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THE DESIRABILITY OF A DOLLAR APPRECIATION, GIVEN A CONTRACTIONARY U.S. MONETARY POLICY

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ABSTRACT

Undesirable real effects have been attributed to floating exchange rates in general, and the 1980-83 appreciation of the dollar in particular. In the appreciating country, the U.S., export industries lose competitiveness and so output falls. In the other country, say Europe, the exchange rate change worsens inflation.

This paper starts from the premise that these undesirable side effects are attributable, not to the exchange rate, but rather to the decision in the U.S. to switch to a more contractionary monetary policy in order to fight inflation. <u>Given the U.S. contraction, it might be desirable for the dollar to appreciate in the sense that it allows each country to attain the best possible tradeoff between aggregate output and inflation.</u> This conclusion follows from the assumption that in each of two sectors, nontraded goods or exportables, the relationship between output and inflation is concave. A U.S. contraction will then give the maximum reduction in inflation per lost output only if it is shared equally by both sectors. This means allowing the currency to appreciate; under a fixed exchange rate the burden of contraction would be borne disproportionately by the nontraded goods sector. The exchange rate change is also good for Europe. Given the U.S. contraction, the European export sectors would suffer a disproportionate loss in output if European currencies were not allowed to depreciate against the dollar.

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The great rise in the value of the dollar against virtually all foreign currencies during 1980-82 has brought forth protests from all sides. In the United States, firms that produce for export or that compete with imports have lost competitiveness. Output in these industries has declined in consequence. In Europe,[1] prices of traded goods have gone up. The Europeans' struggle against inflation has been endangered, and they have thus felt obliged to contract their economies. All this--an exacerbated recession at home and alienated allies abroad--due to an exchange rate that appears to be far out of equilibrium.

Exchange rates have seen similar fluctuations since 1973. But for the first time, more than a few American economists are joining those in the media, business and government, who seriously question the floating rate system. Rudiger Dornbusch (1982, p. 4) believes that "exchange rates in the 1970s have not worked well." C. Fred Bergsten (1982, p. 1) argues that "massive currency misalignments are distorting international trade and capital movements. The dollar is overvalued by at least 20 per cent, on average.... These imbalances...add significantly to national growth problems, both in countries with overvalued currencies (which suffer competitive losses) and countries with undervalued currencies (which are driven to adopt restrictive monetary policies)." There are really two steps to the argument, first that the exchange rate swings are not due to economic fundamentals, and second that they have harmful real effects. While almost no one is seriously urging an early return to fixed exchange rates, the new skepticism toward floating entails a renewed interest in foreign exchange intervention and capital controls.

The first point to make is that we have a good idea why the dollar has been so strong over the last three years. By the end of 1979, public concern with high levels of U.S. inflation had reached a near-panic state. One might say that the political consensus had swung in favor of a willingness to suffer a recession in order to bring down inflation. In any case, the Federal Reserve Board under Chairman Paul Volcker began a strict program of monetary restraint: slow money growth and consequent high real interest rates. With the support of the administration elected a year later, the Fed stuck to that program for three years.

All our models tell us that a monetary contraction causes an appreciation of the currency, whether it is the Mundell-Fleming model with imperfect capital mobility, the Dornbusch and Frenkel monetary models, or the Branson-Henderson-Kouri portfolio-balance model. It is true that the existing theoretical models of exchange rate determination have some conflicting properties. It is further true that recent attempts to see which models fit the data best on a monthly basis have reached the disturbing conclusion that none of them any longer fits the data well at all.[2] But this just says that we are going to have to be exceptionally clever with our econometrics if we want to avoid such problems as structural shifts andendogeneity of other variables. Our econometric difficulties are no reason to give up our theoretical knowledge, certainly not when the gross empirical facts--the 1980-82 data point--are in accordance.

The complaint that the appreciation of the dollar has been harmful is not as easily disposed of. Dornbusch (1982, p. 31) states the claim in extreme form: "There is <u>no</u> sensible argument that tightening of money should involve as a desirable side effect a loss of exports, an increase in imports ....Because these side effects are undesirable, both here and abroad, we should attempt to the maximum possible extent to immunize the world economy against these spillovers." But it is the position of this paper that the appreciation of the dollar is the natural concomitant of the U.S. monetary contraction, not just in the sense that appreciation is what we would expect from the contraction, but in the sense that it is actually desirable, in that welfare in the United States and in Europe is greater than it would be under fixed exchange rates, given the contraction.

It used to be said that flexible exchange rates allowed each country to pursue its own internal economic policy goals regardless of the policies of its trading partners. Early Keynesian models with no capital mobility gave the result that a floating exchange rate guaranteed complete insulation by shutting off the trade balance. A domestic contraction, for example, would cause the currency to appreciate, "bottling in" the loss of domestic output and preventing any loss in foreign output. The claim of complete insulation has long since been abandoned. Robert Mundell showed that when capital is internationally mobile, economic disturbances are transmitted internationally, because floating rates, though they guarantee a zero balance of payments, do not guarantee a zero trade balance. When a domestic monetary contraction appreciates the domestic currency, the foreign country experiences an expansion of output in response to its improved competitiveness.[3]

While the literature on transmission has been extended in a variety of directions, the analysis of the welfare effects of fixed vs. floating rates continues to have some conspicuous holes. Everyone rediscovers Mundell's finding that under floating rates a policy change in the United States is transmitted to Europe, with the implication that if Europe was previously where they wanted to be in terms of the output-inflation tradeoff, they are now worse off. The world is proclaimed to be a complex interdependent system, governments are urged to coordinate policies and avoid large exchange rate swings, while skepticism is expressed as to the likelihood that the governments will do so, as if they are members of a weak cartel who are fated to succumb to the temptation of pursuing their short-term individual self-interest to the collective detriment.

The first hole to be plugged is the simple point that just because a U.S. disturbance would have an impact on Europe if it kept its policy variables unchanged, it does not follow that Europe is worse off. The Europeans can change their policy variables in response. Indeed, the Europeans have chosen to meet the U.S. contraction with a contraction of their own to mitigate the large depreciation of their own currencies. This is sufficient to explain why Europe has not experienced the expansion of the Mundell-Fleming model. The inhibition of domestic demand for European goods caused by heightened real interest rates has offset the stimulus to foreign demand caused by their improved competitiveness.[4] For the Europeans to have been made worse off by the U.S. policy change, it would be necessary to argue that the terms of their output-inflation tradeoff worsened.

But none of this answers the question whether, given a shift in U.S. policy priorities, Europe and the United States are worse off or better off with the change in the exchange rate than they would have been without it. As regards U.S. welfare, this paper will argue that given the decision to contract to fight inflation, we are better off if the currency appreciates so that the loss in demand is felt by the export or tradable sector as well as by the domestic or nontradable sector. While one might make an argument for equal sharing of the pain on equity grounds, the argument made here is on the grounds of obtaining the best possible terms for the tradeoff between aggregate output and aggregate inflation. As regards European welfare, the paper will argue that, given the U.S. contraction, they too are better off with a dollar/European exchange rate that is at least somewhat lower. Under a fixed exchange rate, the Europeans would experience a loss in export demand. If they do not change their own demand policy, any gain in competitiveness will mitigate the involuntary movement down the Phillips curve (to lower output) that they would otherwise experience. If they do adjust their demand policy in response to the U.S. contraction, a lower exchange rate will still improve their output-inflation tradeoff by improving the balance between their export and nontraded goods sectors.

