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by Edmund S. Phelps

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The series "Temi di discussione" intends to promote the circulation of preliminary drafts of papers prepared by the staff of the Banca d'Italia or presented by visiting economists at seminars held in the Bank, in order to stimulate critical comments and suggestions.

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The author is Mc Vickar Professor of Political Economy at Columbia University. This paper is one of a series written while Visiting Scholar at Banca d'Italia. The author was fortunate to have the assistance and advice of two staff members, Lorenzo Bini Smaghi and Luigi Guiso, in analyzing the models here and in relating them to the existing open-economy literature. Special thanks are due to Stefano Micossi for his thoughtful efforts to ease the way. The interest and hospitality of so many others of the Bank is also much appreciated. Long and useful discussions with K. Velupillai are also gratefully acknowledged.

It is hoped that this paper will serve to commemorate the dynamic aggregative model by James Tobin some thirty years ago and to break the obsessive spell which that paper has long cast over the present author.

The virtual absence of domestic-capital and net foreign-asset accumulation from open-economy macroeconomic models is a notable gap. To fill that gap this paper develops by stages a picture of small open economies that casts the dynamics of national wealth and domestic capital in central roles. The models in this paper are used to explore the channels by which fiscal and monetary policies influence the course of employment and prices, thus to examine the theoretical effectiveness of the standard macro-policy tools for economic stabilization.

A distinctive feature of the series of models here is their treatment of investment or capital-stock decisions along the capital-theoretic lines proposed by Keynes and Tobin 1/. The present paper is also differentiated from most of the open-economy literature by its aggregative view of the economy -- national income is a function of aggregate national wealth, and aggregate domestic product a function of aggregate domestic capital, with equilibrium relative prices of goods "given". In the models here these relative prices are given since all currently produced goods are tradeable and world prices are taken as given.

In contrast, open-economy macro analysis has come to emphasize the effects of macro policies on the real exchange rate and real interest rate (so called), and even to regard (or seems to regard) these effects as necessary concomitants for the effectiveness of these macro policies in stabilizing employment.

According to conventional open macro models, at least those positing perfect or substantial international capital mobility, the effectiveness of fiscal stimulus springs from relative price effects arising from national monopoly power or from a non-traded goods sector. A permanent fiscal stimulus in the form of a tax

cut or higher public expenditure, even if adding to domestic demand, has no effect, given the money-supply path, on total domestic output; with the exchange rate free, a real appreciation maintains interest-rate parity only through full "crowding out" of exports 2/. Paradoxically, the real appreciation effect renders fiscal stimulus effective if the stimulus is expected to be temporary: then expectations of a recovery of the exchange rate, both nominal and real, generate a rise of interest rates, nominal as well as real, and thus spur the velocity of money. It seems dubious, however, to credit substantial fiscal-policy effectiveness to these relative-price mechanisms -- taking for granted that such effectiveness exists, which is itself an unsettled question 3/-4/. There is evidence that in some countries a fiscal stimulus has provoked a fall of the currency, not an appreciation.

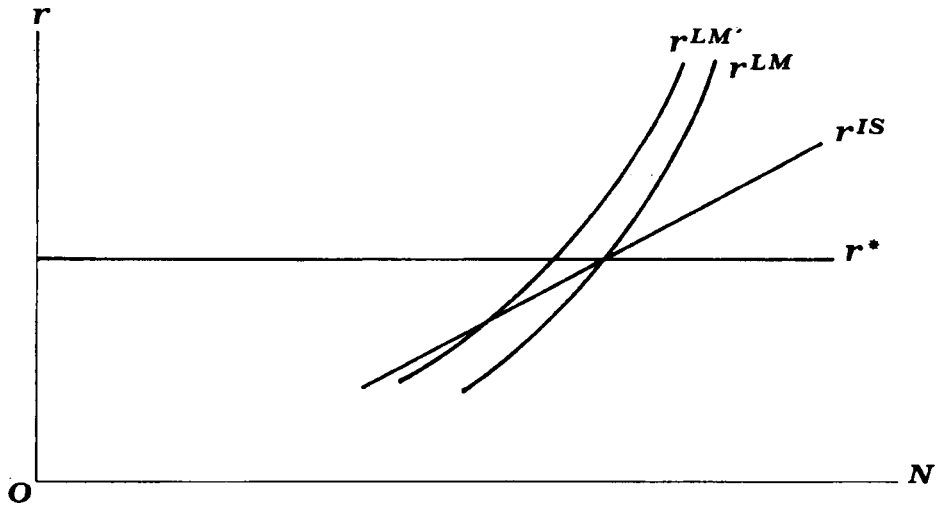
Monetary stimulus is conventionally portrayed as expanding employment by reducing the "real" interest rate -- more properly, the interest rate in terms of domestic product, or product-interest rate 5/. The reduction is seen as necessary for the (temporary) real depreciation on which (temporarily) increased export and import-competing production is said to depend. But according to much statistical analysis of the last few years money innovations do not "cause" interest-rate innovations, nor have the econometric investigations of more traditional type given adequate support to this view. Furthermore, we may note, even though our own model lacks investments needing domestic content as well, that if non-tradeable capital were introduced, then increased output might require a higher real interest rate to damp the resulting rise in investment spending on domestic goods; the study by Tanzi (1980) finds evidence of just such a positive "IS" relation between the product-interest rate and economic activity. In this case a real appreciation must come into play to resolve the discrepancy between the higher domestic interest rate and the world rate.

Our departures from the conventional models are captured in

large part by Figure 1. Since domestic relative prices are given by (and are identical to) world relative prices, the real rate of interest in terms of (any basket of) domestic goods is identical to the world real interest rate, r^*, in terms of (that basket of) foreign goods; there cannot be a real exchange depreciation or appreciation that would support a discrepancy between the domestic real interest rate and the world real rate since the real exchange rate is constant, independent of domestic actions. This constancy of relative prices also causes the IS curve (for a given value of Tobin's "q") to be unambiguously upward sloping, as higher utilization brings higher returns as a ratio to capital goods' producers prices (in real terms, or consumer-good units). As a result, a monetary shock causing a leftward shift of the LM curve (along which r^{LM} is calculated using a fixed inflation rate) from the initial three-way intersection generates a discrepancy between r^{IS} and r^*. The resolution of this discrepancy brings Tobin's "q" into play, which is a crucial variable for the dynamics of the capital stock.

Part I of this paper considers a model, referred to here as the prototype model, in which the incentive effects, or substitution effects, of taxes and subsidies are ignored. Section A sets out the structure of the model, section B a stability analysis of the model, and section C studies the effects of monetary and fiscal policy. In the prototype model tax cuts are expansionary only because they are rationally expected to be inflationary. Part II of this paper examines a richer model, one with fiscal incentives effects, in which the fiscal stimulus studied takes the form of a subsidy or tax inducement to investment. Although all capital goods are tradeable, this policy is shown to work through the supply side to expand employment as well as output and the capital stock.

Figure 1



I. MODELS WITH ALL PRODUCTION TRADEABLE

A. Structure of the Prototype Model

Subject to a significant exception, one can say that in the models of this section all goods are tradeable and the law of one price applies. For every consumer good and every capital good there is a foreign price, P^*_{Ci} and P^*_{Kj} respectively, in terms of some foreign currency or amalgam of such. With E denoting the exchange rate, the equations $P_{Ci} = EP^*_{Ci}$ and $P_{Kj} = EP^*_{Kj}$ determine the producer prices at home in units of local currency: a home producer would not produce a capital good for home sale at a price less than EP^*_{Kj} and could not obtain a price at home or abroad greater than EP^*_{Kj}. The exception is that the asset-market valuation of such an asset, Q_j, could be lower, since capital goods in place cannot be exported nor consumed.

As the country's perfectly competitive producers maximize profit, the resulting allocation of employed labor, N, and the various capital stocks, K_1, K_2, K_3, ..., serves to maximize the real value of domestic output, Z:

$$Z = \max \left\{ \sum_i (P^*_{Ci}/P^*_{C1}) F^i(N^i, K^i_1, K^i_2 P^*_{K2}/P_{K1}, \ldots) + \sum_j (P^*_{Kj}/P^*_{C1}) G^j(N^j, K^j_1, K^j_2 P^*_{K2}/P_{K1}, \ldots) \right\}$$

subject to the input totals

$$\sum_i N^i + \sum_j N^j = N, \quad \sum_i K^i_m + \sum_j K^j_m = K_m, \quad m = 1, 2, \ldots$$

Upon aggregating the fixed-weight outputs and, further, assuming that producers have not invested in the wrong mix of capital goods, so that $F^i_2 = F^i_3 = \ldots = F^j_2 = F^j_3 = \ldots$, we can write 6/

$$(1) \qquad Z = F(N, K), \quad K = \sum_j (P^*_{Kj}/P^*_{K1})K_j.$$

F is taken to be a well-behaved CRS production function, like F^i and G^i. It will be supposed that each of the relative prices above remains fixed over time so that the index numbers Z and K are intertemporally comparable. P_C will denote an index of consumer-good prices (e.g., $P_C = P_{C1}$) and P_K an index of capital-good (producer) prices. Since these relative prices are arbitrary the country may (or may not) specialize in consumer-good or capital-good production.

