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by

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I. Introduction

This paper examines some selected aspects of the recent debate over "vicious" and "virtuous" circles that has accompanied the evolution of floating exchange rates during the 1970's. That evolution has gone through a number of stages since the onset of generalized floating early in 1973. Initially, fluctuations in exchange rates were wide. The dollar gyrated wildly, reflecting in part changing expectations about the prospective behavior of OPEC capital flows. Soon, however, it became apparent that many currencies could be classified as belonging to one of two polar groups. The pound and the lira depreciated while, at the same time, inflation rates in the U.K. and Italy rose. The D-mark and the Swiss franc appreciated while inflation rates in Germany and Switzerland diminished. Some currencies, however, could not at first be readily assigned to either the weak currency group or the strong currency group. These currencies included the yen and the dollar, as well as the Canadian dollar and the French franc. Later, beginning near the end of 1977, the dollar, preceded by the Canadian dollar, joined the weak currency group. The yen joined the strong group. The French franc has

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continued in an intermediate position to the time of this writing (August 1979).

Experiences over the last six years have, then, differed widely among countries. For both weak and strong currency countries alike, however, a substantial amount of feedthrough from the exchange rate to domestic prices, as well as the reverse, has been noted. The rapid feedthrough from exchange rates to prices has, apparently, exacerbated inflation in weak currency countries while helping to reduce inflation in strong currency countries. Thus, these patterns of a depreciating currency and high inflation on the one hand, and an appreciating currency and low inflation on the other, have been dubbed "vicious" and "virtuous" circles, respectively.

This association between exchange rate changes and inflation acquired policy significance in the mid 70's because it seemed to provide an argument against clean floating. Clean floating, it was said, produced "circles". There appeared to be a case, in the opinion of some, for intervention to support weak currencies: it would help reduce inflationary pressures and create greater freedom for domestic policy action. This was the direction in which the views of the Secretariat of the Organization for Economic Cooperation and Development appeared to be moving. The position of the U.S. Treasury at the time was strongly in favor of cleaner floating. Therefore, the Treasury set out to demolish the circles argument in order to forestall acceptance of the policy prescriptions of its proponents.

This policy debate has lost some of its urgency as a result of the general trend toward more managed floating that began, for the United States, in 1978. But a number of theoretical issues, and considerable residual confusion, remain. The issues and the confusion stem, in part, from the lack of a concise and generally accepted definition of a "circle".

Virtually any succession of price level increases (decreases) and exchange rate depreciations (appreciations) experienced by a country may be labelled a vicious (virtuous) circle without doing violence to currently accepted uses of the term. As a result, a number of substantively different economic phenomena have been identified as circles of one sort or the other.

Because the discussion of vicious and virtuous circles began with the advent of flexible exchange rates, attention has often been focused on a class of circles that presume as a "benchmark" the case of an economy with a fixed exchange rate. Some analysts have pointed out that fixed exchange rates in a country with a payments deficit, so long as they can be maintained without controls through the drawing down of reserves or capital inflows, give a country certain temporary advantages as contrasted with floating. Import and export prices do not rise and therefore do not add to domestic inflation. Inflation is exported, stability imported. The home currency appreciates in real terms.

Compared to this necessarily temporary situation, any performance of the real exchange rate that is less favorable to price stability could be dubbed a vicious circle. For instance, if the local currency remains constant in real terms, depreciating nominally with the rate of inflation (or the international inflation differential), the economy may be moving in equilibrium but there will be no imported stability or exported inflation.

A more obvious and less disputable form of vicious circle would be the case in which the exchange rate overshoots its equilibrium level, whether that is an unchanged real exchange rate or a changing one. Overshooting has been widely believed to have occurred and has been theoretically validated,

principally on the basis of more rapid clearing in asset markets than in goods markets.

Although a fixed exchange rate regime is a plausible benchmark to use when attempting to isolate phenomena which are to be defined as vicious and virtuous circles, it is not the only possible benchmark. Nor is it the most appropriate for our purposes in this paper. A major objective of the sections that follow is to establish the relationship between certain country characteristics -- including the monetary authority's choice of domestic objectives -- and the existence and severity of vicious and virtuous circles. In many models, among them ours (and, possibly, in reality), intervention in the foreign exchange market and domestic monetary policy are identical in their effects. It is, accordingly, impossible for the monetary authority simultaneously to fix the exchange rate and to set a domestic variable such as unemployment at independently determined values. Taking as a benchmark a fixed rate system would, then, preclude investigation of the effects of various domestic objective functions on the part of the country's monetary authority. Therefore, to facilitate the analysis and exposition of the paper, we use the following alternative definition of a vicious circle: A vicious circle refers to the price level increase and exchange rate depreciation experienced by a country following a shock or a series of shocks.[1/] These changes are measured relative

