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IMPERFECT ASSET SUBSTITUTABILITY AND MONETARY POLICY UNDER FIXED EXCHANGE RATES

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ABSTRACT

This paper presents a long-run model of the open economy in a world of fixed exchange rates and imperfect substitutability between bonds denominated in different currencies. The model explicitly accounts for the wealth flow accompanying current-account imbalance and for the flow of interest payments associated with international lending. The model's implications are quite different from those of models based on a "flow function" description of the capital account. In particular, we find that open-market policy is not in general neutral in the long-run when there exists outside government debt. We also find conditions under which the central bank is able to hold the domestic price level constant in the face of an inflationary disturbance from abroad without exhausting, in the long run, its stock of domestic assets.

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Introduction

A central message of the monetary approach to the balance of payments is that changes in its money supply have no long-run effect on a small, open economy with a fixed exchange rate. It is by now widely accepted that there is a close link between the degree of international capital-market integration and the speed with which monetary disturbances are reversed. It is also widely accepted that when a country's capital market is to some extent insulated from the world market, unwanted money flows originating in the balance of payments can be completely neutralized or sterilized by offsetting open-market operations, but only in the short run. In the long run, the central bank exhausts its stock of domestic assets if it is sterilizing a surplus, or its stock of foreign assets if it is sterilizing a deficit, and the economy then moves to its underlying, real equilibrium position.

Theoretical justification for these assertions has been offered in influential papers by Mundell (1961) and Swoboda (1972, 1973).[1] But the line of argument adopted in these papers, while assuming instantaneous clearing of the domestic money market, ignores equilibrium in international asset markets, and instead models the capital account as a continuing flow responding to the level of domestic interest rates. Detractors of this capital-flow function approach, notably Willett and Forte (1969) and Branson (1970), have

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[1] Mundell's paper is reproduced in Mundell (1968). Swoboda's 1973 paper is reproduced in Johnson and Nobay (1974) and Frenkel and Johnson (1976).

portant as they are in the adjustment to external equilibrium, are on the whole ignored in the literature taking the capital-flow-function view. We shall see that this omission contributes to the latter's central message that in the open economy, money is always neutral in the long run.

Sections I and II present a model of an open economy in which asset holders allocate their wealth among domestic money, domestic bonds, and foreign bonds. The economy is small in the sense that it cannot affect foreign prices or interest rates. An income-expenditure relation underlies aggregate absorption, and agents' expectations of inflation, which enter the expenditure function through the real domestic interest rate, are rational. Short-run equilibrium for the economy is determined by the simultaneous clearing of goods and asset markets, while long-run equilibrium occurs only when the inflation rate is zero and the current-account is in balance. We explicitly take the net flow of interest payments from abroad into consideration in specifying national income and the current account, for this much-neglected item has an important effect on the dynamic bahavior of the economy.

Section III analyzes the impact and stationary-state effects of unanticipated and anticipated open-market purchases of domestic bonds. Contrary to the well-known Mundell-Swoboda result, we find that expansionary monetary policy does have a long-run effect, which is deflationary. This non-neutrality is related to agents' failure to fully capitalize the stream of tax liabilities associated with the government debt.

The finding that open-market policy has a long-run effect when there is outside government debt raises the issue of monetary autonomy. Accordingly,

flationary disturbances, and a policy of gearing monetary policy to the requirements of external balance may not always be necessary.

Section VI offers some concluding remarks.

I. The Static Model

We consider a small, open economy whose central bank is committed to a fixed exchange rate. Output produced at home is less-than-perfectly substitutable for foreign output, so that purchasing-power parity need not hold. Wage and price flexibility guarantees full employment, and real output, y, is fixed. Goods are assumed to be perishable: only financial assets exist.

The financial sector of the economy is based on the work of Kouri and Porter (1974). There are three assets--bonds denominated in domestic currency units, bonds denominated in foreign currency units, and domestic money--and two groups of wealth owners--domestic residents and foreign residents. Both types of bonds have fixed nominal face value. The domestic money supply consists exclusively of the liabilities of a central bank, which holds both domestic and foreign-currency assets. We assume that the central bank's foreign-exchange reserves are held in the form of non-interest-bearing currency. Similarly, we assume that the central bank's domestic assets consist of bonds issued by the home government, and that no interest is paid on government bonds in the central bank's portfolio.