In the models here the law of one price is seen as determining the price level through the exchange rate:

$$(2) \qquad P_C = EP^*_C$$

Domestic producers adjust output to equate marginal cost to price. Hence, if P_{C1} serves as the price level index P_C,

$$(3) \qquad W = P_C F_N(K, N)$$

where W denotes the money wage. Aggregate employment is thus determined through the exchange rate. The unit real rental on capital, R, is given by

$$(4) \qquad R = F_K(N, K) \equiv \left[F(1, N/K) - F_N(1, N/K)N\right]/K \equiv R(p)$$

where $p \equiv P_C/W$, the consumer price level "in wage units", is the reciprocal of the real wage.

There are the familiar distinctions between gross domestic product, Z, and gross national income, or product, Y, and between domestic capital, K, and nationally owned capital, S. For simplicity we focus on the gross debtor case in which the national wealth consists only of foreign shares and only

foreigners own the domestic capital stock. Hence

(1') $Z \equiv p^{-1}N+R(p)K$

(5) $Y = p^{-1}N+R^{*}(p^{*})S$

As noted in the introduction, the real interest rate satisfies

(6) $r = r^{*}\ (=i^{*}-\dot{P}_C^{*}/P_C^{*}+\dot{E}/E+\dot{P}_C^{*}/P_C^{*}-\dot{P}_C/P_C)$

since $EP_C^{*}/P_C = 1$ here. This means that the world's shareowners require that the country's shares offer the same foreseen real rate of return as that available elsewhere in the world.

In the prototype model the real rate of return on shares, given perfect foresight following "news", is

(7) $r = q^{-1}(F_K-\mu)+(1-q^{-1})\dot{K}/K+\dot{q}/q$

as is argued at some length in Phelps (1978) and Risager (1984). But it should be noted that this equation will eventually be modified to take into account the influence of profits taxation and investment tax incentives. In (7) $q \equiv Q/P_C$, the ratio of the nominal price of shares, Q, to the consumer-good price index, P_C. A share is effectively a claim to one unit of K. To accord with the prevailing convention we choose units such that $P_K/P_C = P_K^{*}/P_C^{*} = 1$ so that $q = Q/P_K$; consequently $q = 1$ whenever Q equals the index of producer prices, P_K, which is the marginal cost of "reproducing" a unit of capital either by home production or importation, whichever is cheaper.

To derive (7) one can start with a self-evident relation, $rq = F_K - q\mu - (1-q)(\mu+\dot{K}/K) + \dot{q}$. To the net rent per share is subtracted the algebraic loss to the shareowner from gross investment when $q \neq 1$. Then manipulate terms to obtain (7).

It can be seen from (7) that if $q > 1$ firms would by

implication want to invest at an infinite rate in an effort to maximize their returns; the capital stock would jump under instantaneous tradeability and q would jump back to 1. Hence $q \leq 1$. (We shall avoid such a jump in addressing the analysis at first to circumstances in which deflation or disinflation rather than boom conditions are the result. But we will want to consider a downward jump by way of an exercise). For investment behavior, then, there are two cases:

$$(8) \qquad \dot{K} \begin{cases} = -\mu K & \text{if} \quad q < 1 \\ \geq -\mu K & \text{if} \quad q = 1 \end{cases}$$

Equating the righthand sides of (6) and (7) gives the arbitrage condition that the share return must equal the foreign return, r^*. Using (8) the share return can be simplified since if $q = 1$ then $\dot{K}/K$ does not matter, while if $q < 1$ then $\dot{K}/K = -\mu$. Hence the arbitrage condition, for $q \leq 1$, is

$$(7') \qquad r^* = q^{-1}(F_K - \mu) + (1-q^{-1})(-\mu) + \dot{q}/q \equiv \frac{F_K - q\mu}{q} + \dot{q}/q$$

or

$$(7'') \qquad \dot{q}/q = r^* + \mu - q^{-1}F_K \equiv r^* + \mu - (f_K + \mu)q^{-1}$$

where $f_K \equiv F_K - \mu$. Note that the righthand side may be written $r^* - f_K - (f_K + \mu)(q^{-1}-1)$ from which it follows that $q < 1$ when $r^* > f_K$; for if $q = 1$ then $\dot{q} > 0$ would be implied, hence that $q > 1$ in the future.

The nominal interest rate, i, defined by

$$(9) \qquad i = r + \dot{P}_C/P_C,$$

enters into the supply-demand for money equation in the usual

way:

$$(10) \qquad M = P_C L(Y_d, i), \quad L_Y > 0, \; L_i < 0, \text{ or equivalently}$$

$$(10') \qquad i = h(Y_d, M/P_c), \quad h_Y > 0, \; h_M < 0.$$

Here the first argument is not national product but disposable cash income, that is, national cash income plus interest income on the net debt, all of which is indexed and domestically held, less taxes, which are in turn smaller than public outlays by the amount of the real deficit, δ:

$$(11) \qquad Y_d = NW/P_C+(\bar{F}_K^*-\mu^*)S+r^*(D-D_{CB})-(G+r^*D-r^*D_{CB}-\delta)$$

The rationale for cash flow is simply the Baumol-Tobin transaction cost of going out of and into cash for consumer and asset purchases 7/.

With the inversion $i = h(Y_d, M/P_C)$ and using (6) and (9) to substitute for i, we obtain

$$(10'') \qquad \dot{P}_C/P_C = h\left[NW/P_C+(\bar{F}_K^*-\mu^*)S-G+\delta, \; M/P_C\right] - r^*, \quad h_Y > 0, \quad h_M < .0$$

A wealth accumulation equation and a wage equation are required to close the model. From the accounting relation

$$q^*\dot{S}+\dot{q}^*S = p^{-1}N+r^*q^*S-G+\delta-C-\dot{D},$$

one obtains a related relation,

$$q^*\dot{S} = p^{-1}N+\left[q^{*-1}(F_K^*-\mu^*)+(1-q^{*-1})(-\mu^*)\right]q^*S-G-C$$

$$= p^{-1}N+F_K^*S-\mu^*q^*S-G-C,$$

where the bracketed expression represents dividends on the

country's (overseas) shares and where $-\mu^*$ has been substituted for $\dot{K}^*/K^*$ without violating the relevant theory (as in (7')). Specializing to the case in which $q^* = 1$ we posit a simple saving rule,

$$(12) \qquad \dot{S} = p^{-1}N + f_K^* S - G - c\left[p^{-1}N + f_K^* S - G + \delta\right] - b(S+D), \qquad 0 < c < 1, \quad b > (1-c) f_K^*$$

The specification of the behavior of money wages presents a familiar set of hard choices. As far back as Phelps (1968) it was understood that the periodical and non-synchronized pattern in the individual firms' wage-setting behavior provided an attractive explanation of why the average money wage level does not jump despite discrete macro shocks and thus cannot prevent employment from being jarred from the steady-state equilibrium employment level -- which level, if invariant to inflation, is called the natural employment level. Firms that schedule their annual wage revision on the ith day of the year and that anticipate steady wage inflation over the year ahead will set the wage, W_i, above the flexible level, $\tilde{W}_i$, which would be adequate if wages were continuously revised, by a percentage margin equal to half the expected percentage increase, ω_i, over the year in the desired, or flexible, wage:

$$\log W_i = \log \tilde{W}_i + (1/2)\omega_i$$

Making certain linear approximations, Mussa (1981) has shown how this wage system leads to a simple equation for the rate of change of the average money wage, W,

$$\frac{\dot{W}(t)}{W(t)} = \gamma\left[\log \tilde{W}(t) - \log W(t)\right] + \frac{\dot{\tilde{W}}^e(t)}{\tilde{W}(t)}, \qquad \gamma > 0,$$

where $\dot{\tilde{W}}^e(t)/\tilde{W}(t)$ is the instantaneous expected rate of growth of the flexible wage (which need not clear the market) 8/. Upon associating the algebraic shortfall of the actual (nominal) wage from the flexible level, which would keep employment at the natural level if it were continuously instituted by all the firms, with the algebraic excess of employment over the natural level which must result via the LM curve, we have

$$\frac{\dot{W}(t)}{W(t)} = g\,(N(t) - \tilde{N}) + \frac{\dot{\tilde{W}}^e(t)}{\tilde{W}(t)}, \quad g > 0,$$

where the natural employment level, $\tilde{N}$, is treated as fixed over time. As a rough approximation suited to the "stationary" settings found in sections A, B, and C below we will work with the still simpler relation 9/

$$(13) \qquad \frac{\dot{W}}{W} = g\,(N - \tilde{N}), \quad g > 0$$

In any disinflation exercise a different representation of the staggered wage-setting process must be substituted for (13). Note that indexation of a firm's wage to the general price or general wage level has been omitted. But it is doubtful that private mid-stream indexation to adjust a firm's wage in the last six months, say, of its run would make a crucial difference. Governmental indexation is another matter.

With the addition of the wage change equation, the prototype model (which omits certain incentive effects of the tax structure) contains the requisite number of equations to determine the paths of the thirteen endogenous variables, Z, N, K, P_C, E or M, R, Y, S, r, q, i, Y_d and W. In this system δ (t) and thus D(t), given the initial D_0, are taken to be exogenous. If M(t) is exogenous then E is endogenous and vice-versa.

