilibrium. With very few exceptions, however, the analytical literature on contractionary devaluation has concerned itself with a much narrower issue--the impact effects on output and employment. 2/ Since such short-run effects may well be reversed in the medium term, this is indeed an important shortcoming. Second, if expectations are rational, it is well known that even impact effects cannot be examined without solving out the economy's future path. Thus the static models that dominate this literature are typically forced to rule out rational expectations. The remedy to both of these problems is to employ fully specified dynamic models. However, models which incorporate forward-looking price expectations, sluggish nominal wage adjustment, and accumulation of both sector-specific capital and financial assets are simply not analytically tractable. We therefore do not solve a general model which takes all of these considerations into account simultaneously, but rather treat them as a series of topics within a consistent analytical framework. In the absence of a solution to a fully-specified dynamic model, our analysis will proceed under the following simplifying assumptions:

1/ As an alternative to this "dependent economy" model which emphasizes the relative price between traded and nontraded goods (the real exchange rate), we could have used a "Keynesian" or "complete-specialization" type model which emphasizes the relative price between exports and imports (the terms of trade). However for the purposes of discussing contractionary devaluation, the results from dependent economy models can be reinterpreted so as to apply to complete-specialization models, as will be noted where necessary.

2/ By impact effects we refer to effects conditional on the initial values of the state variables.

a. Only the impact effects of a nominal devaluation are considered.

b. It is assumed (and not derived) that a nominal devaluation results in a--possibly less than proportional--real devaluation on impact. The empirical relevance of this outcome is fairly well established (Edwards (1988)).

c. The treatment of expectations consists of the following:

   (1) all changes in relative prices induced by the devaluation on impact are assumed to be perceived as permanent; and

   (2) the expected post-devaluation rate of inflation is taken as given.

The remainder of the paper is divided into three parts, covering sequentially the effects of devaluation on aggregate demand and aggregate supply, and issues arising from stability considerations. The discussion of effects on aggregate demand in turn consists of separate sections on consumption, investment and the nominal interest rate. Within each of these sections, particular effects that have been cited in the literature are identified and analyzed separately. The aggregate supply discussion, in turn, is divided into sections on nominal wages, imported inputs, and working capital. Finally, there is a brief discussion of stability issues addressing the question raised by Calvo (1983) and others of whether a contractionary impact of devaluation can be compatible with stability and uniqueness of the economy's long-run equilibium.

II. Effects on Aggregate Demand

In a small open economy producing traded and nontraded goods, the demand curve facing the traded goods sector is given by the law of one price:

(1) $P_t = EP_t^*,$

where P_t is the domestic-currency price of traded goods, E is the nominal exchange rate (units of domestic currency per unit of foreign currency), and P_t^* is the foreign-currency price of traded goods, which we take to be unity. Aggregate real demand for nontraded goods, however, which we denote d_n, consists of the sum of domestic consumption (c_n), investment (i_n) and government (g_n) demand for such goods:

(2) $d_n = c_n + i_n + g_n$

The first part of this paper examines the effects of devaluation on the components of equation (2). Consumption and investment demand are treated separately in Sections 1 and 2, while government demand is incorporated into the discussion of the government budget constraint in subsection 1.e. The domestic interest rate, which affects both consumption and investment demand, is treated separately in Section 3.

1. Consumption

In this section we examine the effects of devaluation on consumption demand for nontraded goods. We will consider a fairly general specification of household behavior, in which demand for nontraded goods depends on the real exchange rate $e = P_t/P_n$, where P_n is the domestic-currency price of nontraded goods, on real factor incomes received by households (y) net of real taxes paid by them (t), on real household financial wealth (z), and on the real interest rate $r-\pi$, where r is the domestic nominal interest rate and π is the expected rate of inflation. Possible distributional effects on aggregate consumption are captured by a shift parameter denoted δ. Consumption demand for nontraded goods thus takes the general form:

(3) $c_n = c(e, y-t, r-\pi, z, \delta)$.

We now examine the effects of devaluation on each of the arguments of c( ).

a. Relative price effects

Devaluations bring about changes in relative prices that affect the demand for domestically-produced goods. Within the "dependent economy" framework adopted in this paper, it is necessary to distinguish between the relative price effect on the demand for traded goods and for nontraded goods. 1/ As mentioned above, the total (domestic and foreign) demand for domestically-produced traded goods is perfectly elastic and therefore not affected by relative price changes. Although the domestic demand for these goods is affected by relative prices, which is important for balance of payments purposes, it is the total demand which is relevant for output and employment in this sector. On the other hand, changes in relative

1/ Relative price effects and real income effects in complete-specialization models can be derived as special cases of those analyzed here. The derivation is contained in an appendix available from the authors on request.

prices that affect the domestic demand for nontraded goods will affect the total demand for these goods since both demands are the same by definition. A devaluation, therefore, will have a relative price effect on the demand for domestically-produced goods through its effect on the demand for nontraded goods. A real depreciation of the domestic currency, i.e., an increase in the relative price of traded to nontraded goods, holding real income constant, will increase the demand for nontraded goods, and vice versa. This implies a positive partial derivative c_1 in equation (3). This substitution effect, present in most models, is excluded in Krugman and Taylor (1978), by the assumption that consumers demand only nontraded goods.

b. Real income effects

Devaluations also produce changes in real income that affect the demand for domestically-produced goods. These real income changes can be decomposed between those resulting from changes in relative prices at the initial level of output, and those resulting from changes in output at the new relative prices. Since we are discussing effects on the demand for domestic output, we will be interested primarily in the change in real income at the initial level of output, which provides the autonomous effect. In order to obtain the endogenous change in output, it would be necessary to solve the complete model, including demand and supply factors simultaneously. The discussion of the autonomous real income effect will be sufficient to illustrate the forces at work.

In order to analyze the income effect we need some definitions. The price level will be denoted by P, with

(4) $$P = E^{\beta} P_n^{1-\beta}$$

where β is the share of traded goods in consumption. Real income is equal to

(5) $$y = y_n e^{-\beta} + y_t e^{1-\beta}$$

where y_n is the production of nontraded goods and y_t is the production of traded goods.

The effect of a real devaluation on real income for a given level of output is ambiguous. Differentiating (5) with respect to e, keeping y_n and y_t constant yields:

(6) $$\frac{dy}{de} = e^{-1}(\alpha - \beta)(y_n e^{-\beta} + y_t e^{1-\beta}) \gtrless 0,$$

where α is the share of traded goods in total output:

(7) $$\alpha = (e\ y_t)/(e\ y_t + y_n).$$

Equation (6) shows that the impact effect on real income depends on whether traded goods have a higher share in consumption or in income. Clearly, a variety of results are possible. Assume, for example, that there is no expenditure on investment goods so that consumption and expenditure are the same, and assume also that there is no public sector expenditure so that $c_n = y_n$. In this case the net effect on real income depends on whether consumption of traded goods is higher or lower than y_t, *i.e., on whether there is a trade deficit or a trade surplus. If* there is a deficit, $\beta>\alpha$ and real income declines with a real devaluation. The reason is that the goods whose relative price has increased--traded goods--have a higher weight in consumption than in income. The incorporation of investment goods and public sector expenditure naturally complicates these relationships. 1/

For models with traded and nontraded goods, besides the ambiguous effect on real income derived here for given levels of output, the demand for nontraded goods may also increase due to a higher level of output of traded goods. The production of traded goods will generally increase as long as the price of its inputs do not rise by the full amount of the devaluation. As examined later, this will depend on whether salaries are indexed, on inflationary expectations, and on other factors.

c. Effects through imported inputs

The presence of imported inputs is an additional factor that may have a negative effect on the demand for domestically-produced goods following a devaluation. The reason is that under certain conditions imported inputs make it more likely that the real income effect of a devaluation, discussed in the previous sub-section, be negative.

1/ In complete-specialization models the real income effect for a given level of output is unambiguously negative. The reason is that in those models with specialization in production the goods whose relative price increases with a devaluation (imported goods) necessarily have a higher weight in expenditure than in production.

The modification that imported inputs introduce in the previous analysis is that they must be subtracted from domestic output to obtain national income. A real devaluation, therefore, not only affects real income through the channels mentioned in the previous section, but it also affects real income by changing the real value of imported inputs.

There are two opposing effects of a real devaluation on the real value of imported inputs. On the one hand, a real devaluation increases the relative price of imported inputs in terms of the basket of consumption, thereby increasing the real value of the initial volume of imported inputs. On the other hand, if the price of labor does not increase by the full amount of the devaluation, the relative price of imported inputs increases and domestic producers have an incentive to substitute labor for imported inputs, thus reducing the volume of imported imports. Clearly, the net effect of these two opposing forces depends among other things on the degree of factor substitutability in production, and on the extent to which a devaluation is transmitted to wages.

In order to illustrate this we will use a very simple example, and we will mention later the modifications required if some of the assumptions are relaxed. Assume that traded goods are produced with a fixed amount of specific capital, and with labor. Nontraded goods are produced with an imported input and labor according to a CES production function with elasticity of substitution σ. Using the definition of the price level described in (5), real national income is:

$$(8)\quad y = y_n e^{-\beta} + y_t e^{1-\beta} - m e^{1-\beta}$$

where m is the volume of imported inputs, which are used in the nontraded goods sector. As in the previous section, we calculate the effect of a devaluation on real income for a given level of output. This is done by differentiating (8) with respect to e, keeping y_n and y_t constant, which yields:

$$(9)\quad \frac{dy}{de} = e^{-1}\,(\alpha-\beta)(y_n e^{-\beta} + y_t e^{1-\beta}) - (1-\beta)\, e^{-\beta} m - e^{1-\beta}\,(dm/de)$$

The first term in (9) is the result obtained when there are no imported inputs--see equation (6)--while the remaining terms arise only in the presence of imported inputs. The second term is the increase in the real value of the initial volume of imported inputs. The last term represents the substitution away from imported inputs, where (dm/de) is calculated for a given level of nontraded goods output. We should also remember that, as mentioned in the previous sub-section, there is another effect on the demand for nontraded goods due to a higher level of traded goods output, which is not included in (9). This effect is positive as long as wages do not increase by the same amount as the nominal devaluation. 1/

Assuming cost minimization in the nontraded goods sector, we obtain:

$$(10) \quad (dm/de) = -e^{-1} \, m \, \sigma \, \theta_w \, (\hat{E} - \hat{W}) \, (\hat{e})^{-1}$$

where θ_w is the share of wages in nontraded goods costs, $\hat{E}$ is (dE/E), $\hat{W}$ is (dW/W), and $\hat{e}$ is (de/e); since E is the nominal exchange rate it is also the price of imported inputs, and W is the wage rate.

However, $\hat{e}$ is not independent of $\hat{E}$ and $\hat{W}$. Since $e = (E/P_n)$ by definition, and P_n is equal to the unit cost of production, by profit maximization, we obtain:

$$(11) \quad \hat{e} = \hat{E} - \hat{P}_n = \hat{E} - \theta_w \hat{W} - \theta_m \hat{E} = \theta_w (\hat{E} - \hat{W}).$$

Equation (11) indicates that a real devaluation can only be obtained if wages increase by less than the full amount of the nominal devaluation.

Using (9), (10), and (11), the net effect on real income that is added by the presence of imported inputs when there is a real devaluation is

$$(12) \quad e^{-\beta} \, m \, [\sigma - (1 - \beta)]$$

The presence of imported inputs will thus contribute to a reduction in real income when $(1-\beta) > \sigma$. It is clear that the net effect is ambiguous, and a variety of results are possible. For example, if there is no substitution in production, $\sigma = 0$, as in Krugman and Taylor (1978), the net effect is necessarily negative. 2/ In comparing our results with those of previous authors we must keep in mind that while we are discussing the effects of a real devaluation, previous papers usually

1/ This abstracts away from working capital considerations (see Section III.3).