The private sector, consisting of non-central bank asset holders, ignores the composition of the central bank's balance sheet in arriving at portfolio decisions. The three assets are gross but imperfect substitutes in private portfolios, and we write the asset demand functions as:

$$L(r,r^*,Py/V)V = \text{domestic demand for money}$$

currency equal the stock D of government debt held by the private sector, that is, that

$$H(r,r^*,Py/V)V + sF(r,r^*,P^*y^*/V^*)V^* = D, \tag{1}$$

where s is the exchange rate. When condition (1) holds, excess domestic demand (say) for money must equal excess domestic supply of foreign bonds, and so the asset markets can be brought into equilibrium through trades with the central bank with no change in r. The public debt D is viewed by the private sector as outside debt--a key stipulation.

Our description of the asset markets is concluded with the assumption

$$H_V V + H > F_{V^*} V^* + F, \tag{2}$$

which will be important in the analysis to follow. The condition states that domestic residents have a larger marginal propensity to allocate wealth to holdings of domestic securities than do foreigners.

The service account--the net flow of interest payments from abroad--plays a central role in the model's dynamics.[6] Since the central bank's foreign assets earn no interest, we can write the service account as

$$\alpha(r,P,V) = r^*B(r,r^*,Py/V)V - rsF(r,r^*,P^*y^*/V^*)V^*, \tag{3}$$

where domestic real output, foreign nominal output, and the world bond rate, which will remain fixed throughout, have been suppressed. It is easily seen that $\alpha_P < 0$ and $\alpha_V > 0$.[7] α_r is certainly negative if foreigners are

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[6] The importance of the service account has been emphasized by Willett and Forte (1969). Also, see Flood (1977).

[7] An increase in nominal product increases the demand for money balances, which induces repatriation of funds held abroad and, in portfolio equilibrium, a smaller service surplus. In calculating α_V, it should be remembered that $dV = -sdV^*$. Our assumption that foreign reserves earn no interest does not affect the sign of α_V or α_r. For if they do, we can write $\alpha = r^*[(1-H)V - \Delta] - rsFV^*$, where Δ is the domestic source component of the monetary base.

This formulation recognizes the effect on absorption of factor payments from abroad. We note that in the present context, wealth influences absorption only indirectly, through its effect on the service account. The model is extended in Section V to include a direct wealth effect on spending; this modification alters the model's long-run properties in some cases.

Equation (4) implies there is no government consumption. Since taxes just equal the interest payments on the public debt, the government's budget is always balanced.

For a given level of wealth V and given expectations of inflation, equations (1) and (4) determine the short-run or instantaneous equilibrium of the economy. This is depicted in Figure 1. The AA schedule is the locus of points along which asset markets clear; from (1),

$$\left.\frac{dr}{dP}\right|_{AA} = -\frac{H_P}{H_r V + sF_r V^*} > 0$$

so that this schedule slopes upward.[9] When the price level rises from a point on AA, an excess demand for real money balances and an excess supply of domestic debt emerge. A return to equilibrium requires that r increase to raise foreign and domestic demand for domestic bonds. The GG schedule consists of those points at which the goods market clears; from (4),

$$\left.\frac{dr}{dP}\right|_{GG} = -\frac{\tau(\delta'(\tau)E + X'(\tau)) + \delta(\tau)E_1(\alpha_P - \alpha/P)}{\delta(E_1\alpha_r + PE_2)}$$

When $\alpha > 0$, this schedule is unambiguously downward sloping. An increase in P leads to an excess supply of output, for it discourages net exports, induces a

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[9] From now on, we take y = 1 when convenient.