B. Stability Analysis of the Prototype Model

When M(t) is exogenous and $q < 1$ the above system reduces to five differential equations:

$$(14i)\quad \frac{\dot{N}}{N} = \frac{F_N N/K}{-F_{NN}}\left\{h\left[NF_N(N,K)+f_K^*S-G+\delta(t),\frac{M(t)F_N(N,K)}{W}\right]-r^*-\frac{\dot{W}}{W}\right\}+\frac{\dot{K}}{K}$$

$$(14ii)\quad \frac{\dot{q}}{q} = -\frac{F_K(K,N)}{q}+\mu+r^*$$

$$(14iii)\quad \dot{S} = (1-c)\left[NF_N(N,K)-G\right]+\left[(1-c)f_K^*-b\right]S-c\,\delta(t)-bD(t)$$

$$(14iv)\quad \dot{K} = -\mu K$$

$$(14v)\quad \frac{\dot{W}}{W} = g\,(N-\tilde{N})$$

However, within any interval in which $q = 1$ it is trivial that $\dot{q} = 0$ almost everywhere (save possibly at the end point of the interval) so that the differential equation in $\dot{q}$ requires $\dot{K}$ to be such in relation to $\dot{N}$ as to satisfy $0 = -F_K(K,N)+\mu+r^*$. In such an interval, then, p, $F_K(K,N)$ and $F_N(K,N)$ are unvarying, like q in that interval. For intervals where $q = 1$, therefore, the system reduces further to

$$(15i)\quad 0 = h\left[Np^{-1}+f_K^*S-G+\delta(t),\frac{M(t)p^{-1}}{W}\right]-r^*-g(.)$$

$$(15ii)\quad \dot{S} = (1-c)\left[Np^{-1}-G\right]+\left[(1-c)f_K^*-b\right]S-c\,\delta(t)-bD(t)$$

$$(15iii)\quad \dot{W} = W\,g\,(N-\tilde{N})$$

where $R(p) = r^* + \mu$ determines the constant p. Since the steady state also satisfies (15) the constant p is the steady-state value, $\bar{p}$.

The steady-state solution, where $\dot{N}=\dot{q}=\dot{S}=\dot{K}=\dot{W}=0$, occurs at $(\bar{N},\bar{q},\bar{S},\bar{K},\bar{W})$ satisfying

$$r^* = h(\overline{Np}^{-1} + \bar{S}f_K^* - G,\ M/\overline{pW})$$

$$\bar{q} = 1$$

$$\bar{S} = \left[b-(1-c)f_K^*\right]^{-1}\left[(1-c)(\overline{Np}^{-1}-G) - bD\right]$$

$$r^* = F_K(\bar{K},\bar{N}) - \mu$$

$$\bar{N} = \tilde{N}$$

where M and D are constant and $\bar{p}$ is equal to $F_N(\bar{K},\bar{N})^{-1}$. Thus for a steady state the wage must equate the nominal interest rate implied by h at $\bar{N}$ and $\bar{S}$ to r^*. National wealth, S, must rise until b(S+D) makes consumption absorb the national income net of government spending.

It is clear that $\bar{W}$ is proportional to M while q, p, and the rest are invariant -- the (built-in) neutrality of money. An increase of D crowds out S (with a coefficient greater than unity). Thus it increases $\bar{W}$ and $\bar{P}$ $(=\overline{pW})$.

To obtain a view of the stability properties of the system consider an initial situation in which the initial wage, W_o, is greater than $\bar{W}$ though K and S are initially at their steady-state levels. Then, it will be seen, there is a <u>first phase</u> in which $N<\bar{N}$, hence $F_K(\bar{K},N)-\mu < r^*$, therefore $\dot{q} < 1$ and $\dot{K} < 0$. But if the system is ever to approach the steady state there must be a <u>second phase</u> during which $q = 1$ so that, sooner or later, "rebuilding" of the capital stock can commence. In

this phase, with $F_K(K,N) = r^* + \mu$, capital and output subside or recover always in fixed proportion to domestic employment, a pattern reminiscent of the growth model sketched by Harrod (1939). The solution for the growth rate of employment derivable from (15) is essentially Harrod's warranted growth rate of capital; if capital were to race ahead output would rise relatively less, employment would fall, q would drop below one and gross investment would pause; but this phase is only semi-Harrodian since the warranted growth rate of the capital stock is not a constant nor a function of society's thrift (as measured by 1-c, say). We shall see that once in the second phase, defined by q continuously equal to one, the economy remains indefinitely in that phase. The economy thereupon approaches its steady state.

The conventional macro diagrams in Figure 2 provide a useful preliminary view of these two phases, though not an adequate analysis. In panel 2A excessive wages (or insufficient money supply) have left the aggregate demand schedule "deficient" for supporting employment at the natural level; the prospect of ensuing deflation exacerbates the deficiency. Panel 2B reveals the LM shortfall lying behind the deficiency **10/**. In these diagrams the numeral 1 marks the starting point in the first phase. From any point in this phase the motion is indicated by the arrows: Falling K is likely to pull LM leftward, though the $F_K - \mu$ curve is pulled leftward faster; at the same time W and S are falling due to the slump ($N<\bar{N}$), which tends to pull LM rightward; so the gap between the curves tend to narrow -- and is necessarily closed in the stable case. The point at which the gap is first closed, labelled 2, marks the beginning of the second phase. Thereupon the steady decline of W pulls LM rightward, helped by falling S until S rebounds, while K grows proportionally with N, so that $F_K - \mu$ is pulled rightward in step with LM **11/**. An adequate analysis, however, requires a study of the phase diagrams of the two equation systems.

The main features of the second phase are derived from the

Figure 2a

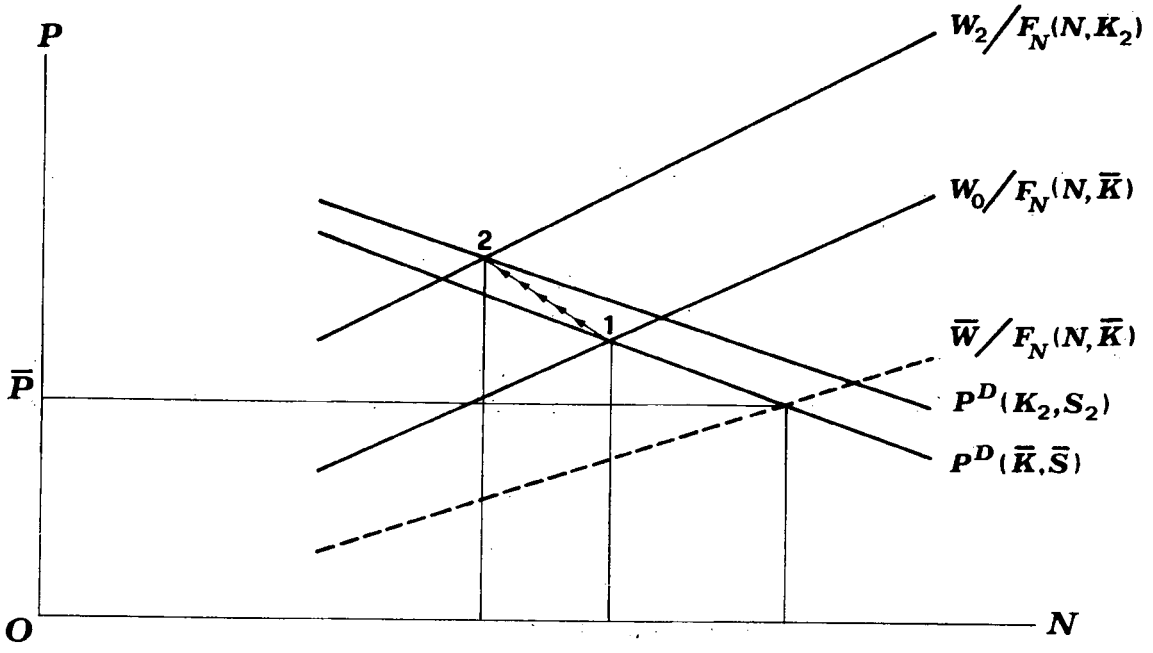
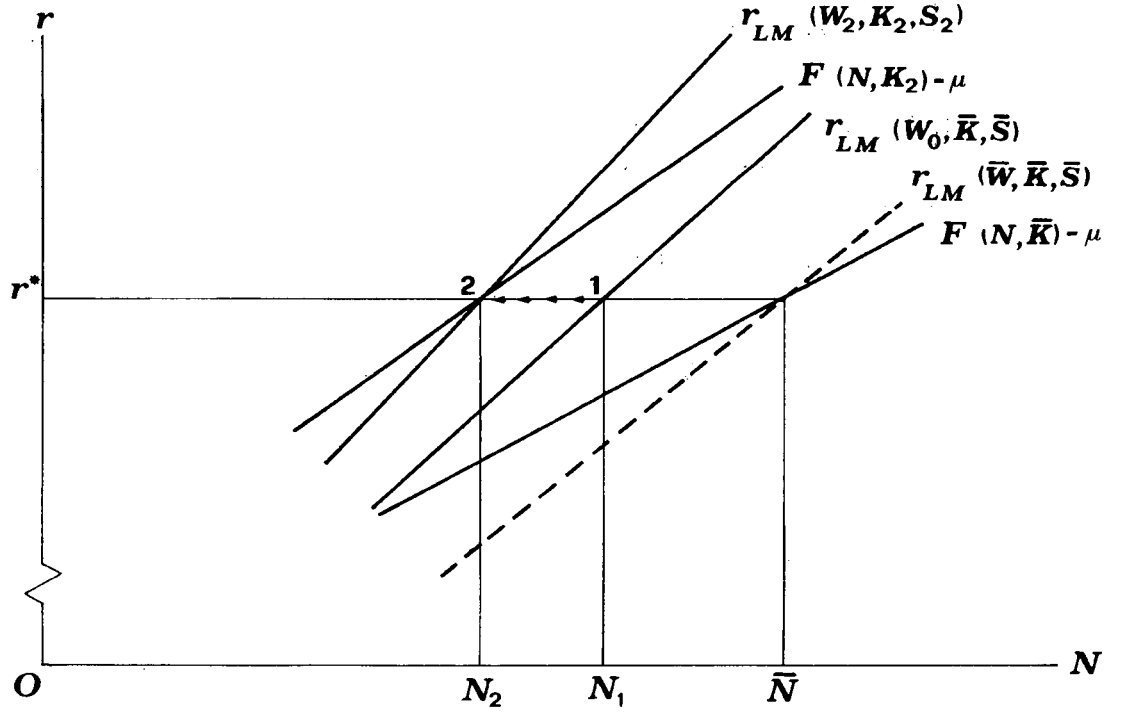