2/ One of the earliest discussions of devaluations in the presence of imported inputs is contained in Coppock (1971), who also assumes $\sigma = 0$. However, Coppock's model does not analyze the determination of domestic output, and therefore the discussion in that paper cannot be directly related to our results.

discuss nominal devaluations. However, with proper care comparisons are possible. For example, if wages increase by the full amount of the nominal devaluation, $\hat{W} = \hat{E}$, there is no change in relative goods prices and therefore no real devaluation to analyze in our framework. In papers that take a nominal devaluation as the starting point, a situation with nominal wages fully indexed to the exchange rate results in no real income effect for a given level of output, which is equivalent to our result. See, for example Hanson (1983), Gylfason and Schmid (1983), Gylfason and Risager (1984) and Nielsen (1987). In general, results by previous authors can be reproduced by, and interpreted as, giving certain specific values to the various parameters in (9) and (12). Some of those authors deflate nominal magnitudes by the price of the domestic good in complete-specialization models, which is equivalent to assuming $\beta = 0$. Also, in such models the share of the domestic good in production is equal to one; this is equivalent to assuming $\alpha = 0$. This is done for example by Shea (1976), who uses a Cobb-Douglas production function, therefore also assuming $\sigma = 1$, with the result that a devaluation has no effect on real income for a given level of output. Finally it must be remembered that we are discussing in this section the real income effect, and no substitution effect in consumption is included.

Some of the assumptions used above could be relaxed, but this would not affect the main conclusions. For example, it can be assumed that traded goods also use imported inputs. In this case the only difference is that y_t should be interpreted as the value added--instead of output--in the traded goods sector. 1/ Similarly, the nontraded goods sector can be assumed to use some specific capital, as in Edwards (1987). This would merely result in a more cumbersome expression that would still depend on the same type of parameters as those mentioned above. In fact, if it is assumed that specific capital combines with labor according to a Cobb-Douglas production function to produce "value added," and then value added (instead of labor as in our previous discussion) combines with imported

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1/ The presence of imported inputs in the production of traded goods does not affect the analysis because a devaluation by itself does not change the relative price between final traded goods and imported inputs. However, if a devaluation is undertaken together with some other policy that affects this relative price, the structure of the production function of traded goods becomes relevant for deriving the effect on output. One such case is analyzed by Buffie (1984b) who assumes that simultaneously with the devaluation there is a lowering of import tariffs and export subsidies that apply only to final goods, which results in an increase in the relative price of imported inputs with respect to final traded goods. However, it is clear that the change in relative prices in Buffie's model is brought about by the change in commercial policy rather than by the devaluation.

inputs according to a CES production function to produce the nontraded good, equation (12) remains intact. In other words, the condition for a contractionary effect due to the presence of imported inputs remains $\sigma < (1-\beta)$. This result can be derived easily from our discussion of the effects of imported inputs on the supply function (Section III.2), where we assume this alternative production structure that includes specific capital as a factor of production in the nontraded goods sector.

In summary, the net effect on real income that is added by the presence of imported inputs is ambiguous. It is more likely to be negative the lower is the elasticity of substitution between imported inputs and primary factors, and the higher is the share of nontraded goods prices in the price index.

d. Income redistribution effects

Another factor frequently mentioned as a possible cause for a decline in the demand for domestically produced goods following a devaluation is the redistribution of income from sectors with high propensity to spend on this type of good to sectors with a lower propensity. Alexander (1952) recognized the possibility that redistribution of income may affect expenditure, and included it as one of the direct effects of a devaluation on absorption. He discussed redistribution of income in two directions, both of them associated with an increase in the price level: first, from wages to profits due to lags in the adjustment of wages to higher prices, and second, from the private to the public sector due to the existing structure of taxation. If profit recipients have a lower marginal propensity to spend than wage earners, or if the public sector has a lower propensity to spend than the private sector, absorption will decline for a given level of real income. It must be noticed, however, that while Alexander was interested in the effects on the trade balance and therefore examined the behavior of total expenditure, we are interested in the effects on the demand for domestic output and thus are concerned with the behavior of the demand for this particular class of good.

Of the two types of redistribution mentioned above we will examine in this section the shift of income from wages to profits, leaving the shift from the private to the public sector to be discussed later. Although also recognized by other authors, such as Cooper (1971a, 1971b), the redistribution from wages to profits has been examined formally by Diaz Alejandro (1963), and Krugman and Taylor (1978). Both of these papers present models in which the only impact effect of a devaluation is to redistribute a given level of real income from wages to profits due to an increase in prices, keeping wages constant. Both show that this may cause a reduction on the demand for domestic output if the marginal propensity to spend on this type of good is lower for profit recipients than for wage earners. 1/ Diaz-Alejandro's discussion is more precise since he specifically distinguishes the marginal propensity to spend from the marginal propensity to consume--Krugman and Taylor assume that the marginal propensity to invest is zero--and also distinguishes expenditure on traded goods from expenditure on nontraded goods--Krugman and Taylor assume that all the final demand is for nontraded goods.

Although theoretically correct under the assumptions made in those papers, this is not the only type of redistribution of income between workers and owners of capital that is possible to associate with a devaluation. For example, in a model with traded and nontraded goods, flexible wages and sector specific capital, a real devaluation would reduce real profits in the nontraded goods sector, increase real profits in the traded goods sector, and would have an ambiguous effect on real wages. Real wages would increase in terms of nontraded goods but would decline in terms of traded goods. Sectoral considerations may therefore become important, and it is not clear a priori what would be the effect of this type of redistribution on the demand for the domestically-produced good. Cooper (1971a, 1971b) mentions the possibility of redistribution from the factors engaged in purely domestic industries to the factors engaged in export and import-competing industries, and recognizes that while in some cases this may have reduced demand, under different circumstances this may induce a spending boom. Furthermore, in the longer run when all factors of production are mobile, the redistribution of income may depend on technological considerations. For example, in a Heckscher-Ohlin model, real wages and profits in terms of either of the two goods depend on factor intensities. A real devaluation will increase real payments to factors used intensively by the traded goods sector and will reduce real payments to the other factor. All these considerations imply that the pattern of redistribution may change through time as the economy adjusts to the new situation following a devaluation. It seems natural to think of the redistribution of income as a dynamic process encompassing the various situations mentioned above. First, nominal wages are fixed for some period after a devaluation, then wages adjust to the new price level and workers move between occupations while capital remains sector specific, and finally capital also moves to the sectors with higher returns.

Besides the theoretical issues mentioned above, there still remains the question of how important the effect on the demand for domestic output

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1/ Barbone and Rivera-Batiz (1987) show that in the presence of foreign investment this redistribution effect may be present even if all domestic residents have the same marginal propensity to consume nontraded goods. The reason is that part of the additional profits is remitted abroad to foreigners whose marginal propensity to consume domestic nontraded goods is necessarily zero.

of redistribution from wages to profits is likely to be. Alexander (1952) emphasizes that what is important is the marginal propensity to spend, so that even if profit recipients have a lower marginal propensity to consume than wage earners, higher profits may stimulate investment and the redistribution of income may therefore result in increased absorption. However, Diaz-Alejandro (1963) argues that investment expenditure is even more biased towards traded goods than consumption expenditure, and since investment expenditure is undertaken by profit recipients, the demand for domestically produced goods is likely to decline. Even accepting this proposition about the relative sizes of the marginal propensities to spend on domestic output of workers and owners of capital, the next question is how important is the redistribution of income that will lead to a change in the pattern of aggregate expenditure. On this issue the evidence does not provide firm support for the hypothesis of redistribution against labor. Using data from 31 devaluation episodes, Edwards (1987) shows that in 15 cases there was no significant change in income distribution, while in eight cases the share of labor in GDP declined significantly and in seven others it increased significantly.

e. Effects through changes in real tax revenue

To the extent that devaluation affects the real tax burden on the private sector, thus redistributing income from the private to the public sector, this will represent a separate channel through which a contractionary effect on economic activity may result. This effect may operate through the demand for domestic output or through its supply, and in the former case through private consumption expenditure or through private investment. Up to the present, only the effects of devaluation on the real tax burden faced by consumers has figured prominently in the literature, and in this section we shall focus on this effect.

Krugman and Taylor (1978) point out that in a large number of developing countries governments derive a substantial proportion of their revenues from import and export taxes. Thus, a nominal devaluation which succeeds in depreciating the real exchange rate will increase the real tax burden on the private sector by increasing the real value of trade taxes, for given levels of imports and exports. It is straightforward to show that this will continue to be true after allowing for quantity responses on the part of imports and exports, as long as the price elasticity of demand for imports is not too large. 1/ The result depends, however, on the presence of *ad valorem*, rather than specific taxes on foreign trade. To the extent that nominal devaluation results in increases in the domestic price level, the presence of specific taxes would reverse the effect emphasized by Krugman and Taylor, since the real value of nonindexed

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1/ This can readily be demonstrated in a model in which traded goods are differentiated into exportables and importables.

specific taxes would fall as the result of an increase in the general price level brought about by a nominal devaluation.

The latter is, of course, simply a specific instance of the Olivera-Tanzi effect (see Olivera (1967) and Tanzi (1977)), which surprisingly has played no role in the contractionary devaluation literature. This effect is present when lags in tax collection or in adjusting the nominal value of specific taxes causes the real value of tax collections to fall during periods of rising prices. To the extent that nominal devaluations are associated with at least temporary bursts of inflation, the Olivera-Tanzi effect should be expected to be operative during the immediate post-devaluation period when prices are rising. Since the real tax burden would fall as a consequence of this effect, devaluation would exert an expansionary short-run effect on aggregate demand through this channel.

A third channel through which devaluation may affect aggregate demand via its effect on the real tax burden borne by households is that of discretionary tax changes caused by the effects of devaluation on government finances. To clarify this point, let us suppose that other than trade taxes, all remaining taxes are levied on households in lump-sum fashion. To incorporate the two channels discussed above, let us write the government's real tax receipts, denoted t, as:

$$t = t\,(e, \hat{P}, \tau);\; t_1>0,\; t_2<0,\; t_3>0,$$

where τ is a parameter which captures the effects of discretionary taxes, and the first two terms in the function t( ) capture the trade-tax and Olivera-Tanzi effects. The government's budget constraint takes the form:

$$(13)\quad t(e, \hat{P}, \tau) = e^{1-\beta}\, g_t + e^{-\beta}\, g_n + r^{*}e^{1-\beta}F_G - e^{1-\beta}\,(\dot{D}_G/E + \dot{F}_G),$$

where g_t and g_n denote government spending on traded and nontraded goods respectively, r^* is the foreign nominal interest rate, F_G is net public external debt, and D_G is net government borrowing from the central bank. 1/

The first point to be made from identity (13) is that, in the Krugman-Taylor case, the increase in the real value of trade taxes attendant on a real devaluation cannot be the end of the story. As (13) makes clear, this increase in t must be offset somewhere else within the government budget, since (13) must hold at all times. The effect of an increase in

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1/ As is realistic in most developing countries, we assume that the government does not borrow directly from the public.

real trade taxes on aggregate demand will depend on the nature of this offset. If, for example, the offset takes the form of a reduction in discretionary taxes (τ), leaving real tax receipts t unchanged, the contractionary effect on aggregate demand will disappear altogether. Other possible offsets will differ in their consequences for aggregate demand, in ways to be explored below.

A nominal devaluation which results in a real depreciation may potentially affect each of the entries on the right-hand side of the identity (13). Among these, several authors have noted the importance of the existence of a stock of foreign-currency denominated external debt in affecting the possible contractionary effects of a nominal devaluation (see Gylfason and Risager (1984), van Wijnbergen (1986), and Edwards (1986)). In each case, however, the external debt has been treated as if owed by the private sector. 1/ As is well known, external debt in developing countries is typically largely owed by the public sector. In fact, currency substitution and capital flight have probably made the private sector in many developing countries a net creditor in foreign-currency terms. The sectoral allocation of debt can be ignored, and all debt treated as private debt, only in the case of complete Ricardian equivalence, which is discussed below. For the present, we examine the implications of public external debt in the absence of Ricardian equivalence.