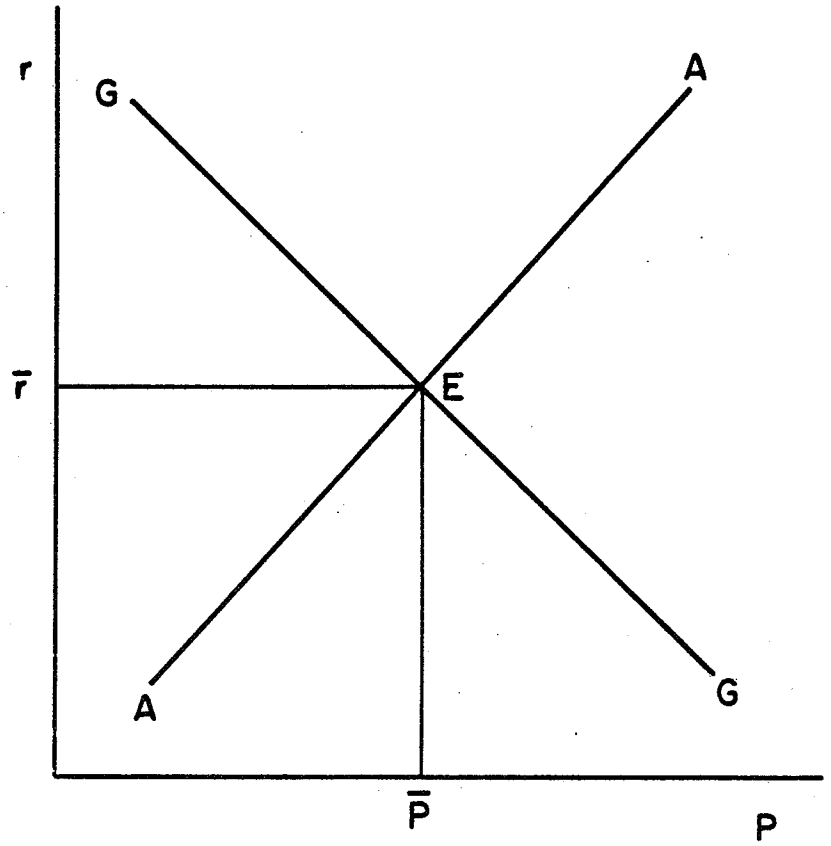

Figure 1

$$\dot{P}/P = \pi(P,V;D) \tag{7}$$

governing the evolution of the inflation rate along a perfect foresight path.

The second differential equation comes from the relation between domestic wealth and the current account. We have assumed there is no government budget deficit, and so the rate of increase of domestic nominal wealth equals the surplus on current account. Thus, we have

$$\dot{V} = PX(\tau) + (\delta(\tau)-1)PE(y + \alpha(r,P,V)/P, r - \pi) + \alpha(r,P,V). \tag{8}$$

Substituting the reduced forms $r = \rho(P,V,D)$ and $\pi = \pi(P,V;D)$ into (8) gives the equation

$$\dot{V}/P = \nu(P,V;D), \tag{9}$$

which describes the real change in wealth per unit time on the assumption that asset and goods markets clear.

The system consisting of (7) and (9) describes the dynamic behavior of the economy contingent on a set of initial conditions. Each point on the resulting path is a point of short-run or momentary equilibrium, for, by construction, the asset and goods markets clear at each instant. Short- and long-run equilibrium coincide only when $\dot{P}/P = \dot{V}/P = 0$.

We next investigate the local stability of this system. Linearizing in a neighborhood of long-run equilibrium, we can write the equations of motion as

$$\begin{bmatrix} \dot{P}/\bar{P} \\ \dot{V}/\bar{P} \end{bmatrix} = \begin{bmatrix} \pi_P & \pi_V \\ \nu_P & \nu_V \end{bmatrix} \begin{bmatrix} P - \bar{P} \\ V - \bar{V} \end{bmatrix}. \tag{10}$$