Figure 2b



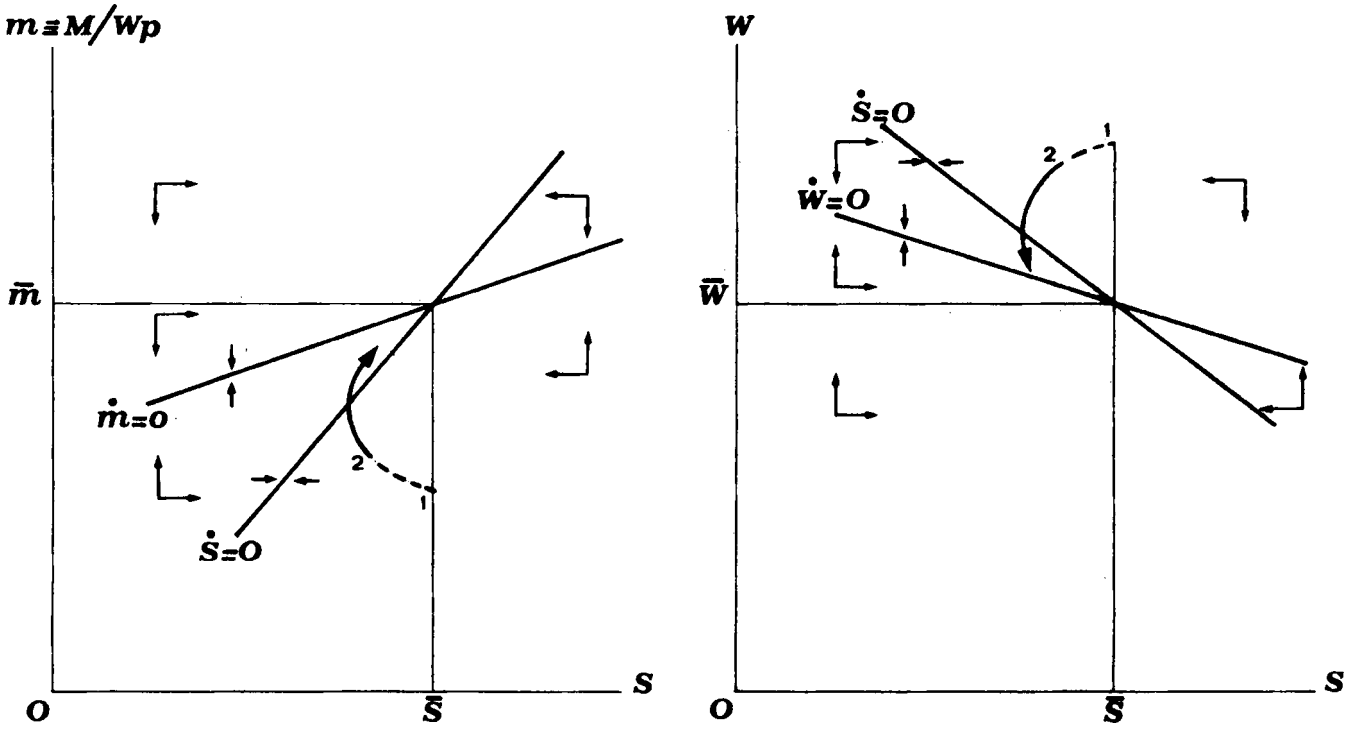
phase diagram of equation-system (15) in Figure 3. Although the slump is into its recovery phase here, the wage continues to fall as long as the slump remains -- as long as $N<\bar{N}$. At first, national wealth, S, may still be falling as well. Conceivably the wage overshoots, setting the stage for a boom following the slump: W might reach $\bar{W}$ when W is still falling, and therefore N is still less than $\bar{N}$, a case of overshooting wages. But Figure 3 shows this does not happen. Since the sag of S during the slump reduces the demand for real balances (at $\bar{N}$) and thus temporarily lessens the increase in the supply of real balances needed to boost employment to the natural level, a wage level less than $\bar{W}$ would imply $N>\bar{N}$ and hence such a wage level cannot be reached at any time during the slump. Thus the "flexible wage" is actually elevated during the slump. Yet, as Figure 3 indicates, this "flexible wage" level is only approached, not attained, because at some point S begins to recover, causing the flexible wage to fall toward $\bar{W}$ always ahead of the actual wage.

The fundamental properties of the first phase can be grasped from the phase diagram for equation system (14) in Figure 4. A rigorous analysis of stability here would be quite demanding, owing to the nonclassical discontinuity exhibited in investment behavior. But for that very reason the essential nature of the solution (which is clear enough once hit upon) may be worth conveying here in the main text for interested readers. For an analysis of the first phase we rewrite a subset of the equation system (14) in the following form:

$$(14'i)\quad \frac{\dot{p}}{p} = h\left[p^{-1}\, n(p)\, K_o e^{-\mu t} + f_K^* S - G + \delta(t),\ M/pW\right] - r^* - g(n(p)K_o e^{-\mu t} - \tilde{N})$$

$$(14'ii)\quad \frac{\dot{W}}{W} = g\left[n(p)K_o e^{-\mu t} - \tilde{N}\right]$$

Figure 3

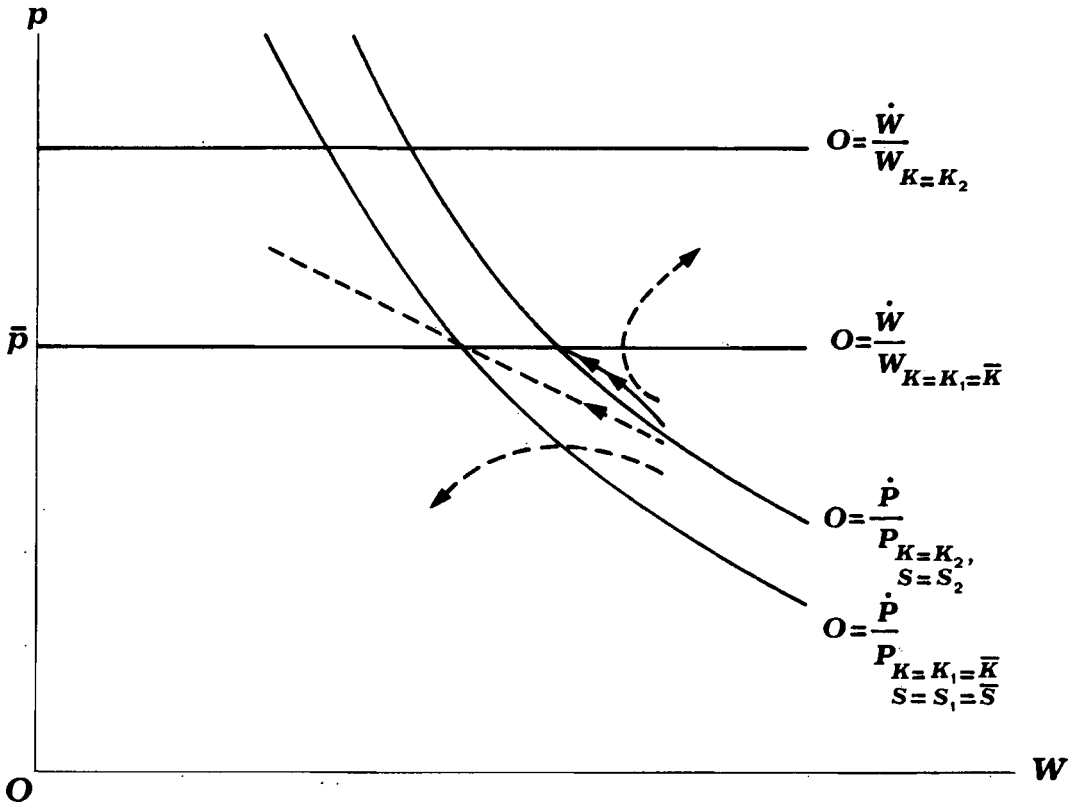


$$(14'iii)\quad \dot{S} = (1-c)\left[p^{-1}\, n(p)\, K_o e^{-\mu t} - G\right] + \left[(1-c)f_K^* - b\right] S - c\,\delta(t) - bD(t)$$

where n(p) denotes the employment - capital ratio considered as a decreasing function of the product wage, p^{-1}, hence $n'(p) > 0$. Recall that we are discussing balanced-budget behavior, so $\delta(t) = 0$ and $D(t) = D$ for all t.