We assume that prices are sticky in the currency of the country producing the good in question, and adjust only gradually over time to conditions of excess supply or demand. <u>The key assumption in deriving our results is that the inflation/output tradeoff within each of the two sectors, domestic goods and exportables, is concave upward.</u> Empirical support for the concavity of the curve lies in the familiar observation that at high levels of unemployment and excess capacity, changes in output come more easily than changes in inflation, whereas the reverse is true closer to full employment and peak capacity utilization.[5] Theoretical support for concavity lies in the rationale that the aggregate supply curve gets its slope from neoclassical firm optimization subject to prices that are flexible, but subject to unskilled wages (or costs of whatever other few factors of production are variable in the short run) that lag behind. For example, if (1) output is given by a Cobb-Douglas production function, with $\gamma < 1/2$ the elasticity with respect to the variable factor, unskilled labor, (2) the firm produces where the marginal product of labor is equal to the real wage, and (3) the nominal wage is proportionate to last period's price level, then one plus the inflation rate will be proportional to output to the power of $(1/\gamma - 1)$.

We will demonstrate six propositions.

(1) TO OBTAIN THE MOST FAVORABLE TRADEOFF BETWEEN AGGREGATE INFLATION AND AGGREGATE OUTPUT, A COUNTRY SHOULD EXPAND EQUALLY OR CONTRACT EQUALLY IN BOTH SECTORS.

The intuition here is that, with concave supply curves, if the contraction were more severe in the domestic sector than in the export sector, the marginal reduction in inflation gained for a given further loss in output would be greater in the latter sector than the former. Our two supply curves are:

$$1 + \pi_N = (Y_N/\overline{Y}_N)^{\delta}$$
$$1 + \pi_X = (Y_X/\overline{Y}_X)^{\delta} \qquad (1)$$

where we have defined

Y_N $\equiv$ output in the nontradable sector

$\overline{Y}_N$ $\equiv$ potential output (the non-inflationary level) in that sector

π_N $\equiv$ the inflation rate in that sector

Y_X $\equiv$ output in the export sector

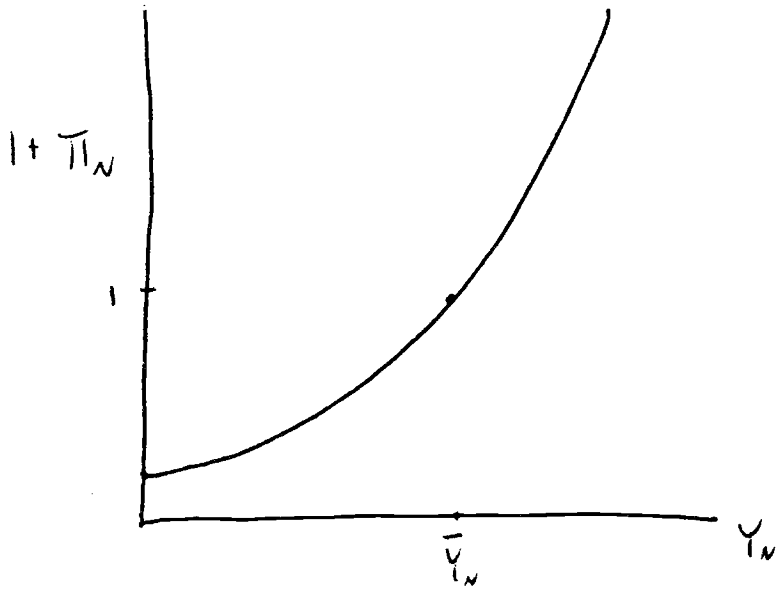
$\overline{Y}_X$ $\equiv$ potential (non-inflationary) output in that sector

π_X $\equiv$ the inflation rate in that sector

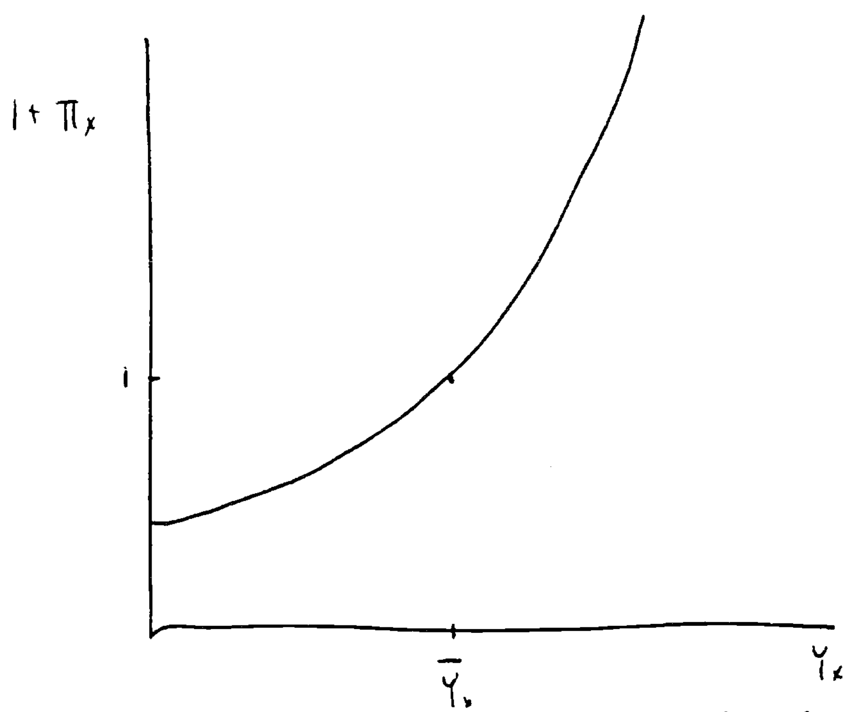
δ $\equiv$ the elasticity of the price level with respect to output, assumed greater than one (this is the concavity assumption), and for simplicity assumed equal in all sectors. In terms of the output elasticity with respect to unskilled wages, we can think of δ as $(1/\gamma - 1)$.

The two supply curves are illustrated in figure 1.

We will focus on the inflation rate π measured by a producer price index, the weighted average of the inflation rates in the two industries:



Output-inflation tradeoff for nontraded goods



Output-inflation tradeoff for traded goods

Figure 1

$$\pi = \alpha\pi_N + (1 - \alpha)\pi_X$$

$$1 + \pi = \alpha(Y_N/\overline{Y}_N)^{\delta} + (1 - \alpha)(Y_X/\overline{Y}_X)^{\delta} \tag{2}$$

The weights are given by $\alpha = \overline{Y}_N/\overline{Y}$ and $1 - \alpha = \overline{Y}_X/\overline{Y}$, where $\overline{Y}$ is aggregate potential output.

Note that if we used a consumer price index that included the price of imported goods, instead of the producer price index,[6] we would find that the price level, as opposed to the inflation rate, would fall instantaneously when the exchange rate falls. Buiter and Miller have shown that any gains against inflation of this nature must be given back later when the real exchange rate returns to its long-run level. We would thus be in the difficult position of having to compare the welfare effects of an unambiguous fall in the rate of price change versus a path that features an initial fall in the price level followed by an increased rate of change. It is easier to leave import prices out altogether.