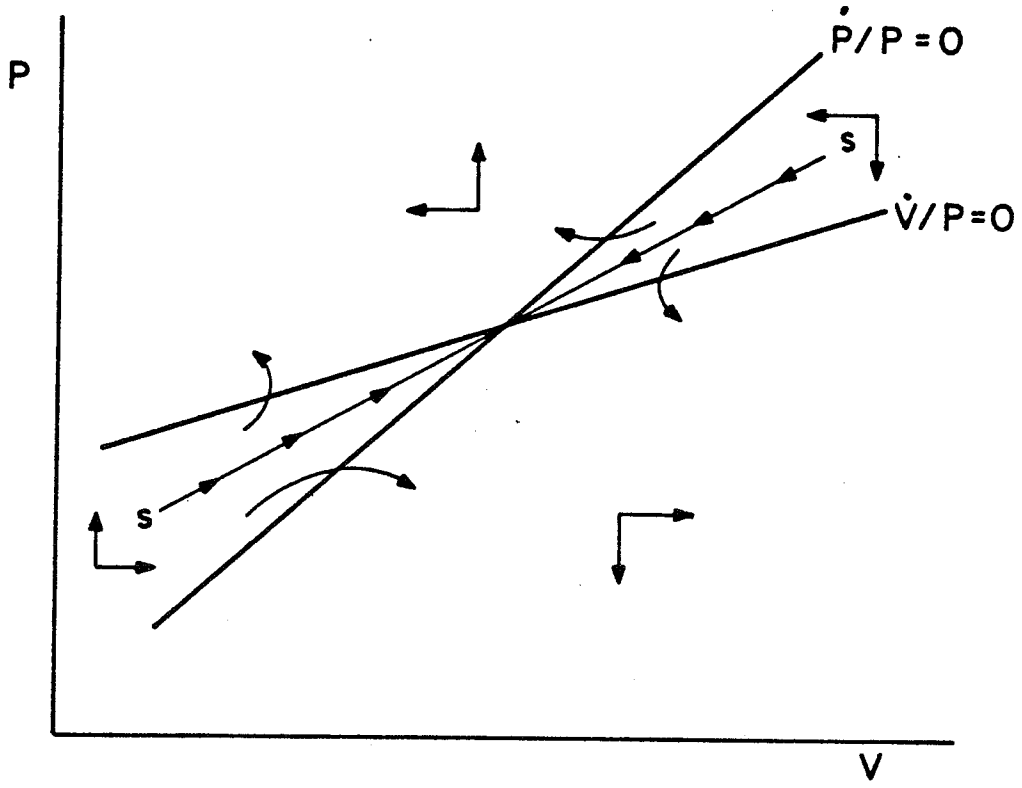

Figure 2

held by the central bank. The conventional "monetary approach" viewpoint is that monetary expansion leads to a flow excess supply of money that eventually leaks away through the balance of payments. The economy in the long run returns to its initial equilibrium, with capital outflow playing an important role in speeding the process of adjustment.

These results are not generally true in a portfolio-equilibrium context. In the present model, expansionary monetary policy has a deflationary effect in the long run. Its initial impact is indeed reversed over time through the ensuing current-account deficit, but the economy overshoots its original equilibrium in returning to a stationary state. In addition, the adjustment process induced by an open-market purchase depends on whether the action is anticipated or a surprise.

Figure 3 depicts the short- and long-run effects of an unanticipated central-bank purchase of domestic bonds. The decrease in the stock of home-currency bonds available to private holders implies a lower asset-market clearing interest rate r for given wealth and price level. In order that the goods market remain in equilibrium for fixed P with $\dot{P}/P = 0$, wealth must be lower than before the open-market purchase, for lower domestic wealth implies a higher domestic bond rate and a smaller inflow of interest payments from abroad, both of which act to reduce absorption. This means that the $\dot{P}/P = 0$ locus shifts leftward. As is shown formally in the Appendix, the $\dot{V}/P = 0$ locus shifts leftward as well. By lowering the equilibrium nominal interest rate, the central bank action causes an improvement in the service account. At each P, external balance thus requires a lower level of domestic wealth than before.

When the open-market purchase occurs, the economy jumps from the initial equilibrium E to temporary equilibrium at E', which lies on the stable branch of the new dynamic system resulting from the change in D. At E', the price level is higher, but nominal wealth, which cannot jump instantaneously, is unchanged. In the transition from E to E', the nominal interest rate falls until domestic and foreign asset-holders are content to hold the smaller stock of domestic bonds. The decline in the real interest rate is smaller than that of the nominal rate, and so the price-level increase necessary for goods market equilibrium is smaller than it would be if expectations were static.[12] As owners of wealth shift their portfolios toward foreign assets, the monetary authority is forced to intervene to prevent the exchange rate from depreciating. This partially offsets the intial expansion of the money supply.

E' is above the external balance schedule, and so the current account is in deficit. Over time, wealth is decumulated and prices fall as the economy moves along the stable path to long-run equilibrium at E". It can be shown (see the Appendix) that the leftward shift of the internal balance schedule for fixed P is greater than that of the external balance schedule. This implies that at E", the price level is lower than it was before the open-market purchase. Thus, the long-run effect of inflationary monetary policy is deflation. The economy cannot return to its original equilibrium at E because a permanent transfer of wealth to foreigners finances the deficit accompanying the process of adjustment.