If the public sector is a net external debtor, a real devaluation will increase the real value of interest payments abroad. As (13) indicates, the government can finance such increased debt service payments by increased taxation, reduced spending, or increased borrowing from the central bank or from abroad. The effects on aggregate demand will depend on the mode of financing. If the government chooses to increase discretionary taxes, the effects on aggregate demand will be contractionary, as private disposable income would fall. This is implicitly the effect captured by van Wijnbergen, Edwards, and by Gylfason and Risager in treating all debt as private debt and deducting interest payments from private disposable income. The effect on private consumption would be similar to that of an increase in discretionary taxes arising from any other cause. As a second alternative, increased real debt service payments could be financed by a reduction in government spending on goods and services. If this takes the form of reduced spending on nontraded goods the contractionary effects on aggregate demand would exceed those associated with tax financing unless the propensity to spend out of taxes approached unity. On the other hand if spending reductions fall on traded goods, the contractionary effects would be nil, since the small-country assumption

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1/ If such debt were in fact owed only by the private sector, of course, then F_G would not appear in (13).

ensures that government demand would be replaced by external demand. 1/ Finally, the increased real debt service payments could be financed by borrowing--either from the central bank or from abroad. In this case, with the exchange rate fixed at its new level, contractionary effects would again fail to appear, as the counterpart to the increased flow of credit to the government would simply consist of an outflow of foreign reserves in the former case, and of increased government external debt in the latter, with no impact on domestic aggregate demand in either case.

In addition to the effect on real interest payments, devaluation would affect the real value of government expenditures on goods and services. Since the real value of spending on traded goods rises while that on nontraded goods falls, the total effect depends on the traded-nontraded composition of government spending. Should the net effect be an increase in real spending, the same financing options as before would present themselves. This would be the case if government spending were heavily weighted toward traded goods. In the alternative case, a reduction in discretionary taxes may ensue, for example, with corresponding expansionary effects on aggregate demand.

Finally, the effect of a devaluation on discretionary taxes will also depend on the monetary policy regime in effect. This channel is captured by the last term on the right-hand side of equation (13). If the central bank pegs the flow of credit to the government in nominal terms, the rise in prices that attends a nominal devaluation will reduce $\dot{D}_G/P$ and call for an adjustment in the government budget, possibly through a discretionary tax increase. If the flow $\dot{D}_G$ is adjusted to accommodate the price increase, on the other hand, no further changes in the budget will emanate from this source. The last option we consider is that in which real valuation gains on the central bank's stock of foreign exchange reserves are passed along to the government. In this case, $\dot{D}_G/P$ could increase, and the financing options would include an expansionary tax reduction.

The preceding discussion requires several modifications in the presence of full Ricardian equivalance. To explore the nature of these modifications, it is necessary to take another look at the ad hoc consumption function (3) to see how it would need to be amended under Ricardian equivalence.

Suppose that the household's utility function is additively separable with a constant rate of time preference, and that instantaneous utility is

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1/ These statements assume that government spending yields no direct benefits to the private sector.

Cobb-Douglas in consumption of traded and nontraded goods. Under these assumptions, the consumption-saving decision can be divorced from the decision about the composition of consumption. Let c(u) denote real consumption at date u. Then, given the rate of time preference, the decision rule that emerges from the household's optimization problem can be summarized as follows:

$$(14) \quad c(u) = f[\rho, w(u)],$$

for a constant real interest rate ρ and real lifetime household resources w(u) given by:

$$(15) \quad w(u) = z(u) + \int_{j=u}^{\infty} (\tilde{y}(j)-\tilde{t}(j))e^{-\rho\,(j-u)}dj$$

where a tilde ($\tilde{}$) over a variable denotes an expectation formed at time u. Assuming static expectations for y and t, that is, $\tilde{y}(j) = y(u)$ and $\tilde{t}(j) = t(u)$, the permanent value of income from production net of taxes is equal to their currently-observed values. Substituting (15) in (14) yields:

$$(16) \quad c(u) = c[y(u)-t(u), \rho, z(u)],$$

which is in the form of (3).

Now we modify (16) to impose Ricardian equivalence. Under full Ricardian equivalence, the real interest rates at which the private and public sectors can borrow or lend are identical, and the private sector uses the government's budget constraint (13) to formulate its estimate of future tax liabilities. To keep within the confines of the Ricardian equivalence literature--which focuses on the choice between tax and bond financing--let us suppose that government deficits are always financed by borrowing abroad. That is, any shocks to taxes, spending, or interest payments are offset by altering the net flow of external financing. Under these assumptions the present value of the households' future tax liabilities are found from (13) to be:

$$(17) \quad \int_{j=u}^{\infty} \tilde{t}(j)e^{-\rho(j-u)}dj = \frac{E(u)F_G(u)}{P(u)} + \int_{j=u}^{\infty} \tilde{g}(j)e^{-\rho(j-u)}dj,$$

where $g = e^{1-\beta}g_t + e^{-\beta}g_n$ and $\rho = r^* - \pi$.

Assuming, as before, that expectations about the flow variables--in this case y and g--are static, and substituting into (15) and (14), we have:

$$(18) \quad c(u) = c\left[y(u)-g(u),\ \rho, z(u)-\frac{E(u)F_G(u)}{P(u)}\right]$$

which is the Ricardian-equivalence version of (16).

Equation (18) suggests the following modifications of previous results:

i. Although a real depreciation may increase the real value of trade taxes, á la Krugman-Taylor, thus reducing private disposable income, real aggregate demand will not contract. Instead, households will finance their increased real tax payments out of saving, since their higher taxes today will be offset by lower taxes tomorrow, leaving lifetime resources unchanged.

ii. The same analysis applies to the Olivera-Tanzi effect. Though today's real tax burden may fall, this will require greater external borrowing, which must be serviced by higher future taxes, so current private spending will remain unchanged.

iii. In the presence of public external debt, a real depreciation will be directly transmitted to lower private demand, even if the increased real cost of external debt service is financed by additional external borrowing, with no increase in taxes levied on the private sector today.

f. Wealth effects

Since an increase in real wealth can be expected to increase household consumption, a devaluation can also affect the demand for domestically produced goods through its effects on real wealth. If the level of domestic expenditure depends on real wealth, and private sector asset holdings are not indexed to the domestic price level, a devaluation changes the real value of existing wealth and thus affects the demand for domestic goods.

Nominal wealth is often taken to coincide with the nominal stock of money, thus converting the wealth effect into a real cash balance effect. Alexander (1952) emphasized this channel when analyzing the consequences of a devaluation for absorption. He noted that a devaluation would increase the price level and thus reduce the real stock of money, which would have two types of effects, both tending to reduce absorption: a direct effect when individuals reduce their expenditures in order to replenish their real money holdings to their desired level, and an indirect effect when individuals try to shift their portfolios from other assets into money, thus driving up the domestic interest rate in the absence of perfect capital mobility. We will be concerned in this section only with the direct effect, since the other is included in our discussion of the interest rate.

The real cash balance effect has been generally recognized and incorporated in the literature on contractionary devaluation. For example, Guitian (1976), Gylfason and Schmid (1983), Hanson (1983), Islam (1984), Gylfason and Radetzki (1985), Buffie (1986a), and Edwards (1987), take this effect into account either by including real cash balances directly as an argument in the expenditure function or indirectly through the use of a hoarding function. In all these cases, a devaluation, by increasing the price level in the presence of a given initial nominal stock of money, reduces real cash balances, thereby exerting a contractionary effect on demand.

This unambiguous result must be modified if the private sector holds other types of assets whose nominal value increases with a devaluation. For example, assume that the private sector holds foreign currency denominated assets in an amount F. Then real wealth would be equal to

$$(19) \quad z = (M/P) + (F\ E/P) = e^{1-\beta}\ [(M/E) + F]$$

The percentage change in real wealth due to a nominal devaluation would be equal to

$$(20) \quad \hat{z} = (1-\beta)\ \hat{e} - \lambda\ \hat{E}$$

where λ is the share of domestic money in private sector wealth. Since $\hat{e}$ is bounded above by $\hat{E}$ (unless the price of nontraded goods declines with a devaluation, which we do not consider), equation (20) has the following implications. If domestic money is the only asset in the portfolio of the private sector, $\lambda = 1$, a devaluation necessarily has a negative effect on real wealth and on demand. This was the case considered above.

If, alternatively, the private sector also holds assets denominated in foreign currency the result is ambiguous. The source of the ambiguity is that, although the real value of the stock of domestic money declines due to the increase in the price level, the real value of the stock of foreign assets increases as long as the domestic price level does not increase by the full amount of the devaluation. The effect on the demand for domestic goods may be positive or negative. It is more likely to be negative the higher is the share of traded goods in the price index β, the lower is the real depreciation $\hat{e}$, and the higher is the share of domestic money in private sector wealth λ. The possibility of the private sector holding foreign assets, although incorporated in several other aspects of analyses of devaluations, is practicaly ignored by the literature on contractionary devaluation.

This framework is also useful to examine the effects of external debt. The presence of private sector external debt reduces the net foreign asset position of the private sector F, thus increasing the share of domestic money in wealth λ, and therefore increasing the likelihood that a devaluation will have a negative effect on real wealth. If the level of external debt is so high as to result in a negative net foreign asset position of the private sector, λ will be greater than one and a devaluation will necessarily have a negative effect on real wealth and therefore a negative effect through the wealth channel on the demand for domestic goods. Thus, the presence of private sector external debt introduces another channel for a devaluation to be contractionary.

The contractionary effects of devaluation in the presence of external debt have been examined by Gylfason and Risager (1984), Van Wijnbergen (1986) and Edwards (1987). They have incorporated these effects in two different ways, by considering the reduction in real wealth as we discussed above, and by focusing on the real value of interest payments. Edwards (1987) models the presence of external debt by deducting external interest payments from private sector disposable income. Since a real devaluation increases the real value of interest payments that are fixed in foreign currency, disposable income declines and with it declines the demand for domestic output. Gylfason and Risager (1984) introduce this channel but they also include external debt as a negative component of wealth, therefore having an additional channel for a negative effect on demand. Van Wijnbergen (1986) also includes both channels, but his definition of disposable income includes capital gains and losses on asset holdings, which allows for the possibility of a rather curious result. In his model the sign of the effect due to foreign debt depends on whether the real interest rate in terms of domestic output is positive or negative. This interest rate would be negative if the rate of increase of domestic output prices is higher than the sum of the external interest rate plus the rate of crawl of the exchange rate. In this case a devaluation, by increasing the real value of a debt on which the country is paying a negative interest rate, would increase disposable income and with it the demand for domestic output.

Among the papers mentioned above, Gylfason and Risager (1984) is the only one to take into account the distinction between private and public external debt. In their definition of real wealth they assume that the private sector considers a certain proportion of total debt as owed by itself, either directly or through future tax payments. In their treatment of interest payments, however, they assume that payments on the public sector share of external debt are financed by taxes, so real disposable income of the private sector is independent of the division of external debt between the private and the public sector. The other two papers consider external debt to be owed exclusively by the private sector.