Let "a" be the share of output that is allocated to nontraded goods.

$$1 + \pi = \alpha(aY/\alpha\overline{Y})^{\delta} + (1 - \alpha)((1 - a)Y/(1 - \alpha)\overline{Y})^{\delta}$$

To find the value of "a" that minimizes π for a given level of Y, we differentiate:

$$\frac{d\pi}{da} = \alpha\delta(aY/\alpha\overline{Y})^{\delta-1}Y/\alpha\overline{Y} - (1 - \alpha)^{\delta}[(1 - a)Y/(1 - \alpha)\overline{Y}]^{\delta-1}Y/(1 - \alpha)\overline{Y} = 0$$

$$(a/\alpha)^{\delta-1} = [(1 - a)/(1 - \alpha)]^{\delta-1}$$

$$a = \alpha$$

Thus the country should allocate output in the same proportions between the two sectors as at full employment. If the government is going to "put the screws" to the construction industry, it should do the same to autos and steel.

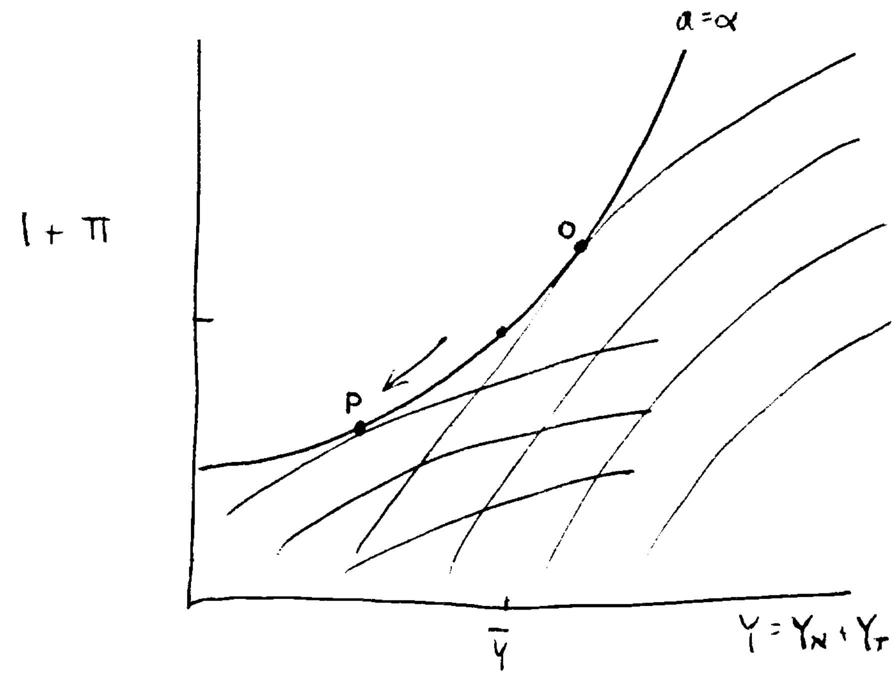


Figure 2

The optimal output-inflation tradeoff with a shift in preferences

A consequence is that the optimal aggregate tradeoff is of the same shape as the individual tradeoffs in the two sectors:

$$
\begin{aligned}
1 + \pi &= \alpha(Y/\overline{Y})^{\delta} + (1 - \alpha)(Y/\overline{Y})^{\delta} \\
&= (Y/\overline{Y})^{\delta}
\end{aligned}
\tag{3}
$$

It is illustrated in figure 2. We draw in upward-sloping societal indifference curves to illustrate the preferences between inflation and output. A shift in priority from fighting unemployment to fighting inflation is shown as a decrease in the slopes of the indifference curves. The tangency moves down the curve to lower levels of inflation and output.

(2) TO CONTRACT EQUALLY IN THE TWO SECTORS, A REDUCTION IN THE LEVEL OF EXPENDITURE MUST BE ACCOMPANIED BY AN APPRECIATION OF THE CURRENCY IN ORDER TO SWITCH EXPENDITURE AWAY FROM EXPORTABLE GOODS.

If there were no change in the exchange rate or other expenditure-switching policies, a contraction of expenditure would be concentrated relatively more in the output of non-traded goods, though it would also have some effect on the output of exportables assuming they enter domestic consumption. Export sales would to a large extent be buoyed by foreign expenditure. If output is to fall equiproportionately in the two sectors some policy like a revaluation of the currency is necessary to switch expenditure away from exportables toward non-traded goods. In the case of foreign expenditure, this means a shift in demand away from the export of the domestic country toward its own goods. In the case of domestic expenditure it means a shift in demand towards its import good, away from its own exportable (and a similar shift away from its non-traded goods, which is assumed to be dominated by the other effects).

We wish to keep output in the two sectors in the same proportions, as we found in equation (3):

$$\frac{Y_X}{Y_N} = \frac{1 - \alpha}{\alpha} \quad . \tag{4}$$

We define

$A \equiv$ domestic expenditure, determined by policy

$A^* \equiv$ foreign expenditure, determined by policy

$x \equiv$ the share of domestic expenditure falling on the exportable good

$x^* \equiv$ the share of foreign expenditure falling on the domestic exportable

$n \equiv$ the share of domestic expenditure falling on the nontraded good, and

$E \equiv$ the exchange rate defined as units of domestic currency per unit of foreign currency.

x , x^* and n are all increasing functions of the exchange rate. In the case of x and n , if the exchange rate increases, i.e. the domestic currency depreciates, domestic consumers substitute away from the importable good, since its price goes up in terms of domestic currency. In the case of x^* , foreign consumers substitute away from the domestic importable as well as from their own nontraded good, since the price of the domestic exportable falls in terms of foreign currency.

Output in the two sectors is determined by demand:

$$Y_X = x(E)A + x^*(E)A^* \qquad Y_N = n(E)A \ . \tag{5}$$

So our condition (4) is

$$\frac{x(E)A + x^*(E)A^*}{n(E)A} = \frac{1 - \alpha}{\alpha} \tag{6}$$

We wish to demonstrate the relationship between E and A :

$$\frac{dA}{dE} = - \frac{\partial\left(\frac{1-\alpha}{\alpha}\right)/\partial E}{\partial\left(\frac{1-\alpha}{\alpha}\right)/\partial A}$$

$$= \frac{(x'A + x^{*\prime}A^*)/nA - (xA + x^*A^*)n'/n^2A}{-x^*A^*/nA^2} ,$$

where x' , $x^{*\prime}$ and n' are the positive derivatives with respect to E . This expression will be positive if

$$(x'A + x^{*\prime}A^*) - (xA + x^*A^*)\ n'/n > 0 \quad . \tag{7}$$

Intuitively the question is whether an increase in E raises the numerator of (6) more than the denominator; we already know that an increase in A does the reverse.

Using (6) in (7), the question is whether

$$x'A + x^{*\prime}A^* > \frac{1-\alpha}{\alpha}\, n'A \quad . \tag{8}$$

Define the elasticity of domestic demand for nontraded goods $\varepsilon_n \equiv n'A/Y_N$, the elasticity of domestic demand for exportables $\varepsilon_X \equiv x'A/wY_X$, and the elasticity of foreign demand for exportables $\varepsilon_X^* \equiv x^{*\prime}A^*/(1-w)Y_X$, where w is whatever share of Y_X happens to be sold to domestic consumers. Then our condition is

$$\varepsilon_X wY_X + \varepsilon_X^*(1-w)Y_X > \frac{1-\alpha}{\alpha}\varepsilon_n Y_N \quad .$$

Using (4),

$$\varepsilon_X w + \varepsilon_X^*(1-w) > \varepsilon_n \quad . \tag{9}$$

Thus the question comes down simply to whether a weighted average of the domestic and foreign elasticities of demand for the exportable exceeds the elasticity of demand for nontraded goods.