Figure 4 shows successive slices of the phase plane for this system, each slice corresponding to a given moment, t, with its current S(t) and K(t). In this system $\dot{p}$ is increasing in p since a higher p lowers M/pW and presumably does not decrease $p^{-1}\, n(p)K$, which implies a higher nominal interest rate, $h(\cdot)$, and thus a higher inflation rate to satisfy $\dot{p}/p + \dot{W}/W = h(\cdot) - r^*$. Similar analysis shows that $\dot{p}$ is also increasing in W. Each $\dot{p} = 0$ locus is therefore negatively sloped. Clearly $\dot{W}$ is increasing in p and functionally independent of W. Each $\dot{W} = 0$ locus is consequently flat. For <u>fixed</u> S and K, therefore, there is saddle-path stability: if S and K are fixed at $\bar{S}$ and $\bar{K}$ respectively, the associated $\dot{p} = 0$ and $\dot{W} = 0$ locus generate a corresponding saddle path -- the dashed straight line in Figure 4 -- that proceeds straight to the steady-state point $(\bar{W},\bar{p})$; initially lower trajectories are always flatter and curve <u>down and away</u> from the latter rest point, while the initially higher trajectories are always steeper and curve <u>up and away</u>, likewise missing the rest point. But K will be decreasing, at rate μ to be exact, as long as $p < \bar{p}$ since that inequality implies $f_K < r^*$ and therefore $q < 1$, as noted circa equation (7"). Since employment, nK, is increasing in K, $\dot{W}$ is increasing in K, so a fall of K would require a rise of $\dot{p}$ to keep employment unchanged and thus keep $\dot{W}$ at zero; so the $\dot{W} = 0$ locus will be rising when K is falling. Since $\dot{p}$ is increasing in K, for we take h to be more sensitive to N than $\dot{W}/W$, a fall of K would also require a rise of p to keep $\dot{p}$ at zero (though a lesser rise than that needed to keep W at

Figure 4


p
$\bar{p}$
O
W
$O=\frac{\dot{W}}{W}_{K=K_2}$
$O=\frac{\dot{W}}{W}_{K=K_1=\bar{K}}$
$O=\frac{\dot{P}}{P}_{K=K_2, S=S_2}$
$O=\frac{\dot{P}}{P}_{K=K_1=\bar{K} \; S=S_1=\bar{S}}$

zero); so the $p = 0$ locus will also be rising as long as K is falling 12/.

The key observation is that the successive fixed-S-and-K loci on which $\dot{p} = 0$ are successively higher and higher. Consequently a trajectory that starts out at a high enough initial p that it would strike the horizontal $\bar{p}$ line with a non-zero slope if S and K were fixed will actually level off and thereupon curve downward if the initial p is not too high for the rising $\dot{p} = 0$ locus to catch up to the trajectory and pull it downward. The initial p given by the original dashed-line saddle is a clear example. Note that if the initial p is that low, the "catch up" will occur when p is still below $\bar{p}$, whereupon p will begin falling; the trajectory will curve down without reaching the $\bar{p}$ line. And if the initial p is too high the trajectory will crash through the $\bar{p}$ line before curving down. There must exist some intermediate trajectory, and just one by virtue of the continuity of the trajectories, that will curve down and away from the horizontal $p = \bar{p}$ line after a point of tangency with that line. This trajectory meets the transversality condition of a "soft landing" that the solution for the path in the first phase must meet: every trajectory that fails to intersect the $\bar{p} = p$ line, because it curves down prematurely, is ineligible since it never produces a transition to the second phase; such trajectories are unstable and inadmissible as solutions here. Every trajectory that (first) strikes the $p = \bar{p}$ line with positive slope, because it curves up or fails to curve down in time, is ineligible since it achieves $p = \bar{p}$ only by generating $\dot{p} > 0$ at that moment, but $\bar{p}$ is an upper bound and the discountinuous drop in $\dot{p}$ would entail a drop in p as well; so such trajectories are inconsistent with correct expectations. The tangent trajectory is the only eligible one. Once the tangency is reached, the economy shifts into the second phase.

C. Policy Effects in the Prototype Model

Here we examine the effects of stabilization policies in the prototype model, beginning with the monetarist case and followed by the fixed exchange-rate case.

1. Monetarist regimes

Let us first take up the effectiveness of fiscal policy in the prototype model.

In our prototype aggregative model, like Tobin's closed-economy aggregative model, there is the familiar problem that a government deficit appears to have no effect on output. The extra consumer spending or the extra government spending that is associated with the temporary deficit must raise the price of domestic output or else raise the stock of capital if it is to elicit more domestic production; if it does not there will simply be a larger import volume or a smaller volume of exports. How can a fiscal stimulus have such an effect?

The closed-economy version of this problem was resolved by Calvo (1980) with the observation that a sustained elevation of G + C, in the familiar language of macroeconomics, tends to crowd out investment, and the ensuing decline of the capital stock drives up the price level in Calvo's fixed nominal wage model. The prospect of the rising price level induces a portfolio shift toward capital goods -- it shifts down our r^{LM} curve -- with the result that the price level jumps up, led by capital goods prices which bear the direct impact, and consequently employment jumps likewise in response to the higher prices.

In the present open-economy model the capital stock is not crowded out by tax cuts nor by increased public spending. Nevertheless, national wealth is crowded out, and this effect will be shown to be vehicle for an expansionary influence on

employment -- though the mechanism is somewhat similar to Calvo's closed-economy mechanism only in certain cases.

Consider a tax cut -- which can be viewed as the outcome of a shift in some "tax function" left implicit here (see Blanchard (1985)) -- that produces an asymptotically vanishing deficit and thus a gradual rise of the public debt toward some higher level: $\delta(0) > 0$, $\delta(\infty) = 0$, $D(\infty) > D_o$. If the economy is in a slump and still in phase 1, what is the effect on employment of this new and (we suppose) unanticipated fiscal policy?

We shall analyse the question while first disregarding the effect of $\delta(t)$ in the monetary equation (14i). With these groundrules the phase 1 system clearly reduces to

$$(16i)\quad \frac{\dot{p}}{p} = h\left[p^{-1} n(p)K_o e^{-\mu t} + f_K^* S - G,\ M/pW\right] - r^* - g(n(p)K - \tilde{N})$$

$$(16ii)\quad \dot{W} = Wg\left[n(p)K_o e^{-\mu t} - \tilde{N}\right]$$

$$(16iii)\quad \dot{S} = (1-c)\left[p^{-1}n(p)K_o e^{-\mu t} - G\right] + \left[(1-c)f_K^* - b\right] S - c\,\delta(t) - bD(t)$$

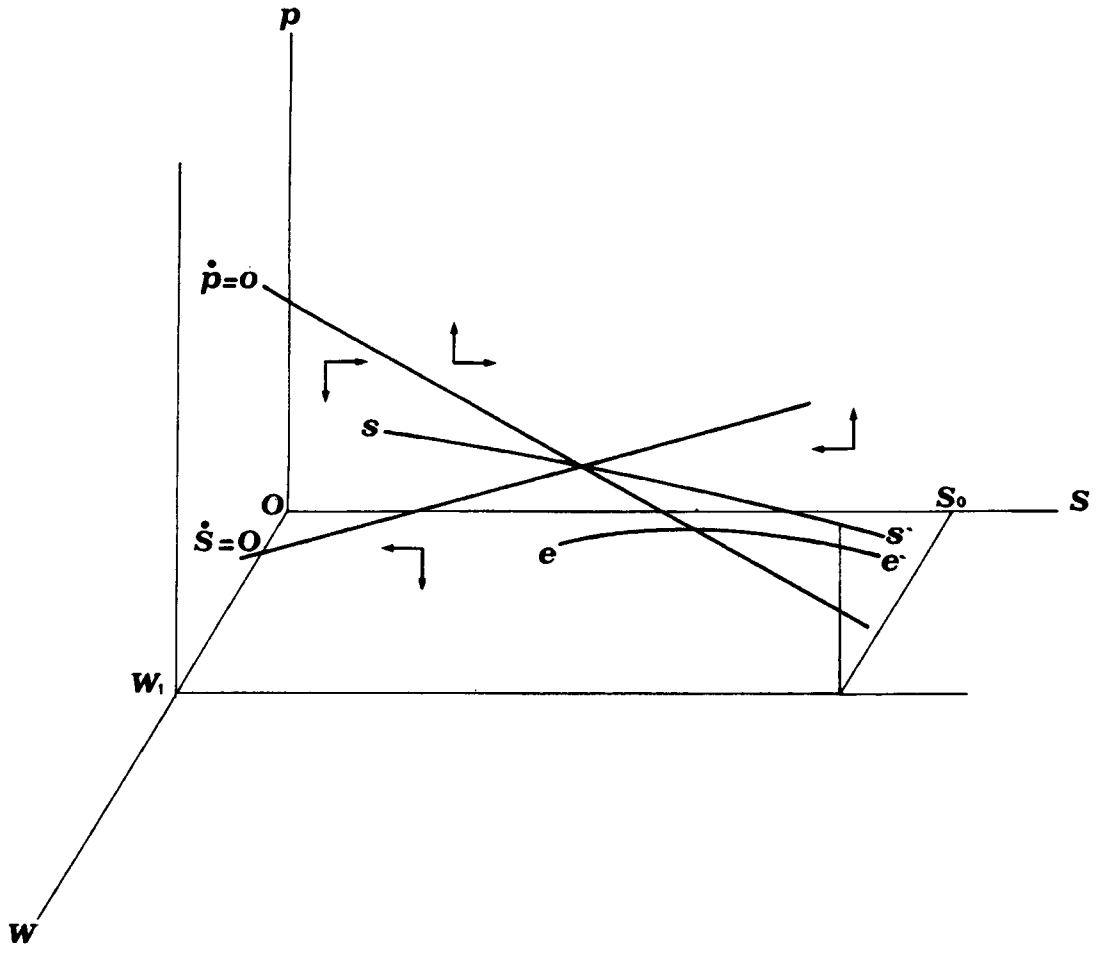
where, as before, n(p) denotes the employment-capital ratio, with derivative $n'(p) > 0$. In this phase of a slump, it is useful to conceive of the actual wage, W, as exceeding the "critical" wage level, $\tilde{\tilde{W}}(K,S)$, which is the wage level just low enough for $f_K(N,K) = f_K^*$ and thus for the commencement of phase 2 in which $q = 1$ and $p = \bar{p}$; therefore, $p < \bar{p}$ throughout phase 1 until the end when p(t) hits $\bar{p} = \bar{F}_N^{-1}$. This recovery of p to its normal level is accomplished through the shrinkage of K and S, which serve to lift $\tilde{\tilde{W}}(K,S)$, and the continuing slump, as measured by $\tilde{N} - N$, which drives down the wage.