We have seen that the authors mentioned above have derived contractionary effects of a devaluation due to the presence of external debt using as channels the effect on real wealth, on real interest payments, or on both variables, and using alternatives definitions of disposable income. This raises the issue of which is the most appropriate way of modeling this effect. It is clear from equation (15) that one correct way is to include debt as a negative item in wealth. A real devaluation that increases real debt reduces real wealth, and therefore reduces consumption. Another way would be to interpret debt as a consol. Then, an increase in real debt increases interest payments permanently, which reduces disposable income permanently, and thus reduces consumption. In this case it would be correct to include interest payments as a negative item in disposable income, but it would be incorrect to include simultaneously debt as a negative item in wealth. Any one of the two would be sufficient, and they would be equivalent since the present value of all future interest payments would be equal to the present level of debt. It must be noticed that the inclusion of interest payments as a negative item in disposable income in a maximizing framework requires that those payments be seen as permanent. The curious result in Van Wijnbergen (1986) mentioned above originates in the inclusion of interest payments in disposable income when real interest rates are negative, a situation that can hardly be seen as permanent. Undoubtedly, the use of ad hoc models for analyzing problems in which expectations play such an important role is a drawback. A more fruitful approach would be to analyze this issue in the context of an intertemporal maximizing framework, as used by Obstfeld (1982) and Svenson and Razin (1983) to study the effects of changes in the terms of trade on expenditure,and the model used by Dornbusch (1983) to study the optimal path of consumption and external borrowing in a dependent economy. Only within this type of framework, in which it is possible to distinguish between transitory and permanent, and between expected and unexpected changes, and which forces the consideration of an intertemporal budget constraint, will it be possible to analyze this issue in a more rigorous and meaningful way.

2. Investment

As indicated in equation (2), the effects of a devaluation on private demand for nontraded goods is composed of effects on consumption demand for nontraded goods as well as on investment demand for nontraded goods from both the traded and nontraded goods sectors. For concreteness we shall assume in this section that the capital stock in each sector consists of traded and nontraded goods combined in fixed proportions. A unit of capital in the traded goods sector consists of γ_n^t units of nontraded goods and γ_t^t units of traded goods, while in the nontraded goods sector capital consists of γ_n^n nontraded goods and γ_t^n traded goods. Then the prices of a unit of capital in the traded sector (P_{kt}) and in the nontraded sector (P_{kn}) are given by:

$$(21)\quad P_{kt} = \gamma_n^t P_n + \gamma_t^t E$$

$$(22)\quad P_{kn} = \gamma_n^n P_n + \gamma_t^n E$$

We suppose that output in each sector is produced using capital, labor, and imported inputs. The marginal product of capital in the two sectors is therefore given by: 1/

$$(23)\quad MP_K^t = F_K^t\ (W/E;\ K_t)\ ; \qquad F_{K1}^t < 0, \quad F_{K2}^t < 0.$$

$$(24)\quad MP_K^n = F_K^n\ (W/P_n,\ e;\ K_n)\ ; \qquad F_{K1}^n < 0, \quad F_{K2}^n < 0, \quad F_{K3}^n < 0.$$

In the short run, the capital stock is fixed. From the first-order conditions for instantaneous profit maximization, an increase in the product wage will reduce demand for labor and this increase in the capital intensity of production will cause the marginal product of capital to fall. A similar effect results from an increase in the real cost of imported inputs. Notice that this variable does not enter (23), since the price of imported inputs in terms of traded goods is not affected by devaluation.

1/ The signs of the partial derivatives with respect to W/E, W/P_n and e, in (23) and (24) assume that factors of production are complementary in the sense that an increase in the use of one factor increases the marginal productivity of the other factors.

Since the demand for investment goods is inherently forward-looking, today's demand for investment in each sector will depend on the anticipated future paths of W, E, P_n, and the nominal interest rate r. Under rational expectations, these paths can only be generated by the full solution of a model. Since we do not present such a solution here, we will examine the issues involved under the assumption that all relative prices are expected to remain at their post-devaluation levels. Under this assumption, the sectoral net investment functions can be expressed as:

$$(25) \quad \dot{K}^t = q^t\left(\frac{EMP_{kt}/P_{kt}}{r+\delta-\hat{P}_{kt}} - 1\right) \quad ; \quad q^t(0) = 0,\ q^{t\prime} > 0$$

$$= q^t\left\{\frac{EF_K^t(W/E,\ K_t)/P_{kt}}{r + \delta - \hat{P}_{kt}} - 1\right\}$$

$$(26) \quad \dot{K}^n = q^n\left(\frac{P_n MP_{kn}/P_{kn}}{r+\delta-\hat{P}_{kn}} - 1\right) \quad ; \quad q^n(0) = 0,\ q^{n\prime} > 0$$

$$= q^n\left\{\frac{P_n F_K^n(W/P_n, e, K_n)/P_{kn}}{r + \delta - \hat{P}_{kn}} - 1\right\}$$

Net investor demand in each sector depends on the ratio of the marginal product of capital to the real interest rate. Gross investment demand is the sum of net investment and replacement investment, where depletion is assumed to take place at the uniform rate δ in both sectors. Equations (25) and (26) can now be combined with replacement investment to yield the total investment demand for nontraded goods:

(27) $i_n = i_n^t + i_n^n$

$$= \gamma_n^t q^t \left\{ \frac{EF_K^t(W/E, K_t)/P_{kt}}{r + \delta - \hat{P}_{kt}} - 1 \right\} + \gamma_n^n q^n \left\{ \frac{P_n F_K^n(W/P_n, e, K_n)/P_{kn}}{r + \delta - \hat{P}_{kn}} - 1 \right\}$$

$$+ \delta(\gamma_n^t K_t + \gamma_n^n K_n).$$

The effects of a real devaluation of the investment demand for nontraded goods can now be examined.

Both Branson (1986) and Buffie (1986b) have emphasized that, since a substantial portion of any new investment in developing countries is likely to consist of imported capital goods, a real depreciation will raise the price of capital in terms of home goods and this will tend to discourage new investment, exerting a contractionary effect on aggregate demand. However, as is evident from (27), this analysis is valid only in the case of investment demand originating in the nontraded goods sector. The situation is precisely the opposite in the traded goods sector, where a real depreciation lowers the real supply price of capital measured in terms of output. In this sector, therefore, this effect operates to stimulate investment, so the net effect of investment demand for nontraded goods of changes in the supply price of capital is ambiguous in principle.

A second channel through which devaluation affects the investment demand for nontraded goods operates through real profits. The analysis of this channel has to be model-specific to a greater extent than the previous one, since it will depend, for example, on the extent to which product markets are assumed to clear--i.e., on whether firms operate on their factor demand curves. The exposition above assumes that they do. In this case, the return to capital is its marginal product, which depends on the initial stock of capital, on the product wage, and in the case of the nontraded goods sector, on the real exchange rate, which determines the price of imported inputs. The effects of changes in product wages on profits, and therefore on investment spending, are emphasized by van Wijnbergen (1986), Branson (1986), and Risager (1984). Both van Wijnbergen and Branson contrast the case of fixed nominal wages with that in which there is some degree of wage indexation. Risager, on the other hand, examines the effect on investment of holding the nominal wage constant over some fixed initial contract length and then restoring the initial real wage. The basic result of these studies is that a devaluation may raise or lower the product wage on impact depending on the nature and degree of indexation. With rigid nominal wages, the product wage would fall on impact and investment would increase in the short run, even if the original product wage were expected to be restored in the future (Risager (1984)). With indexation which gives significant weight to imports, however, the product wage could rise, thereby dampening investment. A common result in "dependent economy" models with some nominal wage flexibility, however, is that a nominal devaluation results in a reduction in the product wage in the traded goods sector and an increase in the product wage in the nontraded sector (see Section III.1). In this case, investment would be stimulated in the former and discouraged in the latter, with ambiguous effects on total investment demand for nontraded goods.

In the presence of imported inputs, a third channel will be operative. The marginal product of capital in the nontraded goods sector will be affected by a real devaluation via the higher real costs of such inputs (van Wijnbergen (1986)), Branson (1986)). The effect is unambiguously contractionary, since the depressing effect on profits in the nontraded sector is not offset by positive effects on profits in traded goods production.

As a final point, notice that in the case of a real depreciation which lowers the product wage in the traded goods sector and raises it in the nontraded goods sector, the three effects analyzed above (i.e., the effects on the real cost of capital, the product wage, and the cost of imported inputs) tend, taken together, to increase investment in the traded goods sector and to decrease it in nontraded goods. If these effects are sufficiently strong, total investment demand for nontraded goods must increase when capital is sector-specific. In this case, an increase in investment demand in the traded goods sector can only be met out of new production. It cannot be offset by negative gross investment in the nontraded goods sector. Thus, whenever a devaluation has a sufficiently disparate effect on sectoral investment incentives as to increase investment in the traded goods sector by more than the initial level of gross investment in the nontraded goods sector, total investment must rise, no matter how adverse the incentives for investment in the nontraded goods sector.

3. Devaluation and the nominal interest rate

An increase in the real interest rate can be expected to reduce private consumption of nontraded goods as well as investment spending on nontraded goods by both the traded and nontraded goods sectors. While the expected-inflation component of the real interest rate is treated as exogenous here, in this section we examine the effects of devaluation on the nominal interest rate. To analyze the effect of a devaluation on the nominal interest rate, it is useful to distinguish between the current effect of an anticipated future devaluation and the contemporaneous effect of a previously unanticipated devaluation. Both types of shocks will be analyzed in this section. The effect of a devaluation on the nominal interest rate will of course depend fundamentally on the characteristics of the economy's financial structure, and many of the diverse results derived in the literature can be traced to different assumptions about these characteristics. We begin by describing a fairly general framework from which various special cases can be derived.

Suppose that domestic residents can hold financial assets in the form of money, domestic interest-bearing assets, and interest-bearing claims on foreigners (denominated in foreign exchange). Assume further that the domestic interest-bearing assets take the form of loans extended by households to other entities in the private sector (other households and firms). The effects of a devaluation on the nominal interest rate charged on these loans--whether a previously unanticipated current devaluation or an anticipated future devaluation--depends critically on the degree of capital mobility, that is, on the extent to which domestic loans are regarded by households as perfect substitutes for foreign assets and on the severity of portfolio adjustment costs. We will assume that portfolio adjustment is costless and distinguish two cases, depending on whether domestic loans and foreign assets are imperfect or perfect substitutes.

If loans and foreign assets are imperfect substitutes, equilibrium in the loan market may be given the fairly general formulation: 1/

$$(28) \quad 0 = H\left(r, r^* + \tilde{\hat{E}}, y, x, \frac{M+EF}{P}\right); \; H_1<0, \; H_2>0, \; H_3>0, \; H_4 > 0, \; H_5<0,$$

where H is the real excess demand function for loans; r is the nominal interest rate on loans; $r^* + \tilde{\hat{E}}$ is the nominal rate of return on foreign assets, consisting of the nominal interest rate r^* and an expected nominal depreciation $\tilde{\hat{E}}$; y is real income; x is a vector of additional variables that have been included in the real loan excess demand function in the contractionary devaluation literature (see below); and $(M + EF)/P$ is real household financial wealth. An increase in r has a negative own-price effect on excess loan demand, while increases in $r^* + \tilde{\hat{E}}$ increase the excess demand for loans as borrowers switch to domestic sources of finance while lenders seek to place more of their funds in foreign assets. An increase in domestic real income causes lenders to increase their demand

1/ The analysis below could equivalently be conducted in the money market.

for money, which they partly finance by reducing their supply of loans, thereby increasing excess demand in the loan market. Finally, other things equal, an increase in private financial wealth both reduces borrowers' need for outside financing and provides lenders with surplus funds which they can place in both loans and foreign assets, after satisfying their own demands for money. This reduces excess demand in the loan market.