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1/ In indexed economies, these price level and exchange rate movements reinforce each other because of the feedthrough from the exchange rate to domestic prices via the nominal wage rate. Note, however, that our definition does not require that this feedthrough be present. Thus, it does not rule out the possibility of vicious circles in non-indexed economies in which there is no short-run feedthrough from the exchange rate to nominal wages.

to the benchmark case of a country whose monetary authority does not pursue external or internal stabilization policies of any kind -- i.e. the domestic money supply is fixed. A circle is more "vicious", the greater the inflation and depreciation incurred in the move to a new equilibrium following a shock. A virtuous circle, by analogy, refers to the reduction in inflation and the currency appreciation experienced by a country following a shock or series of shocks. The same benchmark applies. These definitions make clear that the benchmark case is not that of a country with a fixed exchange rate; the analysis takes flexible rates for granted.

Our purpose in this paper, as mentioned above, is to provide a general analysis of the relationship between certain country characteristics and the occurrence of vicious and virtuous circles. The characteristics we have chosen to examine are (i) the extent to which a country is exposed to exogenous shifts in the demand for its currency and output, (ii) the amount of feedthrough from the exchange rate to nominal wages (via the price index) due to indexing arrangements, and (iii) the relative importance assigned by the monetary authority to the alternative domestic objectives of price stability and full employment. The third of these three characteristics differs from the first two in that it is probably best regarded as a result of deliberate choice by the authorities rather than as a structural feature of the economy.[2/]

2/ We do not explicitly analyze the influence of the degree of openness of a country, a characteristic commonly emphasized in other studies. There are two parameters in our model, however, that reflect openness: α, the share of domestic goods in the price index, and δ, the relative price elasticity of demand for domestic output. Although we have not chosen to do so, then, it is possible to explore the role of openness in our model.

In section II of the paper we provide an outline of our underlying framework. In section III we analyze the benchmark case of an economy whose monetary authority pursues no active stabilization policy. The effects of both real (aggregate demand) and monetary shocks on output, prices, and the exchange rate are examined under alternative assumptions about the degree to which nominal wages are linked to the price level. Section IV analyzes the role of domestic stabilization policies. Here we develop and interpret three of the more interesting results that can be derived using this framework.[3/] First, monetary disturbances (e.g. speculative shifts in currency holdings) are not the most likely initiating causes of vicious or virtuous circles. The circumstances most conductive to a vicious circle, for example, are a negative aggregate demand shock combined with indexed wage contracts, a flexible exchange rate regime, and a domestic objective on the part of the monetary authority of stabilizing output. Second, if a government's domestic objective function is asymmetric, it can be legitimately claimed that its choice of domestic objective determines whether it will find itself caught in a vicious or virtuous circle. By an asymmetric objective function we mean an asymmetric response to positive and negative deviations of a variable from its target value. For example, the monetary authority may choose to neutralize a fall in output below its full employment value, but may not respond to increase in output. Or it may choose to offset increases in the price level (or inflation), but not decreases. Third, when vicious or virtuous circles

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3/ Most of the formal analysis of the paper has been relegated to the appendix.

result from the pursuit of asymmetric domestic objective functions in highly indexed economies, vicious circles will tend to be less stable, or more explosive, than virtuous circles.

Finally, note that while the formal model is cast in terms of levels of prices and output, we will extrapolate our results freely to situations involving real growth and inflation.

II. The Analytical Framework

The results summarized above are derived from a model with one period wage contracts that is intended to provide a compressed representation of the dynamic models now popular in the international finance literature. Among the features it shares with much of this literature are a considerably more "rational" specification of asset markets than the labor market, short-run effects that may differ from the long-run full equilibrium effects implied by the model, and the possibility of "feedthrough" from the exchange rate to nominal wages and domestic prices.[4/] Features less common in other studies include an explicit stochastic structure that incorporates both real and monetary shocks,[5/] and a discussion of the monetary authority's domestic objective function and the reaction function it implies. It will be useful to review in the remainder of this section the major behavioral assumptions of the model, which contains a money market, a goods market, and a labor market.