At the stationary position E", the domestic bond rate r is higher

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[12] With static expectations, the economy would jump to the $\dot{P}/P = 0$ locus.

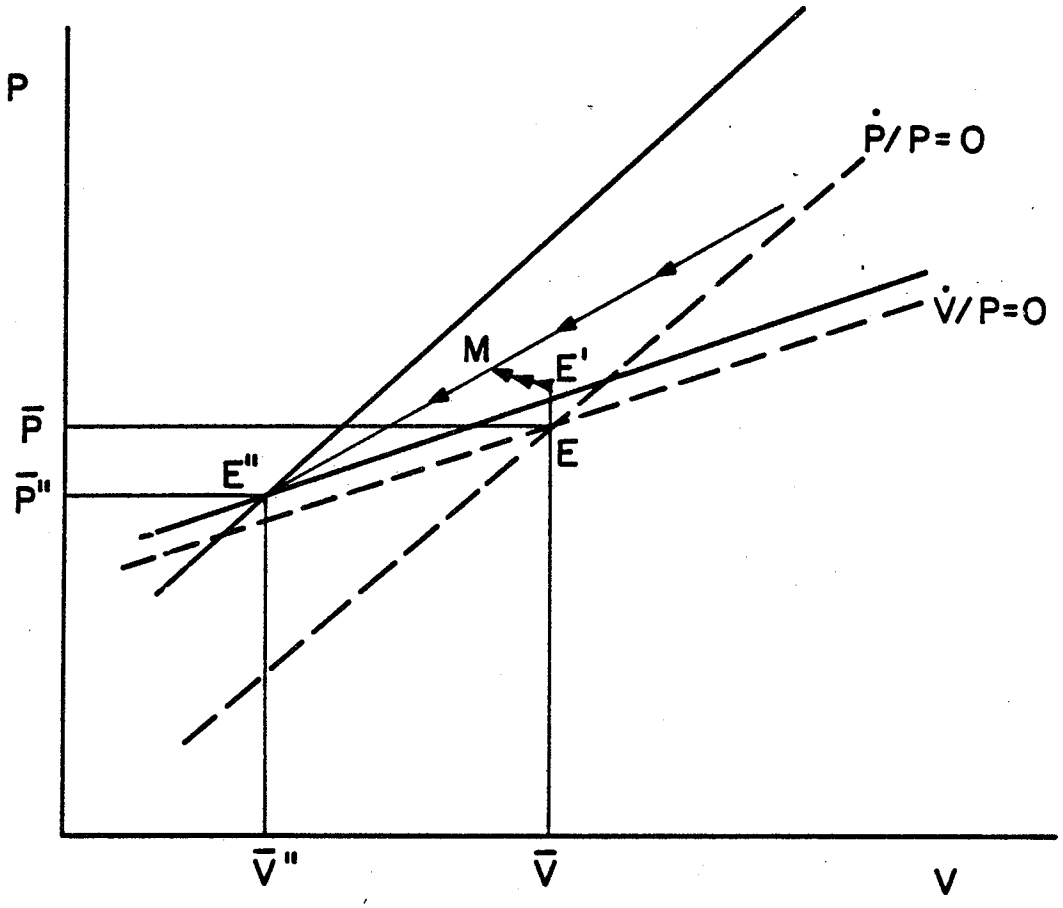

Figure 4

foreign assets enables open-market policy to affect the stationary-state price level and interest rate contradicts the standard long-run neutrality results emphasized by Mundell (1961), Swoboda (1972, 1973), and others. The non-neutrality arises from the assumption that there exists outside government debt, an assumption that builds into the model a parameter under the central bank's control. It follows that the long-run effect of monetary policy can disappear only when individuals fully anticipate and discount the future tax liabilities associated with the government debt.[14]

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[14] For a discussion of the circumstances under which this will occur, see Barro (1974). It can be shown in the case of a small country that when the public fully capitalizes the future tax payments associated with the public debt and central-bank foreign exchange reserves earn no interest, an open-market purchase of domestic debt leads to a long-run fall in wealth just equal to the decline in future tax liabilities to the government, but has no long-run effect on the price level or interest rate. When central-bank reserves earn interest which is distributed to the public, and individuals capitalize this income stream as well, open-market policy loses even its short-run effect. For a detailed discussion, see Obstfeld (1979).