Now consider the effect of a devaluation on the nominal interest rate r at given initial levels of real income y and of the price of nontraded goods P_N and with $\tilde{\hat{E}} = 0$. In the case of a previously unanticipatd devaluation the effect on r will depend, as can be seen from (28), on the composition of household financial wealth. Whether the real excess demand for loans rises or falls depends on whether real household financial wealth decreases or increases. The devaluation will decrease the real money stock but increase the real value of foreign assets. If a large share of household financial wealth is devoted to the holding of cash balances, and if traded goods have a large weight in private consumption (so that the price level P registers a strong increase), the former effect will dominate; real private financial wealth will fall, the real excess demand for loans will increase, and the domestic interest rate r will rise. However, this result will be reversed if foreign assets dominate households' balance sheets and/or traded goods carry a small weight in domestic consumption. In van Wijnbergen's (1986) model, for example, households hold no foreign assets; thus, a nominal devaluation raises the domestic interest rate. By contrast, Buffie (1984a) derives opposite conclusions when he assumes that households hold a substantial portion of their wealth in assets denominated in foreign exchange.

When the partial derivative H_1 ( ), evaluated at $r = r^* + \tilde{\hat{E}}$, approaches minus infinity, domestic loans and foreign assets become perfect substitutes in private portfolios. In this case, (28) is replaced by:

$$(29) \quad r = r^* + \tilde{\hat{E}},$$

i.e., uncovered interest parity holds continuously. Under these conditions, a previously unanticipated current devaluation has no effect on the domestic nominal interest rate. This is the assumption in the models of Turnovsky (1981), Burton (1983), and Montiel (1986).

The effects of an anticipated future devaluation are straightforward. In the imperfect substitutes case, this is represented by an increase in

$\tilde{\hat{E}}$ in equation (28), with E held constant. The domestic nominal interest rate will rise. If the own-price effect H_1 exceeds the cross-price effect H_2, the increase will be lower than the anticipated devaluation. In the perfect substitutes case, however, the domestic rate rises by the full amount of the anticipated devaluation, as indicated in (29).

The literature on contractionary devaluation has placed a substantial amount of emphasis on the importance of "working capital" in developing countries as a source of loan demand, following a key tenet of the "new structuralist" school (Taylor (1981)). This introduces additional effects of a previously unanticipated current devaluation which were not included in the preceding analysis. These effects can be captured by defining the variable x in (28) as:

(30) $x = x(W, E, P_n); \; x_1>0, \; x_2>0, \; x_3<0.$

x now becomes an index of real working capital requirements, which are taken to depend on the wage bill and on purchases of imported inputs (Section III.3). An increase in x increases the demand for loans, which explains the positive sign of H_4 in equation (28). Real working capital requirements are assumed to increase when the nominal wage and/or the domestic-currency price of traded goods increase, and to decrease when the price of nontraded goods rises. The positive sign of x_2 is in keeping with the standard assumption in the literature on contractionary devaluation. It is worth pointing out, however, that this places restrictions on the share of imported inputs in variable costs and on the elasticity of substitution between labor and imported inputs. 1/

Since a previously unanticipated current devaluation is represented by an increase in E and is also likely to increase W, the real excess demand for loans will rise, putting upward pressure on the domestic interest rate. Thus, taking working capital into account may cause the impact on r to be positive even if foreign assets figure prominently in private-sector balance sheets. Working capital considerations, therefore, indeed enhance the likelihood that devaluation will be contractionary. Notice, however, that these considerations become irrelevant if domestic loans and foreign assets are perfect substitutes (in which case (30) applies) and do not affect the analysis of an anticipated future devaluation.

1/ In fact, the sign of x_2 also depends on the properties of firms' loan-demand functions. These functions are discussed in Section III. 3.

III. Effects on Aggregate Supply

Besides affecting demand as described in the previous sections, a devaluation also affects the supply of domestically produced goods. The cost of production of those goods in terms of domestic currency is likely to increase as the prices of the factors of production rise in response to a devaluation. This can be thought of as an upward shift in the supply curve of those goods, which together with a downward sloping demand curve, would result in a lower level of output and a lower real depreciation than otherwise. The literature on contractionary devaluation has identified three channels though which a devaluation may cause an upward shift in the supply curve. These channels are: increases in nominal wages, the use of imported inputs, and increases in the cost of working capital.

1. Effects on the nominal wage

Since labor tends to be the dominant component of cost for most production activities, the effects of devaluation on aggregate supply will be significantly affected by the response of the nominal wage. A variety of approaches have been taken to nominal wage determination in the contractionary devaluation literature.

Some authors do not allow the nominal wage to respond to a current devaluation. A common assumption is to treat nominal wages as exogenous (Krugman and Taylor (1978), Gylfason and Schmid (1983), Gylfason and Risager (1983)). Alternatively, nominal wages have been regarded by some authors as predetermined. This has taken several forms. Buffie (1986b) and Larrain and Sachs (1986) regard the current nominal wage as a state variable, its evolution determined by labor market conditions in a Phillips-type framework without a role for price expectations. Alternatively, Burton (1983) uses a Fischer-type (1977) contracting framework to set the nominal wage in the current period equal to the sum of the (logs of) the target real wage and the current price level expected at the inception of the contract. In Burton's model, the nominal wage can respond to a previously anticipated devaluation, but not to an unanticipated one.

Among models that permit the current nominal wage to be affected by a current devaluation, the most common strategy is to adopt a simple indexation mechanism in which the current wage is proportional to some current price index. Branson (1986), Edwards (1986) and van Wijnbergen (1986) all use this approach. van Wijnbergen also analyzes the special case of indexation in which the real wage in terms of home goods is assumed fixed. Although Turnovsky (1981) does not explicitly analyze the labor market, his model can be interpreted as specifying the nominal wage as a function of the excess demand for labor and last period's expectations of current prices, with current prices themselves set as a fixed mark-up over the nominal wage. A previously unanticipated current devaluation can therefore affect the current nominal wage in this model through labor market conditions.

Equilibrium models of the labor market are presented by Hanson (1983) and Montiel (1986). The former expresses labor demand as a function of the product wage measured in terms of home goods, while labor supply is a function of the real wage in consumption units. The latter uses a Friedman-Phelps formulation in which the labor supply schedule is negotiated one period ahead as a function of the price level expected for that period, and labor demand depends on the product wages in both the traded and nontraded goods sectors.

In this section we will examine the effect of a devaluation on the nominal wage in the context of a general model from which each of the preceding models can be derived as special cases. We assume again a "dependent economy" setup, take capital as sector-specific and fixed in the short run, and allow both sectors to employ imported inputs. With all variables in logs, the aggregate demand for labor is:

$$(31)\quad l = l_o - d_1 (W-E) - d_2 (W-P_n) - d_3 (E-P_n),$$
$$= l_o - (d_1+d_2)(W-E)-(d_2+d_3)e,$$

where l_o, d_1, d_2, and d_3 are positive parameters. An increase in the product wage measured in terms of traded goods reduces the demand for labor in the traded goods sector both by reducing output in that sector and by encouraging the substitution of imported inputs for labor. The magnitude of d_1 depends on the share of labor in the traded goods sector, on the labor intensity of production in that sector, and on the elasticity of substitution between labor and imported inputs in the production of traded goods. The sign and magnitude of d_2 are determined similarly, except, of course, that the nontraded goods sector is involved. Finally, d_3 captures the effect on the demand for labor in the nontraded goods sector of an increase in the price of imported inputs. The demand for labor falls on account of a decrease in the level of output, but increases as labor is substituted for imported inputs. The negative sign in (31) will hold when substitution elasticities are sufficiently small that the former effect dominates the latter. The magnitude of d_3 depends on this substitution elasticity, on the labor intensity of output in nontraded goods, and on the share of the labor force employed in that sector.

Turning to aggregate supply, the current nominal wage is assumed to be given by:

$$(32)\quad W = W + s_1\ (1 - l_o) + s_2\ \tilde{P} + s_3\ (P-\tilde{P})$$
$$= \overline{W} + s_1\ (1 - l_o) + s_3 E - s_3(1-\beta)e+(s_2-s_3)\tilde{E}$$
$$- (s_2-s_3)(1-\beta)\tilde{e}\ ,$$

where $\overline{W}$, s_1, s_2, and s_3 are positive parameters, all variables are again in logs, and a tilde ($\tilde{}$) over a variable now denotes an expectation of its current value formed one period ago. In the contract described by (32), the current nominal wage W consists of an exogenous component $\overline{W}$ (taken hereafter to be zero, for simplicity) plus an endogenous component that depends on the level of employment l relative to its "natural," or full-employment level l_o, on price expectations for the contract period formed when the contract was signed, and on the degree of indexation (s_3) to unanticipated price shocks $(P-\tilde{P})$.

By imposing alternative restrictions, each of the models described previously can be derived as special cases of (32):

a. <u>Exogenous</u> nominal wages follow from $s_1 = s_2 = s_3 = 0$.

b. <u>Prededermined</u> nominal wages with Fischer-type contracts are implied by $s_2 = 1$ and $s_1 = s_3 = 0$.

c. <u>Indexation</u> to the current price level in its simplest form can be imposed by setting $s_1 = 0$ and $s_2 = s_3$.

d. As a special case, <u>fixed real wages</u> follow from $s_1 = 0$ and $s_2 = s_3 = 1$.

e. The <u>simple Phillips curve</u> without expectations is derived with $s_2 = s_3 = 0$. If l is dated one period ago, the nominal wage becomes pre-determined. If, as in (32), the <u>current</u> value of l matters, then the nominal wage is endogenous.

f. a <u>neoclassical</u> labor market model can be produced by setting $s_2 = s_3 = 1$.

g. Finally, the <u>Friedman-Phelps</u> type of Phillips curve formulation emerges from $s_2 = 1$ and $s_3 = 0$.

In this section, we will only impose the restrictions that $s_2 = 1$ and $s_3 < 1$, so that perfectly anticipated inflation has no effect on workers' real wage demands, while the degree of indexation to current prices is only partial. By substituting (31) in (32) and simplifying, the equilibrium nominal wage implied by this more general model is found to be:

$$(33)\quad W = \tilde{E} - \frac{1-\beta+s_1(d_2+d_3)}{1+s_1(d_1+d_2)}\tilde{e} + \frac{s_3+s_1(d_1+d_2)}{1+s_1\ (d_1+d_2)}(E-\tilde{E})$$

$$- \frac{s_3(1-\beta)+s_1(d_2+d_3)}{1+s_1\ (d_1+d_2)}(e-\tilde{e})$$

This formulation immediately points to several important observations. First, in assessing the effects on the nominal wage of an exchange-rate depreciation, the extent to which a nominal depreciation results in a real depreciation is crucial. The equilibrium nominal wage following a devaluation is determined simultaneously with the equilibrium real exchange rate as shown in (33). The second observation is that, in the absence of perfect indexation (i.e., as long as $s_3<1$), it is important to distinguish, in assessing the effects of devaluation on the nominal wage, whether a current devaluation was previously anticipated or not. Assuming, as seems likely, that the effect on the <u>real</u> exchange rate of an anticipated devaluation is smaller than that of an unanticipated devaluation, the effect of an anticipated devaluation on the nominal wage will exceed that of an unanticipated one. 1/

However, a third important observation is that in neither case must the nominal wage necessarily increase. This highlights the importance of an integrated treatment of the labor market in assessing the likelihood that devaluation can be contractionary. To clarify this point, we adopt the working assumption that the price of nontraded goods is constant on impact. This simplifies (33) to:

$$(34)\quad W = \frac{\beta+s_1(d_1-d_3)}{1+s_1(d_1+d_2)}\tilde{E} + \frac{s_3\beta+s_1(d_1-d_3)}{1+s_1(d_1+d_2)}(E-\tilde{E})$$

Notice that if $d_3>d_1$, the effects of both an anticipated and an unanticipated devaluation could be negative. To see why this possibility can arise, notice from equation (31) that if $d_3>d_1$, an increase in E will <u>lower</u> the demand for labor, given W and P_n. The reason is that an

1/ To derive this result, express $\tilde{e}$ as a function of $\tilde{E}$ and $(e-\tilde{e})$ as a function of $(E-\tilde{E})$ in equation (33), and assume $d\tilde{e}/d\tilde{E} \leq d(e-\tilde{e})/d(E-\tilde{E})$.

increase in demand in the traded goods sector is offset by reduced demand in the nontraded goods sector. The latter in turn arises from the effect of an increase in the price of imported inputs, which reduces the level of output and therefore the demand for labor in that sector. This effect will be dominant if the share of labor in the nontraded goods sector is large, if that sector is relatively intensive in its use of imported inputs, and if the elasticity of substitution of labor for imported inputs in that sector is small. Notice that, whether d_3 exceeds d_1 or not, the presence of imported inputs in the nontraded goods sector tends to reduce the increase in the nominal wage that would tend to accompany a devaluation. This acts as an offset to the contractionary effect of a devaluation on the supply of nontraded goods that operates through the imported input channel (see the next section).