The channel by which a fiscal stimulus such as specified

above will expand employment and output can now be identified: by speeding up the decline of S, the fiscal stimulus operates to advance the time at which the price level will reach its normal level; it causes K_2 and N_2, the capital stock and employment levels at which Phase 2 begins, to increase since S will be doing more of the work (thus K and N less of the work) of lifting $\tilde{\tilde{W}}$. Hence the complete recovery of p to the normal level, $\bar{p}$, is hastened. The expectation of the earlier arrival of $\bar{p}$ will cause an anticipatory increase of p(t) at the new policy since the prospective capital gains, being less distant, will be discounted less heavily than before. More accurately, the initial increase in the nominal rate of return from owning overseas assets implied by the prospect of a quicker rise of P and E in that time, given that wages will be falling at the same rate as before or less fast, will cause a rise in the opportunity cost of holding money; and insofar as that effect induces a decrease in the amount of money demanded, there must result an immediate upward jump of the price level. Figure 5 gives a diagrammatic presentation of the essentials in the argument, where the curves and arrows shown are on a slice of the phase portrait corresponding to a particular wage level and capital stock: the (vanishing) increase of δ (t) and the increasing D(t) serve to shift up the $\dot{S} = 0$ surface, which displaces upwards the saddle path, ss', and, what is crucial, the equilibrium path, ee'. (It should be understood that, as W and K are falling, the ee' locus will itself be shifting up, so the actual path taken by p and S is steeper).

In phase 2 also, the "blip" in δ (t) and the rise of D(t) operate to expand employment, though the unanticipated introduction of such a fiscal stimulus in that phase would not cause employment to jump, only to recover at a faster rate. The curve labelled $\dot{S} = 0$ shifts to the left with the result that $\bar{W}$ is increased and $\bar{S}$ as well as $M/\overline{pW}$ are decreased. It might be conjectured by readers that P, being expected to rise ultimately to a higher P, would jump up on the news of the policy change.

Figure 5



But p cannot jump up for if it rose f_K would rise above r^* and thus bring a jump of the capital stock that would erase the increase of p; and neither can W jump. It might next be conjectured that employment and capital will both jump, in equal proportion so that p remains at $\bar{p}$, alongside a jump of $\dot{W}$; the argument would be that an increase of $\dot{W}/W$ raises the flat surrogate IS curve, with intercept $r^* + \dot{W}/W$, so that it intersects the LM curve at a higher N. But such an increase of N would raise gN less than i, as given by h, since the LM curve is steeper than the Phillips curve; only if the curves coincided would such a jump be logically admissible. Clearly, from Figure 3, the shift of the $\dot{S} = 0$ curve merely accelerates the <u>growth</u> of of N and the growth of $\dot{W}$ (which is rising toward zero). Still, this is an expansionary effect and it cumulates with the growth of D(t) and contraction of S(t), although the Phillips-curve behavior of the money wage ultimately brings employment back to the level $\tilde{N}$.

It can be seen that there is a counter-effect that operates as long as δ (t) remains elevated by the new fiscal policy. The implied increase in disposable cash income at each level of employment caused by the increased δ (t) adds to the demand for money and thus produces a contractionary shift of the "LM" component in equations (14i) and (15i). Taken alone, this effect shifts downward the $\dot{p} = 0$ locus shown in Figure 5, since a higher M/pW would be required for the same $\dot{p}$, which displaces the ss' and ee' loci downwards. Two comments are needed here. One point is that δ (t) vanishes while the expansionary influences of the increased D(t) and decreased S(t) live on, so there is an expansionary effect in the medium term at least; and the anticipation of that later inflation will have an expansionary effect in the present. Second, the central bank may choose to accommodate the temporary shift in the demand for money without repudiating its monetarism, so the contractionary effect is neutralized, which leaves the expansionary effect (via the above

inflation mechanism) unopposed.

To put the above result on fiscal stimulus into perspective two remarks are in order. In certain dynamic models, such as Phelps (1984), that extend the earlier Mundell-Flemming framework (1962, 1963), permanent fiscal stimulus is expansionary because there is a real currency appreciation that "wears off" in those models, so there is the expectation of a rebound of the currency, which drives up the interest rate, promotes dishoarding of cash balances, and thus permits output to be higher (and the currency appreciation to be less) than under the Mundell-Flemming complete-crowding-out mechanism; a temporary fiscal stimulus has a similar effect. But it is interesting to see that there is an inflation mechanism that also operates, and can do so with or without the temporary-appreciation mechanism. Thus, fiscal stimulus may be expansionary not because it causes expectations of a reverse depreciation following a currency appreciation but rather because it causes the expectation of a further depreciation after the initial one.

The effects of the monetary stance need less elaboration. An unanticipated and permanent <u>decrease</u> of money supply causes a drop of p and N. From any initial situation with $q = 1$, thus $p = \bar{p}$, such as a phase 2 situation, the economy is sent back to phase 1; and from any phase 1 situation the $\dot{p} = 0$ locus drops, causing the equilibrium to drop. One can think of the cutback of of the money supply as causing a nominal currency appreciation on impact, as r^{LM} jumps above r^{IS}, output unchanged; the implied real appreciation, p unchanged, forces output immediately to slide down to the point where marginal cost and thus p have fallen in proportion to the fall of E, thus erasing the "real" part of the nominal appreciation. Since the real rate r^{LM} falls (with the slide of output) only to r^*, not to f_K (which is reduced by the slide of output), q is pushed down and investment stops if it was not already zero, in contrast to Tobin's closed-economy model in which q bounces back to 1 immediately, deep shocks expected. An unanticipated <u>increase</u> of the money supply

causes employment to jump; in phase 1 this is accompanied by a jump of p, in phase 2 by a jump of K (although it would strain the model to apply it to the latter case).

An unanticipated and temporary decrease of money is the sum of an immediate permanent decrease and a future permanent increase. In phase 1 the sudden anticipation of the future increase of the money supply is expansionary because the resulting expected increase of the future price level causes p to jump in the present. Hence in phase 1 a temporary decrease of the money has a less contractionary effect on p and N than a permanent decrease -- yet some contractionary effect since if p and N rose at first, leading to expected deflation, while the money supply is decreased at first, there would be an excess demand for money which is impossible along an equilibrium path. But if the economy will have graduated to phase 2 by the time of the reversal of the money stock, the anticipation of the future money supply increase cannot be expansionary in the present since the resulting (expected) jump of the capital stock has no (expected) effect on future prices. Interested readers will be able to deduce that when the future restoration of the money supply to its former path puts the economy into phase 2 with something to spare, its expansionary effect in the present is intermediate between the two cases just considered, being neither full nor nil.

Let us touch briefly on the matter of overshooting. It was shown by Dornbusch (1976) that, in his model, a permanent shift of the money supply or of the demand for money may cause the exchange rate to overshoot its new steady state value. This overshooting is possible in the present model too but there is an empirical presumption militating against it. In our model

$$\frac{\dot{E}}{E} = h\left(-\frac{W}{E}\,n\,(E/W)K + f_K^*\,S, \frac{M}{E}\right) - i^*;$$

the presumption is that the first argument is non-decreasing in E/W, which is equal to P/W. On this presumption, were E to fall in proportion or in greater proportion to a given fall of M, leaving M/E unchanged or increased, h would fall, since the reduced E/W, or p, would not cause $p^{-1}n(p)$ to increase, so $\dot{E}$ would be made negative; as E fell more h would fall more, since we suppose $\partial h/\partial E > 0$ in common with the literature, so $\dot{E}$ would still be negative; the ensuing decline of S and K could only reduce h further; and W cannot save matters -- at most it will fall in proportion to M, since W does not overshoot, leaving E/W reduced and still falling. So a fall of E proportionately greater than or equal to the fall of M would lead to an unstable trajectory, while the desired solution is stable.