We cannot prove that (9) holds, but it seems likely. It says that exportables are closer substitutes for the importable good whose price has changed than are nontraded goods. It is often observed that countries tend to trade similar products. A common model, sometimes called the dependent economy model, even assumes that exportables and importables are perfect substitutes. We shall simply assume condition (9). The reader may find the proposition that a devaluation shifts relative expenditure into exportable goods, and that a revaluation shifts relative expenditure out of exportable goods, sufficiently obvious that Proposition (2) can be taken directly.

As long as (9) holds, there will exist some size decline in the exchange rate that will allocate a decline in U.S. expenditure in the desired equal proportions between the two sectors. Of course there is no guarantee that the size of the decline in the dollar/European exchange rate that actually takes place will be of the correct magnitude. It depends obviously on what kind of exchange rate model is assumed and what parameter values. But it also depends on what is done with other policy variables besides expenditure A . First, we must allow for the foreign country responding by changing its level of expenditure A^* . Second, we must recognize that either government can and does affect the exchange rate. In a portfolio-balance model, the central banks can intervene on the foreign exchange market to affect the exchange rate without changing the money supply. In a monetary model, à la Mundell-Fleming, Dornbusch (1976) or Buiter-Miller, the government can affect the exchange rate by varying the monetary/fiscal policy mix, even if effective sterilized foreign exchange intervention is precluded by the assumption of pure floating, or of perfect substitutability between domestic and foreign bonds.

If the domestic country were small, so that it alone cared about its exchange rate, we might content ourselves with the observation that it can obtain the optimum outcome by the proper revaluation, if it so desires. But the necessity to consider the policy options of the rest of the world inspire us to consider some further propositions, beginning with the welfare effects of a decrease in the exchange rate that is smaller than the optimum.

(3) WHEN IT REDUCES EXPENDITURE IN ORDER TO FIGHT INFLATION, EVEN IF THE COUNTRY IS CONSTRAINED FROM DISCRETELY DECREASING THE EXCHANGE RATE, IT IS STILL TRUE THAT AN INCREMENTAL DECREASE IN THE EXCHANGE RATE (APPRECIATION) WILL IMPROVE ITS WELFARE.

The basic intuition here is the same as for Proposition (2): under a fixed exchange rate the reduction in expenditure falls disproportionately on non-traded goods, so that an incremental appreciation to shift expenditure away from exportable goods moves the economy closer to a balanced contraction. The situation is illustrated by Figure 3. The optimal tradeoff pictured in Figure 2 held when the country was free to vary both E and A at will. If the country is constrained from varying E, it will necessarily have a less attractive opportunity set. We assume that we start from a point 0 on the optimal tradeoff curve, where output in the two sectors is proportional to their full-employment capacities, and that the exchange rate is then fixed at

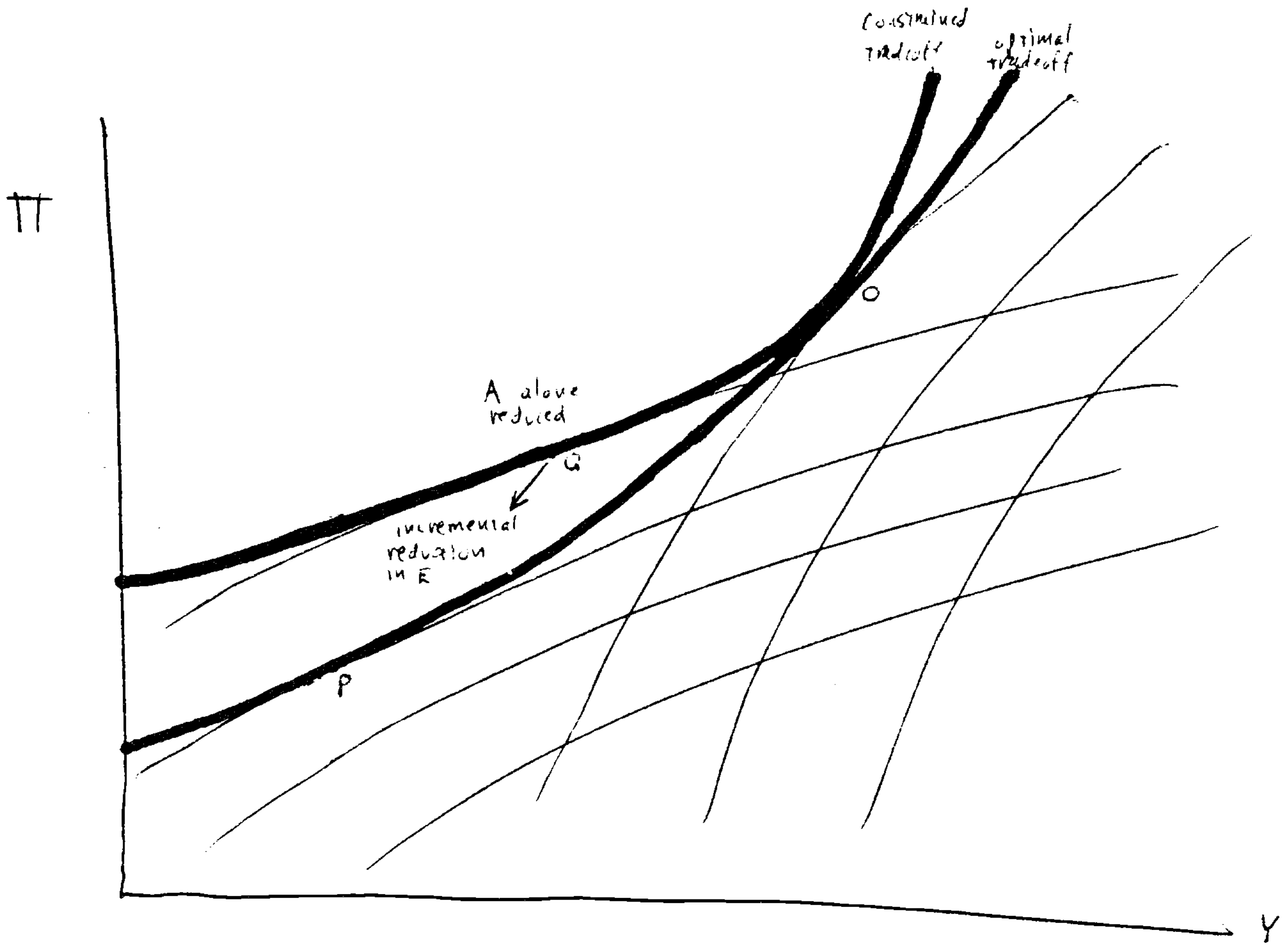


Figure 3

Output-inflation tradeoff with constrained exchange rate that level. Now society's indifference curves shift. With E fixed, the new optimal tangecy point P is no longer attainable, and the economy must settle for the tangency with a more concave constrained tradeoff, at Q . Since the constrained tradeoff is flatter at low levels of output, Q lies above and to the right of P . An incremental decrease in E will incrementally lower π and Y , which is a movement southwestward, so it seems likely that this will improve welfare. But the proposition needs to be proven.