As a final observation, notice from (33) that if $d_1>d_3$, then as long as a nominal depreciation (whether anticipated or unanticipated) results in a less than proportional real depreciation ($0<de/dE<1$), the increase in the nominal wage will be no greater than the increase in the price of traded goods and no less than the increase in the price of nontraded goods. That is, the product wage will fall in the traded goods sector and rise in the nontraded goods sector. 1/

2. Imported inputs

In the event of a devaluation, the price of imported inputs increases by the same percentage as the exchange rate, driving up the costs of production of domestically produced goods. The magnitude of this increase in costs depends on technological factors and on the extent to which the price of other factors of production respond to the devaluation. In order to illustrate these relationships we will use a specific example.

Assume an economy that produces and consumes traded and nontraded goods. Nontraded goods are produced with imported inputs and "value added" according to a CES production function with elasticity of substitution σ. Value added, in turn, is produced with a fixed amount of specific capital and with labor according to a Cobb-Douglas production function. The share of labor in value added is denoted by γ. Nominal wages are assumed to be determined exogenously, and to increase by a given amount as a result of the devaluation. The return on capital, on the other hand, is endogenous and varies so as to clear the market for that factor.

1/ The change in W can be obtained by differentiating (33) with respect to $\tilde{E}$ or $(E-\tilde{E})$ imposing $d\tilde{e}/dE < 1$ or $d(e-\tilde{e})/d(E-\tilde{E}) < 1$. The change in the price of traded goods is unity, whereas that of nontraded goods can be obtained from the definition of the real exchange rate, which implies in logs that $P_N = E-e$.

In analyzing the effect of a devaluation on the supply of nontraded goods, we investigate the increase in costs, or supply price, for a given level of output. This is the upward shift in the supply curve of those goods. The percentage increase in the supply price is:

$$(35) \quad \hat{P}_n = \theta_m \hat{E} + \theta_w \hat{W} + \theta_k \hat{r}$$

where $\hat{E}$ is the percentage of the nominal devaluation, $\hat{W}$ is the exogenous increase in nominal wages and r is the endogenous increase in the return of capital. Since labor and capital are combined according to a Cobb-Douglas production function:

$$(36) \quad \hat{L} + \hat{W} = \hat{K} + \hat{r}$$

Since $\hat{K} = 0$,

$$(37) \quad \hat{r} = \hat{W} + \hat{L}$$

From cost minimization for a given level of production,

$$(38) \quad \hat{L} = \sigma \theta_m \{\theta_w + \theta_m [\sigma (1-\gamma) + \gamma]\}^{-1} (\hat{E} - \hat{W})$$

Therefore:

$$(39) \quad \hat{r} = \hat{W} + \sigma \theta_m \{\theta_w + \theta_m [\sigma (1-\gamma) + \gamma]\}^{-1} (\hat{E} - \hat{W})$$

Equation (40) is useful for examining the effect of the devaluation and the adjustment of salaries on the return to capital. If salaries increase by the full amount of the devaluation, $\hat{W} = \hat{E}$, $\hat{r}$ also increases by the same amount. The reason is simple. At the initial r there is an incentive to substitute value added for imported inputs, and within value added to substitute capital for labor. However, the amount of capital is constant, and thus r increases. The increase in r continues until the initial (W/r) ratio is restored, so that the initial desired (K/L) ratio is also restored. At the end, $\hat{r} = \hat{W} = \hat{E}$, and the same combination of inputs is used to produce the given level of output. An $\hat{r}$ different from $\hat{W}$ would not be an equilibrium one. For example, assume $\hat{r} < \hat{W}$. Then the desired combination (K/L) would be higher, which together with a fixed K implies a lower L, which in turn implies lower "value added". For a given level of output, this implies a higher level of imported inputs. But this change in the use of factors is inconsistent with the change in factor prices. Since r increased by less than W, the price of value added increased by less than the price of imported inputs, so we should expect a decline instead of an increase in the intensity of use of imported inputs.

If wages do not increase by the full amount of the devaluation, equation (39) indicates that the return on capital increases by more than $\hat{W}$. The reason is that if r increases only by $\hat{W}$, producers will want to use the same (K/L) ratio. Since the level of K is fixed, this implies a constant L. But since the price of value added would decline relative to the price of imported inputs, there would be an excess demand for capital and labor. These excess demands are satisfied by an increase in the use of labor and a further increase in the return to capital.

Using (39) to replace $\hat{r}$ in (35), and remembering that $\gamma\theta_k = (1-\gamma)\theta_w$ because K and L are combined according to a Cobb-Douglas function to produce value added, we obtain:

$$(40) \qquad \hat{P}_n = \hat{E} - \gamma(1-\theta_m)\{\gamma(1-\theta_m) + \theta_m[\sigma(1-\gamma) + \gamma]\}^{-1}(\hat{E} - \hat{W})$$

Therefore, if wages increase by the full amount of the devaluation the supply curve shifts upward by the same percentage as the exchange rate. If wages do not increase by the full amount of the devaluation, the supply curve shifts upward by less than the exchange rate, but by more than the increase in wages, since in this case the return to capital increases more than wages as discussed before. In this case it is also clear from (40) that the increase in the supply price will be larger the larger is the share of imported inputs in total costs, and, for a given share of imported inputs, the larger is the share of capital in value added. The increase in the supply price will also be larger the smaller is the elasticity of substitution between imported inputs and value added.

It must be mentioned that equation (40) assumes that value added is produced by capital and labor according to a Cobb-Douglas production function. Therefore, it is assumed that the elasticity of substitution between labor and capital is equal to one. If instead a CES function were assumed for the production of value added, when $\hat{W} < \hat{E}$ the increase in the supply price would be larger the lower the elasticity of substitution between labor and capital. The reason is that the lower that elasticity, the higher must be the increase in the return to capital that is needed to induce producers to increase the employment of labor necessary to compensate for a lower use of imported inputs.

The use of imported inputs in the production of traded goods does not offer new insights since the price of this type of input moves together with the price of output. Even if we assume the same structure of production as the one assumed above for nontraded goods, the level of output will depend on the ratio of (W/E). If wages increase by less than the full amount of the devaluation, output of traded goods increases (ignoring working capital considerations), and vice-versa.

3. Effects through costs of working capital

A number of authors of the "new structuralist" school--notably Taylor (1981) and van Wijnbergen (1983)--have emphasized that a nominal devaluation could exert contractionary effects on the supply of domestic output by increasing the cost of working capital, i.e., financing costs for labor and imported inputs. To examine how this effect could operate, consider first the nontraded goods sector. The need to finance working capital arises from an asynchronization between payments and receipts--much the same as the motivation for the household's demand for money. Suppose that to finance a real wage bill WL_n/P_n and a real imported input bill eI_n the firm is led to hold real stocks of loans outstanding amounting to $h^L(r,WL_n/P_n)$ and $h^I(r, eI_n)$, respectively. 1/ The firm's profits are given by:

$$(41) \quad \pi = P_n y_n(L_n, I_n) - WL_n - EI_n - rP_n h^L(r,WL_n/P_n) - rP_n h^I(r,eI_n),$$

and the first-order conditions for profit maximization are:

$$(42) \quad \frac{dy_n(L_n,I_n)}{dL_n} = \frac{W}{P_n}\,[1+rh_2^L(r,WL_n/P_n)]$$

$$(43) \quad \frac{dy_n(L_n,I_n)}{dI_n} = e[1+rh_2^I(r,eI_n)]$$

1/ A negative interest rate effect on loan demand is included by analogy with the household transactions demand for money, but is not necessary for what follows. In fact, both loan demand and the cost of holding loans in equation (41) should depend on the expected real interest rate measured in terms of nontraded goods. Since we are treating expected inflation as exogenous, however, the expected inflation component of the real interest rate is suppressed here for notational convenience.

These equations can be solved for labor and imported input demand functions of the form:

$$(44) \quad L_n = L_n^D(\frac{W}{P_n}, e, r); \quad L_{n1}^D < 0, \; L_{n2}^D \gtrless 0, \; L_{n3}^D < 0.$$

$$(45) \quad I_n = I_n^D(\frac{W}{P_n}, e, r); \quad I_{n1}^D \gtrless 0, \; I_{n2}^D < 0, \; I_{n3}^D < 0.$$

Substituting these in the short-run production function for nontraded goods yields the short-run supply function for nontraded goods:

$$(46) \quad y_n = y_n^s(\frac{W}{P_n}, e, r); \quad y_{n1}^s < 0, \; y_{n2}^s < 0, \; y_{n3}^s < 0.$$

Repeating this exercise for the traded goods sector yields a traded-goods supply function in the form:

$$(47) \quad y_t = y_t^s(\frac{W}{E}, r); \quad y_{t1}^s < 0, \; y_{t2}^s < 0.$$

The presence of costs of financing working capital has two important supply consequences that affect the likelihood of contractionary devaluation.

The result most often emphasized by the literature is the "Cavallo effect" (Cavallo (1977))--an increase in loan interest rates adds to the costs of financing working capital and shifts the output supply curve upward. This is captured in the negative sign of the partial derivative of r in equations (46) and (47) above. The magnitude of this effect depends on the properties of the functions h^L and h^I. 1/ There are several important aspects of this effect, as applied to the contractionary devaluation issue that have not received much emphasis in the literature:

1/ For given values of r, $(W/P_n)L$, and eI, the smaller their elasticities with respect to the interest rate, the larger the upward displacement of the output supply curves caused by an increase in r. Also, larger values of h_2^L and h_2^I will magnify these upward supply shifts.

a. The Cavallo effect will appear in conjunction with a previously unanticipated current devaluation only if capital mobility is imperfect. As indicated in Section II.3, if domestic and foreign interest-bearing assets are perfect substitutes, the domestic nominal interest rate will not be affected by a devaluation of this type, and no Cavallo effect will materialize.

b. If domestic interest rates do rise, then the Cavallo effect represents the only channel through which devaluation may exert contractionary effects in the traded goods sector.

c. Finally, this effect represents a second channel, in addition to the effects of interest-rate changes on aggregate demand, through which an anticipated future devaluation could affect current output. In the case where domestic and foreign-interest bearing assets are imperfect substitutes, an anticipated future devaluation would stimulate current production in the traded goods sector by lowering the expected real interest rate measured in terms of traded goods. Whether current output of nontraded goods rises or falls will depend on whether the anticipated devaluation lowers or raises the expected real interest rate in terms of nontraded goods.

The second important consequence of the financing of working capital is the effect of working capital costs on the elasticities of the sectoral short-run supply curves (46) and (47). This effect is captured by the cross-partial derivatives of these supply equations. The presence of working capital costs is likely to reduce short-run supply elasticities in both sectors due to the increase in marginal costs associated with the need to finance additional working capital. In the presence of a real exchange-rate depreciation, this reduction in supply elasticities will be unfavorable with respect to economic expansion in response to devaluation in the traded goods sector, but may be either favorable or unfavorable with respect to activity in the nontraded goods sector, depending on whether demand for such goods contracts or expands in response to devaluation.