2. Fixed-nominal-exchange-rate regimes

A fixed-nominal-exchange-rate regime means that government policy constrains itself to meet the side condition $\dot{E}(t) = 0$, typically for all future t. In the present model this reduces to the choice of a constant price level, $\hat{P}$. In principle, this stabilization might be made a constraint on $\delta(t)$, so M(t) would be free to pursue some other objective. However we shall suppose that M(t) is constrained to stabilize E and thus P, which leaves $\delta(t)$ free except for a debt constraint. Then, with $p = \hat{P}/W$, and with $v = W/\hat{P}$ denoting the product wage, the dynamic system in phase 1 is

$$\text{(17i)} \quad \dot{S} = (1-c)\left[vn(v^{-1})K - G + \delta(t)\right] - \left[(1-c)f_K^* - b\right] S - c\,\delta(t) - bD(t)$$

$$\text{(17ii)} \quad \dot{K} = -\mu K$$

$$\text{(17iii)} \quad \dot{v}/v = g\left[n(v^{-1})K - \tilde{N}\right]$$

In phase 2, in which q = 1 and hence $p = \bar{p}$,

$$\text{(18i)} \quad \dot{S} = (1-c)\left[\bar{v}N - G + \delta(t)\right] - \left[(1-c)f_K^* - b\right] S - c\,\delta(t) - bD(t)$$

$$\text{(18ii)} \quad \dot{K} = (\bar{K}/\bar{N})\,N$$

$$\text{(18iii)} \quad 0 = g\left[N - \tilde{N}\right]$$

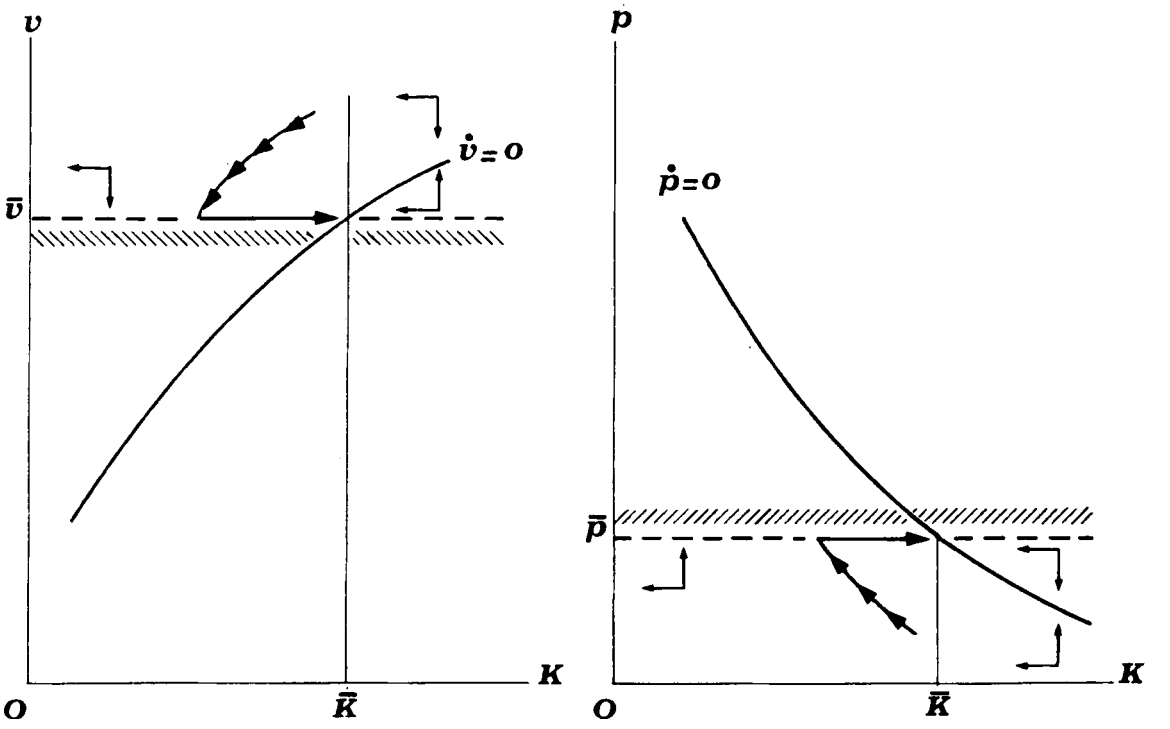
where $\bar{v} = \bar{p}^{-1} = F(\bar{K},\bar{N})$. The condition $p = \bar{p}$ gives (18ii) and adding $P = \hat{P}$ gives (18iii).

It can be seen that the model does not function if $\hat{P}$ is set to exceed $\bar{p}W_o$ since it is then implied that capital and employment increase without bound, accommodated by an infinite injection of money, in an instantaneous jump at time zero. So we restrict our attention to the case in which $\hat{P} < \bar{p}W_o$; the implication of $\hat{P} = \bar{p}W_o$ will emerge as a by-product.

Under the initial condition $\hat{P}/W_o < \bar{p}$ we shall have $\hat{P}/W < \bar{p}$ for some interval of time since W cannot jump down to the level $\hat{P}/\bar{p}$. As long as $p < \bar{p}$, $f_K < r^*$ and hence $q < 1$, so that the economy finds itself in phase 1. Consequently K will be shrinking. If initially the capital stock was $\bar{K}$ or smaller, $p < \bar{p}$ also implies $N < \tilde{N}$, that is, a slump. Hence W and v will be shrinking as well, and p recovering. Clearly the locus of points (v,K) on which $\dot{v} = 0$ is the curve $F_N(\tilde{N},K) = v$, which is shown in Figure 6; the $\dot{p} = 0$ locus in the (p,K) plane, shown in the other panel, is equivalent. The path of recovery toward $\bar{v}$, or $\bar{p}$, cannot touch the vertical axis, otherwise $\dot{v}$ would be vanishing, like $\dot{K}$, as $K \to 0$, and that would imply that $N \to \tilde{N}$ and thus $N/K \to \infty$, which contradicts $p < \bar{p}$. Hence the recovery of p to $\bar{p}$, and v to $\bar{v}$, is achieved with a partial loss of the capital stock. Likewise, N cannot recover to $\tilde{N}$ in this first phase, for that would imply that $N/K \to \tilde{N}/K$ and thus $p \to$ some $p' > \bar{p}$, since K is steadily falling in phase 1. Indeed we cannot rule out steadily falling N in this phase.

Once the equilibrium path reaches the $\bar{p}$ line p(t) cannot rise further since the capital stock will jump to prevent that. The second phase then begins. Thereafter $p = \bar{p}$, $W = \hat{P}/\bar{p}$, hence $N = \tilde{N}$ and $F_N(K,\tilde{N}) = \bar{p}^{-1}$. Thus the second phase is characterized by an instantaneous jump of employment and capital that lands the economy at once in its steady state. This implies an upward jump of $\dot{W}$ to zero and an equal and opposite jump of $\dot{p}$ down to zero, so that $\dot{P}$ remains equal to zero. (Of course, the injection into the

Figure 6



model of some non-tradeable capital goods could be made to eliminate such a jump).

It is apparent that a reduction of $\hat{P}$ worsens employment, casting the economy into phase 1 or widening the gulf between p and $\bar{p}$ if in phase 1 already. It also appears that the fixed-rate regime helps to stabilize employment against demand shocks but lengthens and deepens the slump that results from supply shocks. (However, this latter conclusion would have to be modified in a model of an indexed-wage economy).

II. THE MODEL WITH FISCAL INCENTIVES TO INVEST

When a fiscal policy shift takes the form of subsidies or tax reform to bolster incentives to work or save or invest a richer model is needed to capture the macro effects of the structural change. Here we take up the example of an investment subsidy. For the microeconomics of such a subsidy, or tax credit, we can employ a simplified version of Hayashi (1983).

Each enterprise in our economy now maximizes the present value of the real cash-flow stream with due account of the investment subsidy:

$$\int_0^{\infty} \left[F(K,N) - \frac{W}{p} N - (1-\theta)I \right] \exp\left(-\int_0^t r ds\right) dt$$

where the subscripts indicating the individual enterprise have been omitted and where θ denotes the fraction of investment outlays, I, paid by public subsidy. (The relative price of the investment good has been set equal to one by choice of units). The maximization is subject to the constraint

$$\dot{K} = I - \mu K$$

to which we associate a Lagrange multiplier λ. The first-order conditions for a maximum are

$$(19i) \qquad F_N(K,N) - \frac{W}{P} = 0$$

$$(19ii) \qquad \lambda - (1 - \theta) \leq 0$$

(19iii) $\dot{\lambda} = (r+\mu) - F_K(K,N)$

The above strict inequality cannot occur as long as $I > 0$ at the maximum, in which case $\lambda = 1-\theta$ and $\dot{\lambda} = 0$. It occurs if and only if $F_K(K,N) < (1-\theta)(r+\mu)$, in which case $I = 0$ and $\dot{\lambda} > 0$.

It is evident from (19ii) and (19iii) that λ is the counterpart of q in the previous model; it is, so to speak, "q after tax (or subsidy)". If, for our new model, we define

$$\tilde{q} \equiv \frac{\lambda}{1-\theta},$$

then, by (19ii), $\tilde{q} \leq 1$ and, by (19iii),

$$(20) \qquad \dot{\tilde{q}} = (r+\mu)\,\tilde{q} - \frac{F_K(K,N)}{1-\theta}$$

which is identical to (7') and (7") except that our <u>before tax</u> variable, $\tilde{q}$, has replaced q <u>and</u>, significantly, F_K is multiplied by $(1-\theta)^{-1}$. The new model can use all the other equations of the prototype model, (1)-(6) and (8)-(13), upon replacing q with the new $\tilde{q}$.