We repeat equations (5)

$$Y_X = x(E)A + x^*(E)A^* \qquad Y_N = n(E)A \quad . \tag{5}$$

We substitute them into equation (2) for aggregate inflation, and the equation $Y = Y_N + Y_X$ for aggregate output, to see how these variables depend on E and A :

$$1 + \pi = \alpha[n(E)A/\bar{Y}_N]^{\delta} + (1-\alpha)[(x(E)A + x^*(E)A^*)/\bar{Y}_X]^{\delta} \tag{10}$$

$$Y = n(E)A + x(E)A + x^*(E)A^* \quad .$$

We are interested in the slope of the constrained curve in Figure 3, the terms of the tradeoff between inflation and output as A alone is varied:

$$\left.\frac{d\pi}{dY/\bar{Y}}\right|_{E=\bar{E}} = \frac{\partial\pi(A,\bar{E})/\partial A}{\partial Y(A,\bar{E})/\partial A \, \frac{1}{\bar{Y}}}$$

$$= \bar{Y}\,\frac{\alpha\delta[n(\bar{E})A/\bar{Y}_N]^{\delta-1}n(\bar{E})/\bar{Y}_N + (1-\alpha)\delta[(x(\bar{E})A + x^*(\bar{E})A^*)/\bar{Y}_X]^{\delta-1}x(E)/\bar{Y}_X}{n(\bar{E}) + x(\bar{E})} , \tag{11}$$

At points of tangency like O and Q, the slope is equal to society's marginal rate of substitution between π and Y. There is no way to know what the society indifference curves look like, even whether they are convex or concave. We assume for simplicity that they are linear, that welfare W is given by

$$W = c(Y/\overline{Y}) - d(1 + \pi) \quad . \tag{12}$$

Thus the marginal rate of substitution is constant[7] at

$$\frac{d\pi}{d(Y/\overline{Y})} = - \frac{\partial W/\partial (Y/\overline{Y})}{\partial W/\partial \pi} = \frac{c}{d} \quad . \tag{13}$$

Equating to the slope given by (11), and using $\overline{Y}_N = \alpha\overline{Y}$ and $\overline{Y}_X = (1 - \alpha)\overline{Y}$,

$$\frac{c}{d} = \frac{\delta}{n(\overline{E}) + x(\overline{E})}$$

$$\{[n(\overline{E})A/\overline{Y}_N]^{\delta-1} n(\overline{E}) + [(x(\overline{E})A + x^*(\overline{E})A^*)/\overline{Y}_X]^{\delta-1} x(\overline{E})\} \quad . \tag{14}$$

We can see from (14) how a decrease in the slope c/d of the indifference curves will require a reduction in the only free policy variable, A. Given the non-linearity of equation (14), it is impossible to solve explicitly for A. Nor is it necessary to solve for A in order to demonstrate Proposition (3). However, it will help to make things more concrete if we take a moment out to consider the example $\delta = 2$, which makes (14) linear and allows us to solve for A:

$$\frac{c}{d} = \frac{2}{n(\bar{E}) + x(\bar{E})} \{n(\bar{E})^2 A/\bar{Y}_N + (x(\bar{E})A + x^*(\bar{E})A^*)x(\bar{E})/\bar{Y}_X\}$$

$$A = \frac{\frac{c}{d}\,\frac{n(\bar{E}) + x(\bar{E})}{2} - \frac{x^*(\bar{E})x(E)}{\bar{Y}_X} A^*}{\frac{n^2(\bar{E})}{\bar{Y}_N} + \frac{x^2(\bar{E})}{\bar{Y}_X}} \tag{15}$$

We thus see explicitly how the fall in $\frac{c}{d}$, say from $\left(\frac{c}{d}\right)_0$ to $\left(\frac{c}{d}\right)_1$, causes the government to reduce A, say from A_0 at O to A_1 at P. The question is, what is the effect on welfare of an incremental decline in E from point P? From the expression for welfare (12),

$$\frac{\partial W(A_1,\bar{E})}{\partial E} = c_1 \frac{\partial Y(A_1,\bar{E})/\bar{Y}}{\partial E} - d_1 \frac{\partial \pi(A_1,\bar{E})}{\partial E} \ . \tag{16}$$

Taking our derivatives from (10),

$$\begin{aligned}\frac{\partial W(A_1,\bar{E})}{\partial E} = {} & \frac{c_1}{\bar{Y}} (n'A_1 + x'A_1 + x^{*\prime}A^*) \\ & - d_1\{\alpha\delta[n(\bar{E})A_1/\bar{Y}_N]^{\delta-1} n'A_1/\bar{Y}_N \\ & + (1-\alpha)\,\delta[(x(\bar{E})A_1 + x^*(\bar{E})A^*)/\bar{Y}_X]^{\delta-1}(x'A_1 + x^{*\prime}A^*)/\bar{Y}_X\} \ .\end{aligned}$$

We want to show that a decrease in E increases welfare, i.e. that the expression is negative. This will be true if

$$\frac{c}{d}_1 < \delta \frac{[n(\bar{E})A_1/\bar{Y}_N]^{\delta-1} n'A_1 + [(x(\bar{E})A_1 + x^*(\bar{E})A^*/\bar{Y}_X]^{\delta-1}(x'A_1 + x^{*\prime}A^*)}{(n' + x')A_1 + x^{*\prime}A^*} \ . \tag{17}$$

From equation (14), $\left(\frac{c}{d}\right)_1$ is a weighted average of two terms

(a) $\delta[n(\bar{E})A_1/\bar{Y}_N]^{\delta-1}$

(b) $\delta[(x(\bar{E})A_1 + x^*(\bar{E})A^*)/\bar{Y}_X]^{\delta-1}$

where the weights are

$$\text{(14a)} \quad \frac{n(\bar{E})}{n(\bar{E}) + x(\bar{E})} \quad \text{and}$$

$$\text{(14b)} \quad \frac{x(\bar{E})}{n(\bar{E}) + x(\bar{E})} \quad \text{, respectively.}$$

The righthandside (RHS) of (17) is a weighted average of the same two terms, (a) and (b), with weights

$$\text{(17a)} \quad \frac{n'A_1}{n'A_1 + x'A_1 + x^{*\prime}A^*} \quad \text{and}$$

$$\text{(17b)} \quad \frac{x'A_1 + x^{*\prime}A^*}{n'A_1 + x'A_1 + x^{*\prime}A^*} \quad \text{, respectively.}$$

Now $x' + x^{*\prime}A^*/A_1 > x' + x^{*\prime}A^*/A_0$ because $A_1 < A_0$

$$> \frac{1-\alpha}{\alpha} n' \quad \text{by equation (8)}$$

$$= \frac{(1-\alpha)Y(A_0,\bar{E})}{\alpha Y(A_0,\bar{E})} n'$$

$$> \frac{x(\bar{E})}{n(\bar{E})} n' \quad \text{because we saw in Proposition (1) that outputs}$$

in the two sectors were originally proportionate to their full-employment levels:

$$\alpha Y(A_0,\bar{E}) = n(\bar{E})A_0 \quad ,$$

and

$$(1 - \alpha)Y(A_0,\bar{E}) = x(\bar{E})A_0 + x^*(\bar{E})A^* > x(\bar{E})A_0 \quad .$$

This means that the ratio of the weights (14a) and (14b) is greater than the ratio of the weights (17a) and (17b)

$$\frac{n(\bar{E})}{x(\bar{E})} > \frac{n'A_1}{x'A_1 + x^{*\prime}A^*} \quad . \tag{18}$$

Again by virtue of Proposition (1), the two terms (a) and (b) would be equal at point 0 , i.e. with A_0 substituted for A_1 . (There the slope in equation (14) reduces to $\left(\frac{c}{d}\right)_0 = \delta[Y/\bar{Y}]^{\delta-1}$, as can be seen by differentiating (3).) But since A has fallen to A_1 , both terms have fallen, with (a) falling by more. Thus our finding that equation (14) puts relatively more weight on the first term (a), implies that $\left(\frac{c}{d}\right)_1$ is less than the RHS of (17), which is precisely what we needed to show. This inequality was our condition for $\frac{\partial W}{\partial E} < 0$: an incremental fall in the exchange rate improves welfare.