The demand for the home country's currency (m_t^d) is an increasing function of the domestic price level (p_t) and output (y_t), and a decreasing function of the nominal rate of interest (i_t). All variables except the interest rate are in logs. Money demand is also affected by random shocks (U_t) which, in the present analysis, will be assumed to be permanent.[6/] Thus,

$$m_t^d = p_t + \eta y_t - \lambda i_t + \mu_t, \qquad \mu_t = \mu_{t-1} + U_t. \tag{1}$$

4/See, for example, Bilson (1978), Bruno (1978), Modigliani and Padoa-Schioppa (1978), and Sachs (1979).

5/Our definitions of real and monetary shocks conform to those commonly used in the analysis of financial policies in closed and open economies rather than those used in the indexing literature. In the latter, real shocks are shifts in aggregate supply and monetary shocks are shifts in the quantity-theory money demand function.

6/Formally, both μ, the disturbance term in the money market, and ε, the disturbance term in the goods market, are assumed to be random walks with zero mean.

A positive value of U_t represents an unanticipated, permanent increase in money demand. The domestic price level, p_t, is a weighted average of the price of domestically produced goods, p_t^d, and the price of imports, given by the exchange rate times the foreign price of foreign output or (in log terms), $e_t + p_t^*$.

$$p_t = \alpha\, p_t^d + (1-\alpha)(e_t + p_t^*). \tag{2}$$

The domestic nominal rate of interest is determined by the (fixed) world rate of interest, i^*, and the interest parity condition:

$$i_t = i^* + (e_{t+1/t} - e_t) \tag{3}$$

where the term $(e_{t+1/t} - e_t)$ is the expected rate of depreciation of the home country's currency. 7/

The supply of money is determined by the domestic monetary authority. They may choose to hold the money supply fixed or they may vary it in order to stabilize domestic output or the price level. Much of the analysis of section IV will be concerned with the implications of alternative money supply rules. 8/

The specification of the goods market includes both demand and supply functions. The demand for domestic output is a function of relative prices and a disturbance term:

$$y_t^d = \delta(e_t + p_t^* - p_t^d) + \varepsilon_t, \qquad \varepsilon_t = \varepsilon_{t-1} + E_t \tag{4}$$

7/In general, the notation $x_{t+1/t}$ refers to the expectation at time t of the log value of the variable x during period t+1, based on information available at time t. In our model, the rational expectations solution for $e_{t+1/t}$ is the exchange rate that would equilibrate all markets at full employment output in the absence of any further shocks ($U_{t+1} = E_{t+1} = 0$).

8/The monetary authority's reaction function is formally defined in the appendix.

A rise in domestic prices relative to import prices shifts demand away from domestic output toward imports, reducing aggregate demand. A positive value of E_t, the disturbance term, represents an unanticipated, permanent increase in aggregate demand.

The supply of domestic output depends on the price at which producers are able to sell their output relative to the wage rate they must pay per unit of labor:

$$y_t^s = \sigma(p_t^d - w_t) \tag{5}$$

Employment, in turn, is determined from the production relationship

$$y_t = f(L_t), \text{ where } f'(L_t) > 0, \; f''(L_t) < 0. \tag{6}$$

The greater the equilibrium level of output, the higher the level of employment.

The contracting arrangement that determines the setting of nominal wages is central to the short run behavior of the model. All contracts have a duration of one period and establish a base nominal wage (w_t^*) and an indexing parameter (γ). Contracts for any period t are written at the end of period t-1, so that w_t^* and γ must be set with less than full information on the factors relevant to production and employment decisions in period t. It is assumed that workers and firms set the base wage at the level required to generate an expected level of output equal to full employment output, a fixed quantity denoted by $\bar{y}$. Setting y_t^s equal to $\bar{y}$, w_t equal to w_t^*, and rearranging terms in equation (5) gives

$$w_t^* = p_{t \mid t-1}^d - \bar{y}/\sigma, \tag{7}$$

where $p^d_{t \mid t-1}$ is the expectation at time t - 1 of domestic prices in period t. Thus workers and firms attempt, through the setting of w*, to insure full employment in each subsequent period.

The wage rate actually faced by producers in period t will be the base wage plus an adjustment for unexpected changes in the price level :

$$w_t = w^*_t + \gamma(p_t - p_{t \mid t-1}) \tag{8}$$

(Again, all variables are expressed as log values.) The extent to which the nominal wage is adjusted for unanticipated changes in the price level inside the contract period depends on the size of the indexing parameter, γ. At one extreme, $\gamma = 0$ gives no adjustment of the nominal wage in response to changes in the price level, so that the nominal wage is fixed at w^*_t and the real wage varies inversely with the price level. At the other extreme, $\gamma=1$ provides full adjustment of the nominal wage for changes in the price level, thereby insuring a fixed real wage during the life of the contract. The size of this parameter will figure prominently in much of the analysis that follows since it determines the extent to which exchange rate changes feed through to nominal wages via their impact on the price level.