IV. Contractionary Devaluation and the Correspondence Principle

Several papers have recently introduced a radically new approach to the contractionary devaluation debate. Calvo (1983), Buffie (1986b), and Larrain and Sachs (1987) have produced models in which, if devaluation has a contractionary effect (defined in various ways to be described below) on impact, then the economy's initial equilibrium is dynamically unstable. This raises the intriguing possibility that Samuelson's (1965) "correspondence principle" can be brought to bear on the contractionary devaluation issue. An important question, however, is the extent to which the results derived by these authors are model-specific. This section will review these three papers with this question in mind, to assess whether appeal to the correspondence principle can shed light on the likelihood that devaluation could have contractionary effects.

Calvo (1983) develops an ingenious technique for analyzing staggered contracts in a continuous-time setting. His dynamic system is:

$$(48) \quad \dot{Q} = \delta(V-Q)$$

$$(49) \quad \dot{V} = \delta(V-Q - \beta f)$$

where Q is the average price of domestic goods, V is the price of domestic goods set in newly-negotiated contracts, and f is the excess demand for domestic goods. δ and β are positive parameters, the former measuring average contract length and the latter indicating the sensitivity of price change to excess demand. Calvo specifies f as:

$$(50) \quad f = f(Q - E, r^{*}-\dot{Q})$$

i.e., as a function of the real exchange rate and the real interest rate, with the latter determined from an uncovered interest parity condition. Substituting (48) in (50) and the result in (49), the dynamic system becomes:

$$(48) \quad \dot{Q} = \delta\ (V-Q)$$

$$(51) \quad \dot{V} = \delta\ \{V-Q - \beta f[Q-E,\ \delta\ (Q-V)]\}$$

where r^{*}, which is constant, is set to zero. For this system to possess a unique converging equilibrium path, Calvo shows that a necessary condition is $f_Q(Q-E, 0) < 0$. Since $f_E = -f_Q$, this implies that $f_E > 0$, i.e., a nominal devaluation must <u>increase</u> excess demand for domestic goods. Thus, devaluation cannot be contractionary in an equilibrium that has sensible economic properties.

An important restriction imposed in Calvo's model is that excess demand for domestic goods depends only on the real, and not the nominal, exchange rate. In Part I, the presence of wealth effects on consumption was shown to imply a role for the nominal exchange rate in the demand for home goods. This can be incorporated in Calvo's model as follows: Let the domestic price level P be given by:

(52) $P = P(E, Q); \quad P_1 > 0, P_2 > 0$

and modify the function f to:

(53) $f = f(Q-E, P(E, Q), \dot{Q}); \; f_1 \gtrless 0, f_2 < 0, f_3 > 0$

$\quad = f(Q-E, P(E, Q), \delta(Q-V))$

Then the saddlepath condition becomes:

(54) $f_1+f_2P_2 < 0,$

while devaluation decreases excess demand for the domestic goods if:

(55) $f_1-f_2P_1 > 0$

A negative sign on f_1 is sufficient to ensure that (54) will hold. However, this does not rule out the contractionary devaluation case (55). Devaluation will be contractionary if wealth effects are large (which induces a large value of f_2), and if traded-goods prices figure prominently in the economy's aggregate price level (which implies a large value of P_1). Thus Calvo's model can readily be adapted to render contractionary devaluation compatible with a unique saddlepath equilibrium.

Larrain and Sachs (1986) propose a natural dynamic extension of the Krugman-Taylor model. For our purposes, the relevant portion of this model can be summarized in the single equation:

(56) $N = N(W, E, X),$

where N denotes output of domestic goods, W is the nominal wage, X is the level of exports, and E continues to represent the nominal exchange rate. In the Krugman-Taylor framework, W and X are exogenous. Moreover, devaluation is contractionary, so $N_2 < 0$. Larrain and Sachs show that the sign of N_1 must be the opposite of N_2, so $N_1 > 0$. Finally, an increase in exports is expansionary, so $N_3 > 0$.

Larrain and Sachs add a simple Phillips curve to this model, of the form:

(57) $\dot{W} = \phi(N, X); \quad \phi_1>0, \ \phi_2>0.$

Increased employment, whether in producing domestic goods or exports, increases the demand for labor and thus causes the nominal wage to rise over time. This system is clearly unstable, since;

$$\text{sgn}\ (d\dot{W}/dW) = \phi_1 \ \text{sgn}\ N_1$$
$$= -\phi_1 \ \text{sgn}\ N_2 \quad > 0,$$

because contractionary devaluation implies $N_2 < 0$. However, the authors then show that this result is model-specific. They add a partial-adjustment mechanism for exports, of the form:

(58) $\dot{X} = \psi\{\theta(E, W)-X\}; \ \psi' > 0, \quad \theta_1 > 0, \quad \theta_2 < 0.$

Exports adjust gradually (at a speed determined by ψ') to the difference between desired exports and actual exports. Desired exports in turn depend positively on the exchange rate and negatively on the nominal wage. Larrain and Sachs show that for sufficiently large values of ψ', and of the partial derivatives of θ, the equilibrium (W^*, X^*) is locally stable. Moreover, since they assume $\psi'' > 0$, even if local stability fails to hold the system will reach a stable cycle, rather than explode. In this case, as in Calvo's framework, a modification of the original model renders contractionary devaluation compatible with sensible dynamic properties.

Buffie's (1986a) paper is directly addressed to the relevance of the correspondence principle to the contractionary devaluation debate. He develops a model in which a domestic good is produced using labor, an imported input, and a fixed factor. There are no imported consumer goods and exports of the domestic good depend only on its relative price. Capital flows are absent, and the trade balance is derived from a hoarding function in which the real value of hoarding depends on the difference between real money demand (proportional to real domestic value added) and the real money supply. The real wage measured in terms of domestic goods is predetermined and adjusts gradually over time in accordance with a Philips curve mechanism. The model's dynamics involve adjustment of the real wage and the money supply. Buffie derives the comparative-static properties of his model and finds that in general the effect of a nominal devaluation on the level of employment is ambigous. He then derives the condition for local stability in his model and inquires whether that condition imposes any restrictions on the comparative-static effect of devaluation on employment. He finds that for general technologies it does not. However, for the special cases in which either the technology is separable in imported inputs and domestic value added, or labor and imported inputs are gross substitutes, the stability condition does make it possible to rule out a contractionary effect of output on employment.

In summary, as Calvo (1983) points out, there is no compelling reason why unstable equilibria should be ruled out a priori. Nonetheless, the "correspondence principle" has gained wide acceptance and it is therefore of interest to examine whether ambiguities with regard to the effects of devaluation on real economic activity can be resolved with the aid of the additional restrictions that the presumption of stability provides. The three papers reviewed in this section demonstrate that it is possible to specify models that have the property that the correspondence principle can be used to rule out contractionary devaluation. More importantly, however, these papers also demonstrate that it is also possible to develop stable models in which devaluation is contractionary. Our conclusion is that the relevance of the correspondence principle is inescapably model-specific. A presumption of stability does not in general rule out the possibility that devaluation could be contractionary on impact.

VI. Conclusions

A nominal devaluation is a useful tool of macroeconomic policy when the underlying macroeconomic "fundamentals" are compatible with a fixed exchange rate, but the authorities' stock of foreign exchange reserves is inadequate to defend that rate. In such circumstances, a nominal devaluation can alter the composition of the central bank's liabilities in such a way as to permit the authorities to successfully defend the new exchange parity. However, nominal rigidities imply that the act of devaluation will place the economy on a new transition path toward long-run equilibrium, and the properties of this new path--specifically, the behavior of domestic real output along it--have been the subject of controversy for some time, particularly in the developing-country context where official exchange parities remain the rule even in the post-Bretton Woods era.

The most important conclusion to emerge from our analytical overview of this controversy is that the question has not yet been addressed within the proper analytical framework. In principle, what is of interest is a comparison of the path of some measure of domestic real economic activity--real output, real income, or employment--in the absence of devaluation, with the corresponding path implied by a given nominal devaluation. This requires the (necessarily numerical) solution of a fully-specified dynamic model incorporating the several channels which have been examined here. The literature has not yet produced such a model, and it remains an important topic for future research.

Our purpose here has been to lay out the necessary ingredients of a model of this type by using a unified macroeconomic framework suitable for a small, open developing economy to examine critically the various channels through which a nominal devaluation may affect domestic economic activity. In the absence of a dynamic model, we have been compelled to follow most of the literature in focusing on impact effects. Our findings can be summarized by looking at supply and demand in the traded and nontraded sectors, respectively. We have found it important in many instances to distinguish between the effects of an anticipated future devaluation and those of a current devaluation, and in the latter case between a devaluation which was previously anticipated and one which was not. We focus on a previously unanticipated current devaluation in the brief summary that follows.

The effect of devaluation on demand for traded goods is clear-cut and well known. As long as the law of one price holds and the country in question is small, the demand curve faced by its traded goods sector is perfectly elastic, and will shift up in proportion to the nominal devaluation.

Given the production technology and the stock of capital in the traded-goods sector, the domestic supply of traded goods depends on the nominal wage, the price of imported inputs, and the real interest rate measured in terms of traded goods, which affects the cost of working capital. Of these, the behavior of the nominal wage is likely to prove most important, given the substantial share of labor in production costs. The response of the nominal wage to devaluation will in general depend on the properties of labor contracts in the economy--most importantly on the degree and nature of indexation--as well as on the parameters of labor demand, especially the sectoral allocation of the labor force and the degree of substitutability between labor and imported inputs. In general, it seems reasonable to expect an increase in the nominal wage which is less than in proportion to the amount of devaluation. By contrast, the price of imported inputs will rise exactly in proportion to the devaluation. Finally, ignoring changes in external inflation and assuming that no further devaluation is expected, the behavior of the real interest rate in terms of traded goods will depend on that of the nominal interest rate. This will in turn be heavily influenced by the substitutability between domestic and foreign interest-bearing assets, and in the event of imperfect substitutability, by various properties of asset demand functions. Although an adverse effect on traded-goods supply of higher working capital costs cannot be ruled out, the many ways in which this effect may be mitigated leads us to be skeptical of the possibility that it could result in a contraction of traded-goods output. If the nominal wage rises less than in proportion to the devaluation and effects on working capital costs can be treated as being of a second order of magnitude, therefore, the vertical shift of the demand curve for traded goods is likely to exceed that of the supply curve, and traded goods output can be expected to expand.

Matters are much less favorable in the case of the nontraded goods sector. The supply-side effects of a devaluation are, as in the case of traded goods, unambiguously negative--the price of imported inputs will rise by the full amount of the devaluation, while the nominal wage and the nominal interest rate, as indicated above, are also likely to increase. 1/ An expansion of nontraded goods output is to be expected only in the event of a sufficiently strong increase in demand as to offset the adverse supply shift.

Much of the literature on contractionary devaluation has in fact been devoted to examining the effect on demand for nontraded (or domestic) goods, and specifically on consumption demand for such goods. While the pure substitution effect on consumption is of course favorable, all other factors that affect consumption may--though they need not--work in the opposite direction. The real income effect, for example, is likely to be negative if devaluation occurs under an initial trade balance deficit and demand for imported inputs is relatively inelastic. Depending on the strength of the Olivera-Tanzi effect, real tax payments may well rise, particularly if the public sector is a significant external debtor and relies on taxes to finance increased debt-service payments. Wealth effects on consumption could also be negative, unless the private sector holds substantial assets denominated in foreign currency. The importance of changes in investment demand depends on the extent to which capital accumulation employs nontraded goods. In any event, while a favorable effect on investment in the traded goods sector is likely, this will be at least partially offset by a negative effect on investment in the nontraded goods sector.