In the foregoing we have taken foreign expenditure A^* as given. We now consider the foreign country's reaction to the change in international circumstances.

(4) IF THE EXCHANGE RATE IS NOT ALLOWED TO FALL, THE FOREIGN COUNTRY SHOULD REACT TO THE DOMESTIC CONTRACTION BY EXPANDING ITS OWN EXPENDITURE.

If there were no change in the exchange rate, the foreign country would bear part of the burden, in the form of lost exports, of the domestic contraction. This fact in itself supplies one reason why the foreign country should want its currency to depreciate: to help insulate it from an externally imposed movement down the Phillips curve. But here we begin the analysis by seeing how the foreign country will adjust its expenditure policies. Given the exchange rate, it will want to fight the push down the Phillips curve by following expansionary policies.

We model the foreign country symmetrically to the domestic country. Foreign welfare is a function of foreign income and inflation, which are in turn functions of foreign output of non-traded goods and export goods:

$$W^* = c^* \frac{Y^*}{\overline{Y}^*} - d^*(1 + \pi^*)$$

$$= c^* \frac{Y^*_N + Y^*_X}{\overline{Y}^*} - d^*\left[\alpha^*\left(\frac{Y^*_N}{\overline{Y}^*_N}\right)^{\delta^*} + (1 - \alpha^*)\left(\frac{Y^*_X}{\overline{Y}^*_X}\right)^{\delta^*}\right] \tag{19}$$

Foreign outputs are in turn functions of expenditure shares and expenditure levels

$$Y^*_N = n^*(E)A^*$$

$$Y^*_X = m(E)A + m^*(E)A^* \quad ,$$

where $n^* \equiv$ the share of foreign expenditure falling on their nontraded good

$m \equiv$ the share of domestic expenditure falling on the foreign export (which is of course the domestic import; $m \equiv 1 - n - x$)

$m^* \equiv$ the share of foreign expenditure falling on their own exportable ($m^* \equiv 1 - n^* - x^*$) ,

all of them decreasing functions of the exchange rate.

We assume that the foreign country is starting from a point on its optimal output-inflation tradeoff, i.e. that output is allocated between the two sectors in proportion to their full-employment levels

$$Y^*_N = \alpha Y^* \qquad Y^*_X = (1 - \alpha)Y^* \ ,$$

and that the government then chooses the level of expenditure such that the society's marginal rate of substitution between output and inflation is equal to the terms of the tradeoff.

Analogously to equation (14),

$$\frac{c^*}{d^*} = \frac{\delta^*}{n^*(\bar{E}) + m^*(\bar{E})} \{[n^*(\bar{E})A^*/\bar{Y}^*_N]^{\delta^*-1} n^*(\bar{E}) + [(m^*(\bar{E})A^* + m(\bar{E})A)/\bar{Y}^*_X]^{\delta^*-1} m^*(\bar{E})\} \ . \tag{20}$$

It can be seen from equation (20) that when A falls, the foreign country will have to raise A^* if it wants to maintain optimality.[8]

Figure 4 graphs the inverse dependence of foreign expenditure on domestic expenditure. The curve might be concave or convex. In the graph we choose to show the case where $\delta^* = 2$ so that the relationship is linear.

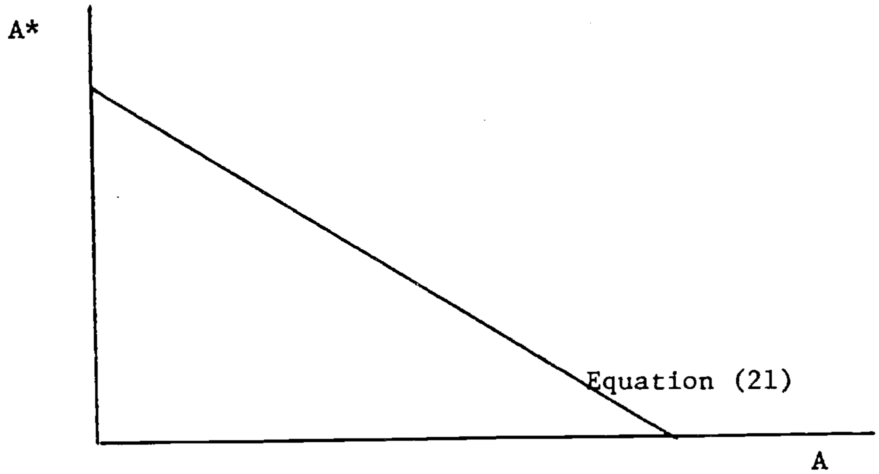


Figure 4: Dependence of foreign expenditure policy on domestic expenditure policy

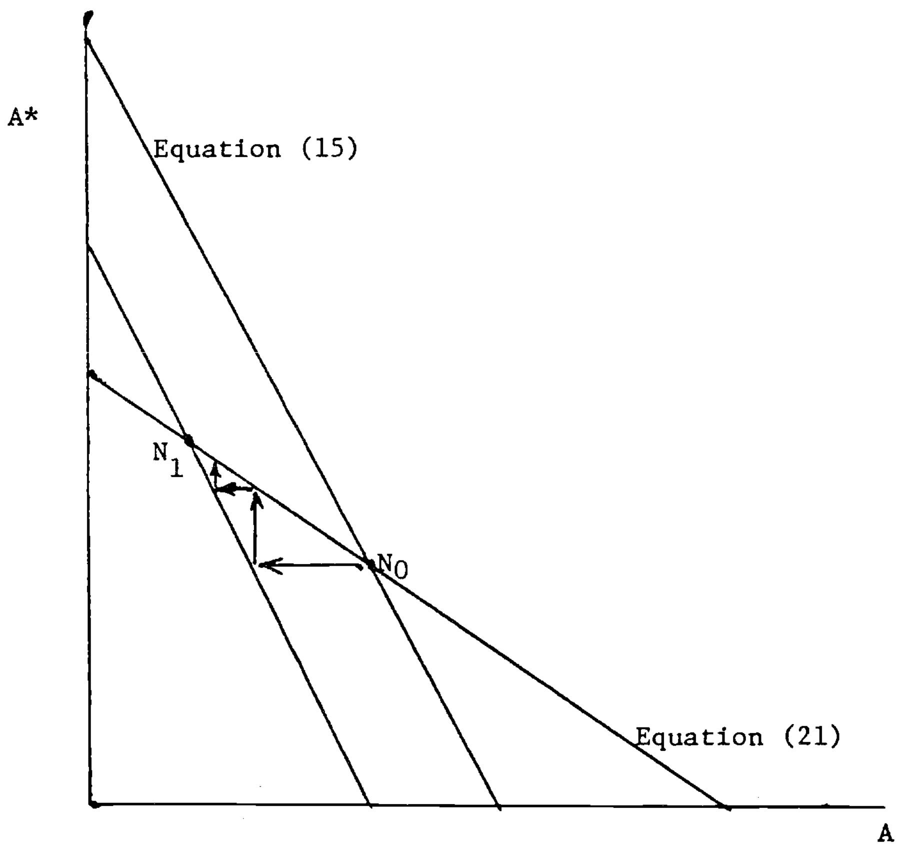


Figure 5: Shift in Nash equilibrium when domestic priorities shift against inflation