The conditions for equilibrium in the goods and money markets close the model.

$$m^s_t = m^d_t \tag{9}$$

and

$$y^s_t = y^d_t \tag{10}$$

Once contracts have been negotiated, the values of the previously unknown disturbance terms associated with period t are realized, and output, prices, and the exchange rate are simultaneously determined by equations (1) through (10).

III. The Benchmark Economy

The analysis of this section is centered around the impact of real and monetary shocks on output, prices, and the exchange rate for an economy in which the monetary authority plays no active stabilization role. Specifically, the money supply is assumed to be fixed: $m_t = m_{t-1}$ for all periods. This case will provide a benchmark for the discussion of alternative stabilization policies pursued in section IV. We turn first to the case of an economy subject only to monetary shocks.

A. Monetary Shocks

The response of our benchmark economy to shifts in the demand for its currency depends crucially on the extent to which nominal wages respond to unanticipated changes in the price level. To see this, we will examine the two extreme cases of a fully indexed economy and a non-indexed economy.

For the fully indexed economy, $\gamma=1$, and the real wage is fixed at its preshock expected equilibrium value. This value, in the case of monetary shocks, is also the post-shock full equilibrium value. Accordingly, the full employment level of output is obtained and prices and the exchange rate move immediately to their full equilibrium values. Formally,[9/]

$$y_t = \bar{y}_t,$$
$$e_t = \bar{e}_t - U_t,$$
$$p^d_t = \bar{p}^d_t - U_t,$$
$$P_t = \bar{p}_t - U_t.$$

9/ The formal solution of the model is described in the appendix.

A "bar" denotes the pre-shock expected equilibrium value of a variable. Alternatively, this would be the full equilibrium value of a variable if the realized values of the two disturbance terms, U_t and E_t, were zero. Thus, a positive shock to money demand causes an appreciation of the exchange rate and a fall in both domestic prices and the price level relative to a situation in which there is no shock. These results are familiar from the study of wage indexation in closed economies. In a fully indexed economy, monetary disturbances have no real effects; output and relative prices are equal to their expected values. Prices and the exchange rate move immediately to their new, full equilibrium values. Changes in money demand causes equiproportionate changes in all nominal magnitudes. Money market shocks are neutral.

In the case of a non-indexed economy, $\gamma=0$ and nominal wages are fixed during the contract period. Output and prices respond to money demand shocks as follows:

$$y_t = \bar{y}_t - \phi_y U_t, \qquad \phi_y > 0$$

$$e_t = \bar{e}_t - \phi_e U_t, \qquad 0 < \phi_e \lesseqgtr 1 \text{ as } \delta\eta \gtreqless \alpha$$

$$p_t^d = \bar{p}_t^d - \phi_{p_d} U_t, \qquad 0 < \phi_{p_d} < 1 \text{ and } \phi_{p_d} < \phi_e$$

$$p_t = \bar{p}_t - \phi_p U_t, \qquad 0 < \phi_p < 1$$

Again, we see the familiar result that monetary shocks do effect output in a non-indexed economy. A positive shock to money demand ($U_t > 0$) causes a reduction in output accompanied by a fall in prices and the exchange rate. Output declines because domestic prices fall while nominal wages remain fixed,

which reduces aggregate supply, and because the exchange rate falls more than domestic prices, which reduces aggregate demand. Whether or not the exchange rate "overshoots" or "undershoots" its new equilibrium value in the short run depends on whether the elasticity of the exchange rate with respect to money shocks, ϕ_e, is greater or less than unity. This, in turn, depends on whether the direct effects on money demand of a change in domestic prices (measured by α) outweigh the indirect effects on money demand of such a change through its impact on income (measured by $\delta\eta$).[10/] Overshooting occurs when $\delta\eta < \alpha$. In the special case in which income remains fixed in the short run ($\delta = 0$, or no aggregate supply response, would guarantee this), the exchange rate necessarily overshoots its new equilibrium value.

Both domestic prices and the price level fall by less than is required for the new equilibrium (ϕ_p and ϕ_{p_d} are both less than unity). These prices necessarily "undershoot" their new equilibrium values. Because output decreases in the short-run, less of a movement in prices is required to equilibrate the money market in the short run than in the long run.