The effects of a fiscal stimulus in the form of a temporarily increased θ now include all the effects in the prototype model plus the <u>incentive</u> effects of the variation in θ. These latter effects would appear whether the extra subsidies were financed by a deficit or instead by an equal reduction of other public expenditure having no incentive effects -- goods dumped into the sea. The impact of a temporary increase is to shock the r_{IS} curve, now given by $(1-\theta)^{-1} F_K - \mu$. The result in phase 1 is to hasten the arrival of phase 2 by advancing the rendez-vous of the r_{IS} curve with the intersection between r_{LM} and r^*. There is a jump of $\tilde{q}$ and a hastening of the time when $\tilde{q}$ is equal to

one. Thus the drag on employment growth from the running down of the capital stock is ended earlier; the faster-growth, Harrodian phase begins sooner. The result of this r_{IS} shock when the economy is in phase 2 is an incipient rise of $\tilde{q}$ above the normal level of one, and hence a surge of investment. This jump of the capital stock shifts rightward the LM curve, thus making its intersection with the r^* line jump to the right, and hence causing a jump of employment and a second jump of the capital stock (in proportion to the employment jump). It can now be seen that in phase 1 the anticipation of the earlier resumption of investment due to the increased investment subsidy means that, under perfect foresight, a lower price level will be expected to develop in phase 2 than would otherwise have occurred; the expectation of that development will generate a flight into money, a currency appreciation, and thus a fall of employment at the outset, the longer term gains notwithstanding.

III. CONCLUDING REMARKS

Scholarly papers are frequently produced as a by-product of the authors' efforts to resolve some puzzle or dispel some confusion, and this paper is an example of that kind. It is not a message-paper. Still, the hope is that as the fog dissipates an interesting result or two will come into view.

A significant finding from a methodological stand-point is that an equilibrium path exists in the model -- a path which, if expected, will be realized. This path is unique, at least in its neighborhood; there is no continuum, or band, of equilibrium paths. The equilibrium path found here bears some similarities, in one phase, to the famous "warranted growth path" in Harrod's pioneering investigation of dynamic equilibrium, but the equilibrium path here is not generally explosive, or divergent.

Perhaps the main substantive result here concerns investment behavior. A contractionary disturbance through wages or the supply and demand for money, no matter how slight if the starting point is the stationary state, causes investment abruptly to shut down. Since investment goods produced at home can always be exported at the undisturbed world-market price, this has no demand effect on home production. But the cessation of capital formation has gradual supply effects on the demand for labor: the consequent decay of the capital stock tends (on plausible assumptions) at least to slow the speed with which employment recovers to its normal, or natural, level; and if the disturbance and the responsiveness of wages to unemployment are not too strong, the declining capital stock tends (on the same plausible assumptions) to drag employment down before falling wages can turn it around. This is with a fixed money supply and flexible exchange rates. With fixed rates and a flexible money supply, a contractionary wage shock will induce a similar disinvestment phase (though monetary shocks will be automatically accomodated). If in such a disinvestment phase a fiscal stimulus is injected in the form of tax incentives to invest, the effect is a boost to

employment and a shortening of the disinvestment phase. If the stimulus does not take that form, its effectiveness will stem only from its tendency to promote a falling demand for money and, thereby, the expectation of a dose of inflation. Although not a pleasant medicine, it could have a place in a balanced disinflation therapy.

A question naturally arises. Does any of this illuminate recent international economic developments: the effects of the distinctive policy stance in the United States in the past few years -- monetary tightening and fiscal stimulus -- and the causes of the mounting slump that has enveloped most of the rest of the world? Perhaps so. The model here supports the hypothesis that a country, such as the United States or any other, can use fiscal stimulus to cushion the recession in employment provoked by the "velocity shock" resulting when monetary policy slows the money supply to signal and sustain disinflation. But the fall of national saving resulting from the budgetary deficit plus any rise in national investment resulting from fiscal stimuli in the form of tax incentives to investment come at the expense of the rest of the world, which must suffer a decline of national investment and thus, through a supply effect on the demand for labor, declining employment alongside declining capital. Of course, this is but one part of the story, and perhaps only a small part. However, the development of models that bring the dynamics of capital and wealth to center stage may open up explanations of recent phenomena without which these recent developments will remain very puzzling.

Notes

1/ In that theory entrepreneurs and capital goods producers compare Tobin's q to 1. If we suppose, letting r denote the real interest rate and F_K the marginal product of capital gross of depreciation loss from exponential decay at rate μ, that the expected variables satisfy $r^e q = \dot{q}^e + F_K - q\mu$, this comparison is equivalent to setting $q = 1$ and weighing $F_K - \mu + \dot{q}$ against r. In the prevailing models, in contrast, the implicit comparison is between $F_K - \mu$ and r. Now it can be shown that $r > F_K - \mu$ implies $q < 1$ with minimal assumptions. But little else can be shown without an entire model. Thus the prevailing shortcut does not have a ready justification.

2/ See Mundell (1963). Some later models impute a positive output effect to the appreciation via its lowering of import prices, which is hypothesized to lower the demand for money. But more recent papers point to a counter-effect in the case of tax cuts: the rise in take-home pay raises the demand for money.

3/ Certainly it is counterfactual to say that increased spending during the Reagan administration has improved America's terms of trade by crowding out exports (of farm goods and farm machinery, for example).

4/ A more plausible theory, that there are transient relative-price effects from permanent or near-permanent fiscal stimuli owing to non-shiftable equipment bottlenecks or to the informational frictions of customer markets, requires a dynamic model, through one of a different sort from that sought here. Phelps (1985) develops a model of temporary fiscal-policy effectiveness (and subsequent boomerang effect) in open economies comprised of Phelps-Winter firms in non-Walrasian competition. A

sequel is planned that will integrate that paper and the present one.

5/ The distinction between real interest and product interest parallels that between the real wage and the product wage. Hence no discrepancy can appear between real rates in two countries defined with reference to the national consumers' basket of goods if the consumers in those countries choose the same basket.

6/ Note that Z is measured in units of the first consumer good, and thus also the real marginal productivities F_N and F_K.

7/ There is no great significance in the implication that, given S and δ, interest received on public debt net of that held by the central bank has no effect on the demand for money, nor the supply of credit. (The same would be true if national product were the determinant of liquidity). This invariance accords with the hedging theory of asset demands in which an increased supply of debt to private individuals would, via the anticipated tax burden, prompt an equal increase in the demand for debt. But this is a coincidence rather than the rationale for use of Y_d.

8/ Mussa's equations, translated from prices into wages, as here, would have provided a bravura finale to the second half of Phelps's 1968 essay. Instead Phelps (1970) added a mathematical appendix, with differential-difference equations, describing only a special case to examine a particular issue.

9/ In fact the previous, seemingly correct equation is unsuitable or at least hazardous for deflation and disinflation analyses since it appears to imply (as the result of its various approximations) that if initially $W = \tilde{W}$ then $W(t)$ can continue to

"track", or match, $\tilde{W}(t)$, thus avoiding a gap of employment from the natural level ($N < \tilde{N}$), as long as the government takes care to ensure that $\tilde{W}(t)$ is continuously differentiable by limiting the choice to smooth, or sufficiently gradual, macro policies.

10/ The worst inadequacy here is that r_{LM} depends on the rate of change of N/K, which is variable to be determined. The equation, from (14i), is $r_{LM} = h(\cdot) - [g(\cdot)+(\dot{p}/p)]$.

11/ In Figure 2's picture employment is portrayed as increasing throughout the second phase, and falling throughout the first phase. The former outcome must occur if f_K^* is close enough to zero that the influence of S upon LM is never critical for qualitative behavior, so the wage dictates the direction of LM. The latter outcome requires that the fall of the capital stock, by reducing real cash balances proportionately more (via marginal cost and price level) than it reduces real national income, raises r_{LM} and does so more than the decrease of the wage is lowering r_{LM}; otherwise employment may rise in phase 1 as well, though less quickly, if (as supposed) the decline of capital stock slows the wage-driven recovery of the LM curve.

The analysis (below) of phase 1 and its terminal conditions indicate, however, that the price-wage ratio will recover smoothly (with continuous first derivative) as the wage is still falling, from which it follows that the price level must likewise be falling at the end of phase 1, hence that the falling wage must sooner or later predominate over the falling capital stock -- so that LM will by that time be falling. Therefore, employment either falls at first and then turns around in phase 1 or else it rises at the outset of phase 1. Hence employment does not "bounce up" at the transition from phase 1 to phase 2.

12/ In addition, S will also be decreasing at least at first, provided that S(0) is equal to $\bar{S}$, as a result of the downturn of

output and employment caused by $p < \bar{p}$. Since $\dot{p}$ is increasing in S, a fall of S would require a further rise of p to keep $\dot{p}$ at zero; so the $\dot{p} = 0$ locus will also be rising on this account at least at first, and since S cannot turn around and with time exceed $\bar{S}$ as long as p and n(p) remain below $\bar{p}$ and $n(\bar{p})$, the $\dot{p} = 0$ locus must remain elevated as long as $\bar{p} < p$. In the argument that follows the extra complexity introduced by S(t) is taken to be negligible as will be the case if f_K^* is sufficiently small.

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