In this case we can solve explicitly for A^* in terms of A, analogously to equation (15):

$$A^* = \frac{\frac{c^*}{d^*}\,\frac{n^*(\bar{E}) + m^*(\bar{E})}{2} - \frac{m(\bar{E})m^*(\bar{E})}{\bar{Y}^*_X}\,A}{\frac{n^{*2}(\bar{E})}{\bar{Y}^*_N} + \frac{m^{*2}(\bar{E})}{\bar{Y}^*_X}} \quad . \tag{21}$$

The absolute value of the slope is almost certainly less than 1.0; it is at any rate less than m/m^* .

(5) GIVEN THE DOMESTIC CONTRACTION, AN INCREMENTAL DECREASE IN THE EXCHANGE RATE WILL IMPROVE FOREIGN WELFARE.

The foreign country is now in the converse situation from that of the domestic country in Proposition (3). There the domestic country had contracted as much as it wanted to, but the contraction was concentrated disproportionately in the non-traded goods sector, so an appreciation of its currency was needed. Here the foreign country has expanded as much as it wants to, but the expansion is concentrated disproportionately in the non-traded goods sector, so a depreciation of its currency is needed. The world is indeed lucky that both countries want the same exchange rate to move in the same direction!

Let A^*_1 be the level that foreign expenditure rises to, according to equation (19), or its linear form (20), in response to the decrease in domestic expenditure to A_1 . Then we want to show that

$$\frac{\partial W^*(A_1, A^*_1, \bar{E})}{\partial E} < 0 \ . \tag{22}$$

If we differentiate equation (19), we find that (22) is true if a condition analogous to condition (17) for the domestic country holds:

$$\frac{c^*}{d^*} > \frac{\delta^*[n^*(\bar{E})A_1^*/\bar{Y}_N^*]^{\delta^*-1}(-n^{*\prime})A_1 + [(m^*(\bar{E})A_1^* + m(\bar{E})A_1)/\bar{Y}_X^*]^{\delta^*-1}(-m^{*\prime}A^* - m'A_1)}{(-n^{*\prime})A_1^* + (-m^{*\prime})A_1^* + (-m')A_1} \qquad (23)$$

(Recall that the derivatives $n^{*\prime}$, $m^{*\prime}$ and m' are negative.) From equation (20), we know that, once the foreign country has raised its expenditure to the optimizing level A_1^* , $\frac{c^*}{d^*}$ is equal to a weighted average of two terms:

$$(a^*) \quad \delta^*[n^*(\bar{E})A_1^*/\bar{Y}_N^*]^{\delta^*-1}$$

$$(b^*) \quad \delta^*[(m^*(\bar{E})A_1^* + m(\bar{E})A_1)/\bar{Y}_X^*]^{\delta^*-1}$$

where the weights are

$$(20a) \quad \frac{n^*(\bar{E})}{n^*(\bar{E}) + m^*(\bar{E})} \quad \text{and}$$

$$(20b) \quad \frac{m^*(\bar{E})}{n^*(\bar{E}) + m^*(\bar{E})} \quad \text{, respectively.}$$

The RHS of condition (23) is a weighted average of the same two terms, (a*) and (b*) , with weights:

$$(23a) \quad \frac{-n^{*\prime}A_1^*}{-n^{*\prime}A_1^* - m^{*\prime}A_1^* - m'A_1} \quad \text{and}$$

$$(23b) \quad \frac{-m^{*\prime}A_1{}^* - m'A_1}{-n^{*\prime}A_1^* - m^{*\prime}A_1^* - m'A_1} \quad \text{, respectively.}$$

Now $-m^{*\prime} - m' A_1/A_1^* > \frac{1 - \alpha^*}{\alpha^*} (-n^{*\prime})$ by the analogous version of assumption (8) for the foreign country,

$$> \frac{m^*(\bar{E})}{n^*(\bar{E})} (-n^{*\prime}) \quad \text{because}$$

by Proposition (1) outputs in the two sectors were originally proportionate to their full-employment levels:

$$\alpha^* Y^*(A_0, A_0^*, \bar{E}) = n^*(\bar{E}) A_0^*$$

and

$$(1 - \alpha^*) Y^*(A_0, A_0^*, \bar{E}) = m^*(\bar{E}) A_0^* + m(\bar{E}) A_0 > m^*(\bar{E}) A_0^* \quad .$$

This means that the ratio of the weights (20a) and (20b) is greater than the ratio of the weights (23a) and (23b):

$$\frac{n^*(\bar{E})}{m^*(\bar{E})} > \frac{-n^{*\prime} A_1{}^*}{-m^{*\prime} A_1^* - m' A_1}$$

The two terms, (a*) and (b*), would be equal to each other if A_0 and A_0^* were substituted for A_1 and A_1^*, again by Proposition (1). But since A has decreased to A_1 and A* has increased to A_1^*, the first term (a*) is now greater than the second (b*). Since the relative weight on the first term is greater in equation (20), $\frac{c^*}{d^*}$ is indeed greater than the RHS of condition (23). Thus (22) holds: a decrease in the exchange rate raises foreign welfare.

We originally proved Proposition (3) on the assumption that foreign expenditure A* could be taken as given. Now that we have recognized that, at the given exchange rate, the foreign country will respond to the domestic contraction by expanding its expenditure, we must take this into account. Equation (14), and its linear form equation (15), tell us that the domestic country, in order to achieve its desired point on the output-inflation tradeoff, will react to the increase in A^* by reducing further its own expenditure A. We could show that at this new point it is again true that domestic welfare would benefit from an incremental fall in the exchange rate. However there is no reason to assume that the process will stop there. Equation (20), and its linear form equation (21), tell us that the foreign country will in turn react to the further contraction by undertaking a further expansion. Then the domestic country will contract further, and so on. The logical thing to do is to take up the question when the process converges.

(6) IN THE NASH EQUILIBRIUM IN WHICH BOTH COUNTRIES ARE SIMULTANEOUSLY SETTING EXPENDITURE TAKING INTO ACCOUNT THE OTHER COUNTRY'S EXPENDITURE, AN INCREMENTAL DECREASE IN THE EXCHANGE RATE WOULD BENEFIT EACH COUNTRY.

Indeed given the further decreases in domestic expenditure and increases in foreign expenditure which are necessary to reach Nash equilibrium, domestic output becomes even more skewed away from nontraded goods than it was under Proposition (3), so the appreciation of its currency is even more needed; and similarly foreign output becomes even more skewed toward nontraded goods, so the depreciation of its currency is even more needed.