B. Aggregate Demand Shocks

The response of our benchmark economy to shifts in the demand for its output depends, as in the case of monetary shocks, on the extent to which nominal wages respond to unanticipated changes in the price level. Again, we will examine the two extreme cases of a fully indexed economy and a non-indexed economy. Unlike the case of monetary shocks, the analysis shows that

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10/This can be seen by substituting equations (2) and (4) into equation (1), giving

$$m_t^d = (\alpha - \delta\eta)(p_t^d - e_t - p_t^*) + e_t + p_t^* - \lambda i_t - \mu_t.$$

If the exchange rate is to move immediately to its new long run value, the coefficient on e_t must be unity, which implies that $\alpha = \delta\eta$.

the short run values of all variables are closer to their full equilibrium values in the non-indexed system than in the indexed system. In developing this result, it is useful to begin by describing the full equilibrium response of the model to an aggregate demand shock. Consider, for example, a positive shock to aggregate demand ($E_t > 0$). If the economy were to adjust fully and instantaneously to this shock, output and the price level would be unchanged, but relative prices would have to adjust in order to reequate aggregate demand and the full employment level of output. Output would be unchanged since full employment output is assumed, in this model, to be fixed and independent of other real magnitudes. With a fixed level of output, no change in the price level is needed to equilibrate the money market. But, in the case of a positive shock to aggregate demand, a rise in domestic prices and a fall in the exchange rate (and therefore import prices) is required to provide an offsetting decrease in aggregate demand and equilibrate the goods market at the full employment level of output.

By comparison, the actual short-run effects experienced by an economy hit with a positive aggregate demnad shocks are as follows: Regardless of the indexing regime, output increases, the domestic currency appreciates (the exchange rate falls), and the price level falls. The price of domestic output rises in a non-indexed economy, but may rise or fall in an indexed economy; the reason for the ambiguity in the case of an indexed economy will be discussed later. As noted above, when the actual short run effects experienced by an economy subject to an aggregate demand shock are compared with the equilibrium responses described above, it is possible to show that the short run values of all variables are closer to their full equilibrium

values in the non indexed system than in the indexed system. This is precisely the opposite of the result obtained in the case of monetary shocks. The intuition behind these results is reasonably accessible. We begin by considering the non-indexed economy.

Increases in aggregate demand are generally associated with increases in output and/or prices. In the non-indexed case, nominal wages remain fixed while domestic prices rise, inducing an increase in the supply of output. Aggregate demand increases, but by less than the initial increase in demand since domestic prices rise relative to import prices, generating a partial offset to the initial increase. Thus we find that the elasticity of output with respect to the shock, E_t, is positive but less than one. With an increase in output, money market equilibrium can be maintained only if the price level falls, the nominal interest rate rises, or both. In both the indexed and non-indexed systems we find that the price level falls, while the direction of movement of the interest rate depends on whether the exchange rate overshoots or undershoots its new, lower full equilibrium value. In any case, the fall in the exchange rate is sufficient to cause a fall in the price level despite a possible rise in domestic prices. It is interesting to note that the condition for overshooting of the exchange rate is precisely the opposite of the condition in the case of monetary shocks, and is independent of whether or not the economy is indexed. If income effects dominate -- i.e., if $\delta\eta > \alpha$ -- overshooting occurs, the exchange rate is expected to depreciate, and the domestic interest rate rises. Otherwise, undershooting occurs, the exchange rate is expected to appreciate, and the interest rate falls.

The rise in output following an increase in aggregate demand is

exacerbated in an indexed economy. This is because the nominal wage rate in an indexed economy is tied to the price level. Since the price level falls following a positive aggregate demand shock, the nominal wage rate is actually reduced in an indexed economy, producing an additional increase in the supply of output. The fact that nominal wages actually fall in the indexed economy explains the ambiguity, mentioned earlier, in the direction of movement of domestic prices. If the nominal wage rate falls, a rise in domestic prices is not necessarily required in order to induce an increase in domestic output. Next, a greater increase in output in the indexed economy means that a larger adjustment in the price level and/or the nominal rate of interest is required in order to equilibrate the money market. The formal analysis shows that the price level does, indeed, fall by more in an indexed economy than a non-indexed economy. Further, we find that if the exchange rate overshoots, it will overshoot by more in an indexed economy, and if it undershoots, it will undershoot by more in an indexed economy. Thus, in either case, the short run value of the exchange rate deviates from its new equilibrium value by more in an indexed economy.