1/ A possible mitigating factor could arise from the behavior of the real interest rate measured in terms of nontraded goods. If the real exchange rate overshoots its equilibrium value after a nominal devaluation, inflation will ensue in the nontraded goods sector. Since such an outcome will be anticipated, this will lower the real interest rate measured in nontraded goods and thereby mitigate other adverse supply influences. Our assumption of exogenous inflationary expectations precluded consideration of such effects. Effects of this sort underline the importance of making use of full dynamic models.

Both consumption and investment demand are dependent on the inter-temporal terms of trade--i.e., on the real interest rate--and it is here that the limitations of our analysis are most severely felt. We have examined the possible effects of a devaluation on the nominal interest rate and, as mentioned previously, emphasized the roles of capital mobility and of certain properties of asset demand functions. However, under perfect foresight, effects on expected inflation depend on the extent of which the real exchange rate overshoots its long-run equilibrium level as the result of a nominal devaluation and on the precise path that the economy follows to reach that equilibrium. Since the empirical evidence suggests some short-run overshooting and therefore some nontraded goods inflation following a nominal devaluation, this channel cannot safely be ignored, and our assumption of exogenous inflationary expectations must be seen as provisional.

We find, then, that the effects of a devaluation on the demand for nontraded goods is quite complex--significantly more so, in fact, than has heretofore been recognized in the literature. In principle, therefore, we cannot unambigously determine whether a devaluation will generate sufficiently favorable effects on the demand for nontraded goods as to overcome its clearly adverse supply-side effects.

Finally, as we have shown (Section IV), the ambiguous net effects of these various channels cannot in general be resolved with the use of restrictions that arise out of stability considerations. In the present state of our knowledge, therefore, there can be no presumption as to the nature of the impact effect of a previously unanticipated devaluation on domestic macroeconomic activity in developing countries.

Relative Price and Real Income Effects in Keynesian Models

The purpose of this Appendix is two-fold: First, to derive the relative price and real income effects of a devaluation on the demand for domestic output in Keynesian models, which emphasize changes in the terms of trade, and show that they depend on the same parameters as those derived in the text for dependent economy models, which emphasize changes in the real exchange rate. Second, to clarify the relationship between two different ways of presenting the structure of the demand for domestic output in Keynesian models.

Discussions about the effects of devaluations are sometimes carried out under the assumption that each country specializes in the production of one good, which is consumed domestically and exported. The country also consumes another good that is imported from the rest of the world. Since it is also assumed that the domestic currency price of the exportable good is either constant or does not increase by the full percentage of the devaluation while the price of the importable is fixed in terms of foreign currency, a devaluation in this framework is equivalent to a deterioration in the terms of trade.

The total effect of a devaluation on the demand for the domestic good can be decomposed into a relative price effect and an income effect. Since the relative price of the domestic good declines with a devaluation, the demand for the domestic good increases on account of the relative price effect when real income, appropriately defined, is held constant.

The total demand for domestic output can be represented by an equation such as (59).

(59) $D(y, \varepsilon) + X(\varepsilon); D_1>0, D_2>0, X'>0$

Where D is the domestic demand for the domestic good, X is the foreign demand for the domestic good, y is real income, and ε represents the terms of trade, defined as the price of the foreign good in terms of the domestic good. 1/ The relative price effect is the sum of the partial derivatives of $\bar{D}$ and X with respect to ε, both of which are positive,

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1/ The foreign demand for our good X also depends on real income of the rest of the world. However, since the results in the paper are derived for a small economy, real income of the rest of the world is an exogenous variable, that we assume constant and do not include explicity in function X.

and can be written as:

$$(60) \quad \varepsilon^{-1} (\eta_d D + \eta_x X) > 0$$

where $\eta_d = D_2 (\varepsilon/D) > 0$ is the pure price elasticity of the domestic demand for domestic output, and $\eta_x = X'(\varepsilon/X) > 0$ is the price elasticity of the foreign demand for our exports. As was the case with the dependent economy model, the relative price effect of a devaluation increases the demand for domestic output.

In the context of the keynesian model presented in this Appendix, the real income effect refers to the change in the domestic demand D resulting from the change in real income y caused by a devaluation while holding domestic output constant. Denoting the level of output by Y, the domestic currency price of domestic output by Q, the domestic price level by P, and remembering that the domestic price of imports is equal to the exchange rate E, we have:

$$(61) \quad P = E^{\beta} Q^{1-\beta}$$

$$(62) \quad y = (YQ/P) = Y\varepsilon^{-\beta}$$

where β is the share of imported goods in the price level, and $\varepsilon = (E/Q)$ represents the terms of trade. From (59) and (62), the real income effect of a devaluation that worsens the terms of trade is equal to:

$$(63) \quad D_1 (\delta y/\delta \varepsilon) = - \beta \, d \, Y \, \varepsilon^{-1} < 0.$$

where $d = D_1 \varepsilon^{-\beta}$ is the change in the demand for domestic output (expressed in terms of real income) due to an increase of one unit in real income. Equation (63) was derived for a given level of domestic output.

Thus, there is a negative real income effect on the demand for domestic output resulting from a devaluation. The reason is very simple. A devaluation causes a deterioration in the terms of trade and therefore reduces the real value of a given level of domestic output in proportion to the share of imports in the price level, β. As a result, the demand for domestic output declines by a proportion d of the decline in real income.

In terms of the results derived in the text for dependent economy models, this is equivalent to setting $\alpha = 0$ (because the country is specialized in the production of the domestic good) in equation (6), which then necessarily implies a negative real income effect.

It will be useful to relate these results for keynesian models to previous results in the literature that were obtained using the same type of model, but using a different structure for the domestic demand for domestic output. In the alternative presentation, the domestic demand for domestic output is obtained as the difference between total domestic expenditure and domestic expenditure on imports. In addition, it is generally assumed that total domestic expenditure measured in terms of domestic goods depend only on domestic output. Therefore, total demand for domestic output is expressed as:

$$(64)\quad A(Y) + X(\varepsilon) - \varepsilon M(Y,\varepsilon)$$

where A is total domestic expenditure measured in terms of domestic output, and M is the volume of imports. In this model, the effect of a devaluation on the demand for domestic output is equal to

$$(65)\quad \varepsilon^{-1}(\eta_x X + \eta_m^* \varepsilon M - \varepsilon M)$$

where $\eta_m^* = -(\delta M/\delta\varepsilon)(\varepsilon/M) > 0$ is the price elasticity of the demand for imports holding aomestic output constant.

If we further assume that the trade balance is in equilibrium at the time of the devaluation ($X=\varepsilon M$), we obtain as the condition for a devaluation to increase the demand for domestic output, the well known Marshall-Lerner condition:

$$(66)\quad \eta_x + \eta_m^* - 1 > 0$$

A devaluation, by reducing the relative price of the domestic good, increases the foreign demand for the domestic good (η_x), but has an ambiguous effect on the domestic demand for the domestic good (η_m^*-1). Since the economy imports a lower quantity but pays a higher price in terms of domestic goods, the amount left to spend on domestic goods out of a given total expenditure A may be reduced by the devaluation. The net effect of these forces is summarized in equation (68).

If the trade balance is not in equilibrium at the time of the devaluation, the condition for an increase in the demand for domestic output becomes

$$(67) \quad (X/\varepsilon M)\ \eta_x + \eta_m^* - 1 > 0.$$

Equation (67) shows that an initial deficit ($X < \varepsilon M$) makes it more likely that a devaluation will reduce the demand for domestic output, since the sum of the import demand elasticities must be higher than one.

These results were challenged by Harberger, and Laursen and Metzler. These authors argued that a deterioration in the terms of trade would cause total domestic expenditure measured in terms of domestic output to increase, instead of remaining constant as was previously held. In other words, they said that total expenditure measured in terms of domestic output (A) was a positive function of ε, in addition to Y. With $A(Y, \varepsilon)$, the effect of a devaluation on the demand for domestic output (for a given level of output) becomes

$$(68) \quad A_2 + \varepsilon^{-1}(\eta_x X + \eta_m^* \varepsilon M - \varepsilon M)$$

Equation (68) shows that once the Harberger-Laursen-Metzler effect is taken into account, a devaluation is more likely to increase the demand for domestic output than was previously assumed, since $A_2>0$. For example, starting from a situation of trade balance equilibrium and assuming that the sum of the import and export elasticities is exactly equal to one, a devaluation would increase the demand for domestic output instead of leaving it unchanged.

All these results obtained with the usual presentation of the domestic demand for domestic output as in (64), can be replicated within the framework presented in (59). From equations (60) and (63), the total impact effect of a devaluation on the demand for domestic output combining income and substitution effects is equal to

$$(69) \quad \varepsilon^{-1}(\eta_d D + \eta_x X - \beta\ d\ Y)$$

Thus, the net effect of a devaluation on the demand for the domestic good depends on a positive relative price effect and a negative real income effect. In order to see how this fits with the results based on equation (64) , it is necessary to establish the following relationships:

(70) $\eta_d D - \beta D - \varepsilon M \eta_m + (1-\beta) \varepsilon M = 0$

(71) $\eta_m^* = \eta_m + \beta m Y M^{-1} \varepsilon^{-1}$

where $m = (\delta M/\delta y) \varepsilon^{1-\beta}$ is the change in the demand for imports (expressed in terms of real income) caused by an increase of one unit in real income, $\eta_m = (-\delta M/\delta\varepsilon)(\varepsilon/M) > 0$ is the pure price elasticity of the demand for imports (holding real income constant) and $\eta_m^* > 0$ is the price elasticity of the demand for imports holding domestic output constant. Equation (70) can be obtained by assuming that total real domestic expenditure $(\varepsilon^{-\beta}D + \varepsilon^{1-\beta}M)$ depends only on real income, and then differentiating this expression with respect to ε holding real income constant. Equation (71) is obtained by differentiating imports M with respect to ε holding domestic output constant. It is clear that η_m^* is composed of a substitution effect η_m and an income effect. The income effect is positive for normal goods since the import elasticities are defined for a decline in ε, which increases real income.

Using (71) to replace η_m in (70), and then using the resulting expression to replace $\eta_d D$ in (69), the total impact effect of a devaluation on the demand for domestic output can be expressed as

(72) $\varepsilon^{-1}\{\eta_x X + \eta_m^* \varepsilon M - \varepsilon M + \beta [D + \varepsilon M - (m + d)Y]\}$

Discussions on this subject based on equation (64) were carried out under the assumption that the relevant price level was the price of domestic output, therefore assuming implicitly that $\beta=0$. Under that assumption equation (72) can be written as:

(73) $\varepsilon^{-1}\{\eta_x X + \eta_m^* \varepsilon M - \varepsilon M\}$

which is exactly equation (65). Assuming in addition initially balanced trade results in equation (66). Finally, the Harberger-Laursen-Metzler effect means that β is different from zero, and that total domestic expenditure measured in terms of domestic goods ($D+\varepsilon M$) increases with a deterioration in the terms of trade, which implies

(74) $\varepsilon^{-1}(\eta_d D - \beta dY) + M - \beta m \varepsilon^{-1} Y - \eta_m M > 0$

Equation (74), together with (70), imply

$$(75) \quad D + \varepsilon M - (m + d) Y > 0$$

Looking at equations (72) and (75), it is clear now that the Harberger-Laursen-Metzler effect has an expansionary effect on the demand for the domestic good. As was the case within the other framework, starting from balanced trade and assuming that the sum of the import and export demand elasticities is equal to one, a devaluation will increase the demand for the domestic good.

In summary, all the results that are obtained by considering the demand for domestic output as the difference between total expenditure and expenditure on imports can be replicated and reinterpreted by directly postulating a demand for domestic output that depends on real income and relative prices. The latter procedure has the advantage of showing explicitly the usual price and income effects, which makes it easier to see the relationship between these results and those derived from other types of models. In particular, it makes clear that the results obtained for the dependent economy model in the text of the paper are general enough so as to apply also to keynesian models once the value of some parameters are set to their appropriate levels.

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