Figure (5) graphs the dependence of domestic expenditure on foreign expenditure on the same axes as the graph showing how foreign expenditure depends on domestic expenditure. The Nash equilibrium occurs at the intersection, point N_o. It is clear from equation (14), or its linear form equation (15), that when the domestic country's marginal rate of substitution between inflation and unemployment, c/d, falls, its policy reaction schedule shifts inward in Figure (5). The two countries can then be thought of as taking turns in adjusting their policies in reaction to each other until the new Nash equilibrium is reached.

We can solve equations (15) and (21) algebraically for the equilibrium point. The solution is

$$\hat{A} = \frac{\frac{c}{d}\frac{\overline{Y}^2}{2}(\alpha + x) - \left(\alpha + \frac{x}{1-\alpha}\right)\left[\frac{c^*}{d^*}\frac{Y^{*2}}{2}(\alpha^* + m^*)\frac{(1-\alpha)}{m^*}\right]}{\left(\alpha + \frac{x}{1-\alpha}\right)\left[-\left(\alpha^*\frac{1-\alpha^*}{m^*} + m^*\right)\frac{1}{m}\right] + \frac{x^*}{1-\alpha}m}$$

and similarly for $\hat{A}^*$.

The derivation of the welfare effects proceeds along the same lines as before. For the domestic country, because the Nash equilibrium point represents an optimal setting of A, equation (14) holds with $A = \hat{A}$ and $A^* = \hat{A}^*$. The condition necessary for

$$\frac{\partial W(\hat{A},\hat{A}^*,\overline{E})}{\partial E} < 0$$

is the same as condition (17), but with $\hat{A}$ substituted for A_1, and $\hat{A}^*$ for A_1^*. We can again think of two terms, the first less than the second because $\hat{A} < A_0$ and $\hat{A}^* > A_0$, of which the RHS of (14) is a weighted average with relatively more weight on the first (14a) than the second (14b), and of which the RHS of (17) is a weighted average with relatively more weight on the second (17b) than the first (17a). It follows that the inequality holds. An appreciation benefits the domestic country.

For the foreign country, because the Nash equilibrium point represents an optimal setting of A^*, equation (20) holds with $A^* = \hat{A}^*$ and $A = \hat{A}$. The condition necessary for

$$\frac{\partial W^*(A, A^*, \bar{E})}{\partial E} < 0$$

is the same as condition (23), but with $\hat{A}$ and $\hat{A}^*$ substituted. Of the two terms, the first is greater than the second. The RHS of (20) is a weighted average that puts relatively more weight on the first (20a) than the second (20b), and the RHS of (23) is a weighted average that puts relatively more weight on the second (23b) than the first (23a). It again follows that the inequality holds. A depreciation of its currency benefits the foreign country.

CONCLUSION

We have shown that, given a U.S. monetary contraction, an appreciation of the dollar is beneficial to both countries in that it allows them each to achieve the best possible tradeoff between output and inflation. We have chosen to concentrate on an incremental change in the exchange rate. The finite change in the exchange rate that actually takes place could be greater than or less than the change, described in Propositions 1 and 2, that is optimal for the domestic country. If the actual change were larger than the optimal change by a wide enough margin, the country could theoretically be worse off than if the exchange rate had not moved at all. But one would have to argue that the output decline in export industries is much greater than the output decline in nontraded industries like housing. In the case of the 1980-82 U.S. contraction, this does not appear to have been the case.

In the only major sector that is unambiguously non-traded, construction, output in the United States fell by 11 per cent from 1979 to 1981. In manufacturing, by contrast, output fell by only 2 per cent. More disaggregated data are available only for employment. For a set of 14 individual industries that are the most clearly non-traded, the 1979-1981 change in employment (1.88 per cent) was almost exactly the same as the change in non-agricultural employment in the economy as a whole (1.91 per cent).[9]

We could have chosen to model explicitly the exchange rate, and each country's level of expenditure, as functions of the countries' monetary policies and fiscal or debt policies, in order to see the welfare effects of the actual exchange rate change. But this approach would have complicated the Nash equilibrium solution considerably. More importantly, the results would have been very dependent on the particular model used. The approach followed here, working directly in terms of the exchange rate and expenditure levels, has allowed us to keep the argument as general and model-free as possible.

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Footnotes

1. Throughout this paper, I will use "Europe" as shorthand for Europe, Japan and the rest of the world.
2. Richard Meese and Kenneth Rogoff (1983) even find that models of exchange rate determination predict more poorly out of sample than a simple random walk.
3. See Mussa (1979) for a review of the standard results on transmission. There are of course a number of other ways besides capital mobility that the insulation claim can be undone. An increase in the exchange rate will not insulate the economy from a foreign contraction if the increase in import prices affects saving (the Laursen-Metzler effect), the demand for money, or nominal wages or other factor costs (e.g. through wage indexation). In this paper I abstract from these factors; in the case of saving and money demand, my treatment of expenditure as a policy variable accomplishes this abstraction automatically.
4. Presumably the contraction in European expenditure has not been as great as the contraction in U.S. expenditure. This would explain the outcome that the dollar/European exchange rate did, after all, fall. It would in turn be explained by the observation that it was in the United States that the fight against inflation was given increased priority; there is no reason to assume a similar political shift in Europe as a whole.
5. For example Robert Gordon (p. 194) offers some evidence that the Phillips curve is flat at high levels of unemployment. J. M. Fleming (p. 471) claimed that "the inverse relationships between unemployment and price inflation...are typically curvilinear, at least in the vicinity of full

employment. As unemployment approaches zero successive percentage declines in unemployment must impart increasingly powerful stimuli to inflation." Fleming used this fact to argue that the average Phillips curve tradeoff among a group of countries will be more favorable under floating exchange rates than fixed exchange rates. However, this is not the same as showing that each country individually will be better off under floating rates, which is the object of the present paper.

6. Or if we allowed the price of the exportable good to be determined on world markets.

7. Even if the indifference curves are not in reality linear, the propositions derived here will be valid in the neighborhood of point O , i.e. for small policy changes (assuming of course the indifference curves are differentiable).

8. Europe has in fact responded to the 1980-82 U.S. monetary contraction by contracting, not expanding, as measured for example by real interest rates. But this is what we would expect in equation (19) from the large discrete appreciation of the dollar. If Europe did not reduce A^* , a sufficiently large fall in E would raise both Y^*_N and Y^*_X , pushing Europe higher on the inflation-output curve than desired.

9. The source for the output figures is the Economic Report of the President, 1983, Table B-11. The source for the employment figures is the Supplement to Employment and Earnings, U.S. Dept. of Labor Bureau of Labor Statistics, Aug. 1981 and March 1982. The 14 non-traded industries and their employment levels are given in Table 1. (Note that employment increased slightly in both sectors, despite the fall in output and increase in the unemployment rate due to the recession.)

Table 1: Employment, in thousands

	1979	1981
Construction	4,462.6	3,995
Local and interurban transportation	262.6	271.8
Trucking and warehousing	1,339.4	1,239.8
Electric, gas and sanitary services	805.7	867.7
Eating and drinking places	4,513.1	4,833.2
Real estate services	954.5	1,029.7
Personal services (e.g. laundry)	904.0	893.6
Auto repair	575.1	577.7
Misc. repair	281.8	296.3
Motion picture theaters	128.0	128.9
Amusement and recreation	712.0	801.7
Health services	4,992.8	5,534.5
Elementary and secondary schools	258.6	292.2
Government	15,947	16,054
TOTAL NONTRADED INDUSTRIES	36,137.2	36,816.6
TOTAL NONAGRICULTURAL	89,823	91,543