The reader is reminded that while our model has been cast in terms of levels, the results can be extrapolated to a situation of growth and inflation. Thus a "fall in nominal wages" would, under more realistic assumptions, refer to a rise in nominal wages of an amount smaller than was anticipated.

This completes the analysis of our benchmark economy. We turn now to a consideration of the role played by government stabilization policies in generating or contributing to phenomena that might be identified as vicious or virtuous circles.

IV. The Role of Stabilization Policy

The discussion of this section will focus on the three propositions set out in the introduction to the paper. We will find that the symmetry of the monetary authority's domestic objective function, as well as its choice of objective, are central to the analysis. The first of the three results considered below assumes symmetric domestic objective functions -- that is, the monetary authority is assumed to respond symmetrically to positive and negative deviations of a variable (such as output) from its target.

Proposition 1. Monetary disturbances are not the most likely culprits in the initiation of vicious or virtuous circles. The circumstances most conducive to a vicious (virtuous) circle are a negative (positive) aggregate demand shock combined with indexed wage contracts, a flexible exchange rate, and a domestic objective on the part of the monetary authority of stabilizing output.

Consider first money disturbances and the effects of alternative responses on the part of the monetary authority to such disturbances. In a fully indexed economy output is unaffected by monetary shocks, so that stabilizing output is not a relevant policy response for such an economy. Stabilizing either the exchange rate or the price level is, however, and any monetary policy that fixes one of the variables at its target (expected) value will also fix the other at its target value. In an economy that is not fully indexed, the monetary authority may choose to stabilize any one of the three variables -- output, the exchange rate, or the price level -- and, in doing so, will succeed in stabilizing the other two. The intuition underlying these results is straightforward: If all random shifts in the demand for the home country's currency are met with the appropriate changes in supply, these shifts need not perturb the system at all. All demand disturbances will be completely neutralized; there will be no real or nominal effects associated with these

shocks. This result can be achieved if the monetary authority attempts to completely stabilize prices, the exchange rate, or (in a non-indexed economy) output. Accordingly, all these policies appear to be appropriate and interchangeable.[11/] Note, however, that there is little here to suggest that vicious or virtuous circles will result from monetary shocks, even in the presence of government stabilization policies.

Consider next real shocks, which in our model take the form of permanent, unanticipated changes in demand for the home country's output. The most hazardous policy the monetary authority can pursue in the face of aggregate demand shocks is to stabilize output in a fully indexed economy. Consider, for example, a negative shock to aggregate demand. From our previous analysis we know that, in the absence of an active monetary policy, output will fall, the price level rise, and the exchange rate appreciate. Now suppose the monetary authority attempts to neutralize the output effects of this shock with an expansion of the money supply. The response of output to increases in the money supply depends on the degree to which wages are indexed to the price level. In the case of an indexed economy that response is zero. In the non-indexed economy it is positive. In fact, the response is a monotonic, decreasing function of the indexing parameter, γ. Accordingly, the increase in the money supply necessary to raise output to its target value following a negative aggregate demand shock will be an increasing function of γ. The larger is the increase in the money supply, the greater will be the increase

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11/Throughout our analysis we assume that the monetary authority correctly perceives the kind of shock (real or monetary) impinging on the economy, and acts only in response to the effects of that shock. The monetary authority does not, in our model, act as a source of shocks.

in the price level and the depreciation of the exchange rate that accompany such a stabilization policy. In the most extreme case of a fully indexed economy, this policy response is explosive. There is no finite increase in the money supply that will drive output to its full employment level. If the monetary authority insists on trying, the increase in the money supply, prices, and the exchange rate will be unbounded. The behavior of the economy under these extreme circumstances approximates nicely the notion of a vicious circle. The key elements in this scenario are a negative real shock that reduces output, flexible exchange rates, a large amount of feedthrough from the exchange rate to nominal wages through the price index, and a policy of stabilizing output at its full employment level.

We can not conclude, however, from the preceding analysis that it is a country's choice of domestic objectives that lands it in hot water. If the economy described above -- one with flexible rates, full indexation, and a domestic objective of stable output -- were hit with a positive aggregate demand shock, a potentially explosive "virtuous" circle would result. Persistent efforts to stabilize output would lead to an unbounded appreciation of the exchange rate and an unbounded fall in the price level.

The preceding discussion constitutes an informal proof of proposition 1. It also provides some background for proposition 2.

Proposition 2. If a government's domestic objective function is asymmetric, it can be legitimately claimed that its choice of domestic objectives determines whether it will find itself caught in a vicious or a virtuous circle.

From the analysis following proposition 1 we may conclude that as long as the monetary authority is assumed to respond symmetrically to increases and

decreases in output, it is chance rather than moral fortitude that determines whether a country becomes caught in a vicious or a virtuous circle. This conclusion is reversed if the monetary authority responds asymmetrically to deviations of output from its target level. Before turning the discussion to asymmetric objective functions, however, it will be useful to comment on the consequences of a policy that stabilizes the price level in the face of aggregate demand shocks. In the absence of an offsetting monetary policy, the price level will fall as output rises in response to a positive aggregate demand shock, and will rise as output falls in response to a negative aggregate demand shock. In any economy that is not fully indexed, policies that stabilize the price level will, therefore, necessarily exacerbate the output effects of aggregate demand shocks. Only in a fully indexed economy in which money is neutral with respect to real variables will it be possible to stabilize the price level without causing wider fluctuations in output.

We turn now to consider the implications of an alternative set of asymmetric stabilization policies that reflect a (possibly) more realistic view of policymakers' objective functions. Assume that a country that puts heavy emphasis on output stabilization views decreases in output as bad, but increases as good or, at a minimum, views them indifferently. That country's domestic objective, then, would be to maintain output at or above the floor level, $\bar{y}$. Similarly, assume that a country that puts heavy emphasis on price stabilization views increases in the price level as bad, but is indifferent toward price level decreases. That country's domestic objective, then, would be to maintain the price level at or below a target level that, in our model, is the previous period's equilibrium value.

Once again, consider the case of monetary disturbances and the effects of alternative responses on the part of the monetary authority to such disturbances. Two countries, each pursuing one of the asymmetric domestic objectives described above over time, would find themselves in very different situations as time passed. The country that responds to and neutralizes only decreases in output, but not increases, would find itself with a persistently increasing price level and a depreciating exchange rate, since these are the price movements that accompany output increases. The country that neutralizes price level increases, but not decreases, would find itself with a persistently decreasing price level and an appreciating currency, although a lower average level of output as well. The first country might be said to be involved in a vicious circle and the second in a virtuous circle. Note, however, that neither the exchange rate regime nor the existence of indexing arrangements is responsible for these situations. The governments' objective functions and the random component in the money demand function are to be blamed for the situations that such countries find themselves in. Thus, proposition 2 is established for the case of monetary shocks.

The circumstances described above meet the definitions of vicious and virtuous circles set out in the introduction. Unlike the "circles" associated with aggregate demand shocks, however, they appear over time in response to a series of shocks and require for their continued existence asymmetric policy responses.

Of course, the possibility of asymmetric stabilization policies is relevant in the case of an economy subject to aggregate demand shocks as well. Again, two countries, both faced with random fluctuations in the demand for their output, each pursuing one of the asymmetric domestic objectives discussed

above, will find themselves in very different situations as time passes. The country that responds to and neutralizes only decreases in output will find itself involved in a continuing series of vicious circles -- that is, rising prices and a depreciating exchange rate -- the severity of which will depend on the extent to which the economy is indexed. The country that responds to and neutralizes only price level increases will find itself involved in a series of virtuous circles -- falling prices and an appreciating exchange rate -- at the cost of a lower average level of output. Clearly, it can be claimed that the governments' choice of objective function and the random component of aggregate demand are to blame for the situations that such countries find themselves in. Thus proposition 2 is established. In the case of vicious circles, however, there is an additional critical factor: the indexing arrangements that prevent monetary policy from havings its desired effect on output.

The preceding discussions provide the background for our third proposition.

Proposition 3. There exists a sufficiently high degree of partial wage indexation to ensure the following: The absolute size of the exchange rate and price level changes that may be expected to be associated with the pursuit of asymmetric domestic objective functions will be larger in the cases in which vicious circles result than in the cases in which virtuous circles result.

In this sense, it may be said that when vicious and virtuous circles result from the pursuit of asymmetric domestic objective functions, vicious circles will tend to be less stable, or more explosive, than virtuous circles. The economic intuition underlying this proposition is, again, straightforward.

We have seen that government efforts to stabilize output in the face of decreases in aggregate demand lead to larger increases in the price level and exchange rate, the greater the degree of wage indexation. Such efforts are necessarily explosive in the extreme case of a fully indexed economy. Efforts to stabilize the price level, however, never lead to unbounded changes in the exchange rate or prices. There is always some finite change in the money supply that will stabilize prices, regardless of the degree of wage indexation. Accordingly, there will always be some sufficiently high (but less than full) degree of indexing for which proposition 3 will hold.

The results of our analysis, as summarized by propositions 1 through 3, suggest that the most extreme form of vicious circle can be expected to occur in countries that have suffered significant negative shocks to aggregate demand and that, in addition, put a relatively heavy weight on maintaining output and employment at or above their full employment levels despite a high degree of wage indexation. Although implications of this sort provide testable hypotheses, empirical verification of our model is beyond the scope of this paper. It is tempting to point out, however, that these circumstances appear to fit the broad outlines of British and Italian experience in the mid 1970's. The analysis also implies that virtuous circles will occur in countries with a full employment objective if they experience positive shocks to aggregate demand. This may describe Japan following the 1973-74 oil crisis.[12/] Finally, virtuous circles may also be expected in countries where a relatively heavy weight is put on preventing increases in inflation. This, presumably, is a fair description of Germany's situation.

12/A disproportionately large share of OPEC's imports fell on Japanese goods during this period.

Appendix

The formal model underlying the analysis of this paper is given by equations (1) through (10) of the text plus the reaction function that determines the nominal money supply:

$$m_t^s = m_{t-1} + \rho_1(e_t - \bar{e}_t) + \rho_2(y_t - \bar{y}_t) + \rho_3(p_t - \bar{p}_t) \qquad \text{(A1)}$$

Here $\bar{e}_t$, $\bar{y}_t$, and $\bar{p}_t$ are the monetary authority's desired levels of the exchange rate, output, and the price level, respectively. While a number of plausible criteria exist for determining these target values, the analytics of the paper are considerably simplified by assuming that the desired level of each variable is the previous period's expectation of the current value of the variable. In our model that expected value also turns out to be the previous period's full equilibrium value of the variable, as well as the current period's full equilibrium value in the absence of any shocks.

Manipulation of the eleven equations constituting the formal structure of the model produces a difference equation in e_t, $e_{t/t-1}$, $e_{t+1/t}$, and the two error terms, U_t and E_t. This difference equation can be solved for the current value of the exchange rate, e_t, and its expected value next period, $e_{t+1/t}$. Substituting these solutions back into equations (1) through (4) of the text yields expressions for output, domestic prices, and the price level in terms of the disturbance terms and exogenous variables. These solutions are given in equations (A2) through (A5) below as deviations of actual values from their expected, or target levels. (E.g. $\hat{y}_t = y_t - y_{t/t-1} = y_t - \bar{y}$, $\hat{e}_t = e_t - e_{t/t-1}$, etc.)

$$\hat{y}_t = [(m_t - m_{t-1}) - U_t]\{\frac{(1+\lambda)\delta\sigma(1-\gamma)}{f(\gamma)}\}$$

$$+ E_t\{\frac{\sigma(1+\lambda)(1-\alpha)}{f(\gamma)}\}, \qquad \text{(A2)}$$

$$\hat{e}_t = [(m_t - m_{t-1}) - U_t]\{\frac{(1+\lambda)[\delta+\sigma(1-\gamma\alpha)]}{f(\gamma)}\}$$

$$- E_t\{\frac{\alpha(1+\lambda) + \sigma(1-\gamma\alpha)(\eta+\lambda\alpha/\delta)}{f(\gamma)}\}, \qquad \text{(A3)}$$

$$\hat{p}^d_t = [(m_t - m_{t-1}) - U_t]\{\frac{(1+\lambda)[\delta+\sigma\gamma(1-\alpha)]}{f(\gamma)}\}$$

$$- E_t\{\frac{(1+\alpha)[1+\lambda - \sigma\gamma(\eta+\lambda\alpha/\delta)}{f(\gamma)}\}, \qquad \text{(A4)}$$

$$\hat{p}_t = [(m_t - m_{t-1}) - U_t]\{\frac{(1+\lambda)[\delta+\sigma(1-\alpha)]}{f(\gamma)}\}$$

$$- E_t\{\frac{\sigma(1-\alpha)(\eta+\lambda\alpha/\delta)}{f(\gamma)}\}, \qquad \text{(A5)}$$

where $f(\gamma) = (1+\lambda)(\delta+\sigma) - \sigma\alpha(1+\lambda\gamma) + \eta\delta\sigma(1-\gamma)$.

The benchmark case discussed in section III is derived by setting $m_t = m_{t-1}$ in equations (A2) through (A5) above. For the special cases of fully indexed and non-indexed economies, γ is set equal to one and zero, respectively.

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