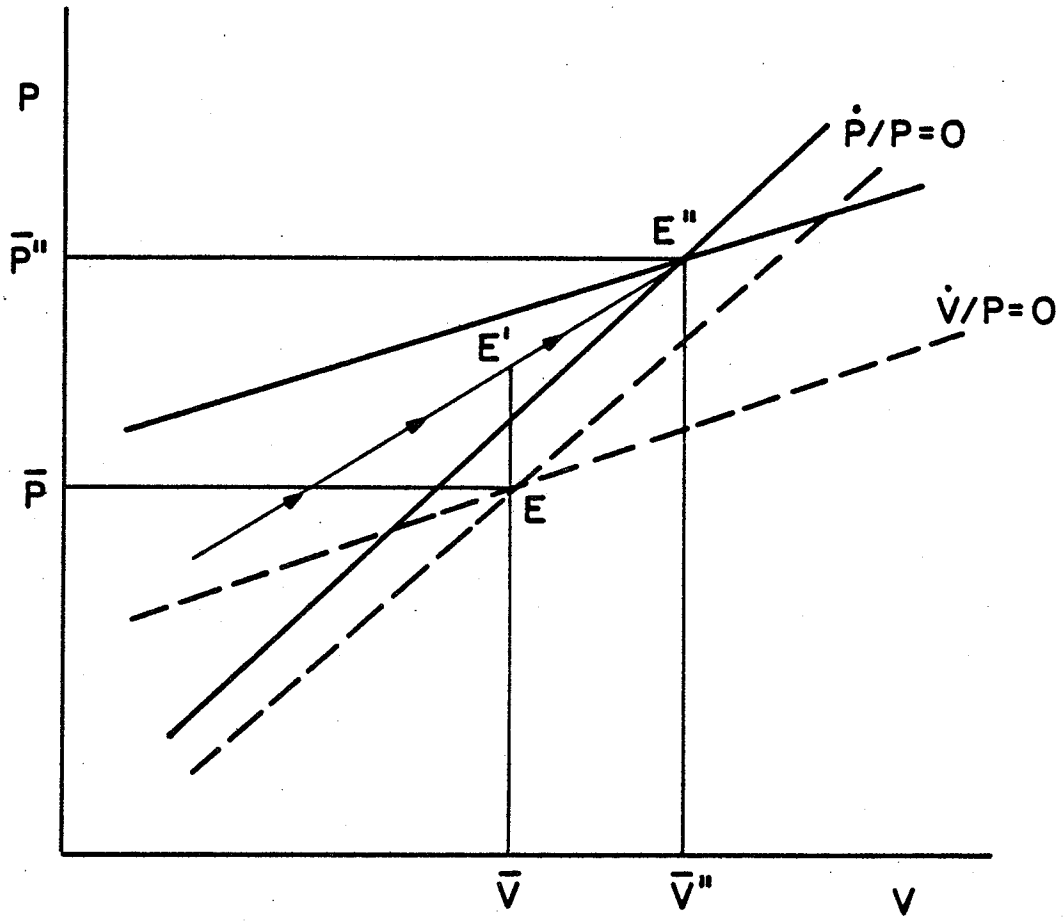

Figure 5

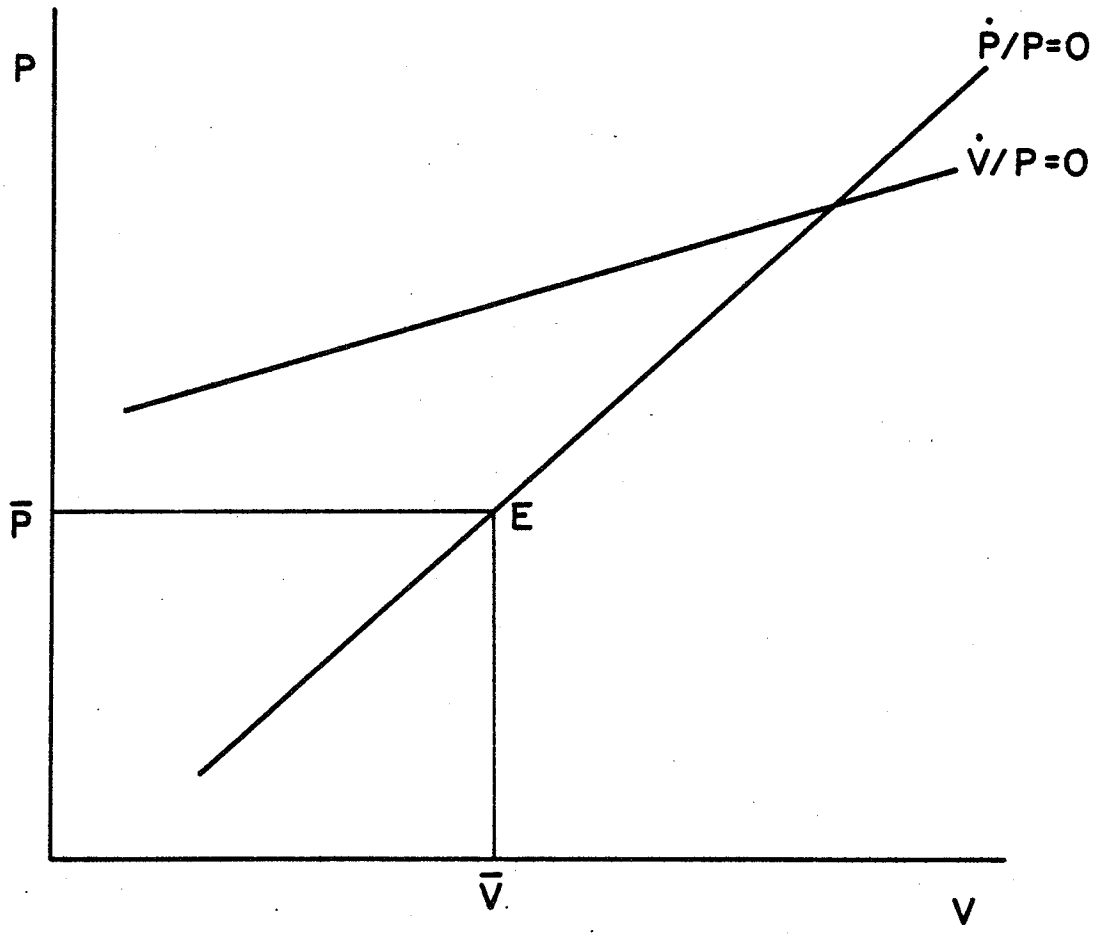

Figure 6

When the monetary authority adopts a price-level target $\bar{P}$, this becomes, in effect, a parameter of the system, and equations (1) and (4) describing asset- and goods-market clearing determine equilibrium values of the nominal interest rate, r, and the stock of outside government debt, D, given the level of domestic net wealth. For given V and $\dot{P}/P = \pi = 0$, there is only one pair (r,D) consistent with the target price-level. Differentiating the resulting system of equations with respect to V, we see that

$$\frac{dr}{dV} = -\frac{E_1\alpha_V}{E_1\alpha_r + PE_2} > 0 \qquad (12)$$

when the price level is pegged. Equation (8), which identifies nominal saving with the current-account balance, still describes the evolution of nominal wealth V. But with the price level fixed and D endogenous instead, we find, using (12), that

$$\frac{d\dot{V}}{dV} = (1 + (\delta-1)E_1)[\alpha_r \frac{dr}{dV} + \alpha_V] + (\delta-1)PE_2 \frac{dr}{dV} = \frac{PE_2\alpha_V}{E_1\alpha_r + PE_2} > 0.$$

The growth of nominal wealth accelerates as long as neutralization continues, and no stationary position is reached before the central bank uses up its holdings of domestic bonds. Once a disturbance has occurred, the goal of price stability cannot be attained through use of monetary policy alone.

What goes wrong? When the central bank prevents the price level from adjusting, domestic spending must be held constant in order that the goods market clear. But the current account surplus entails a rising level of domestic wealth V, and so rising levels of net service payments from abroad and income. It follows, as (12) shows, that the interest rate must rise as long as neutralization continues. Although this reduces spending in part through its adverse effect on the service account, the service surplus must still improve over time as V increases; otherwise, there would be no need for the rise in r. Since income rises while absorption is always held constant, the current

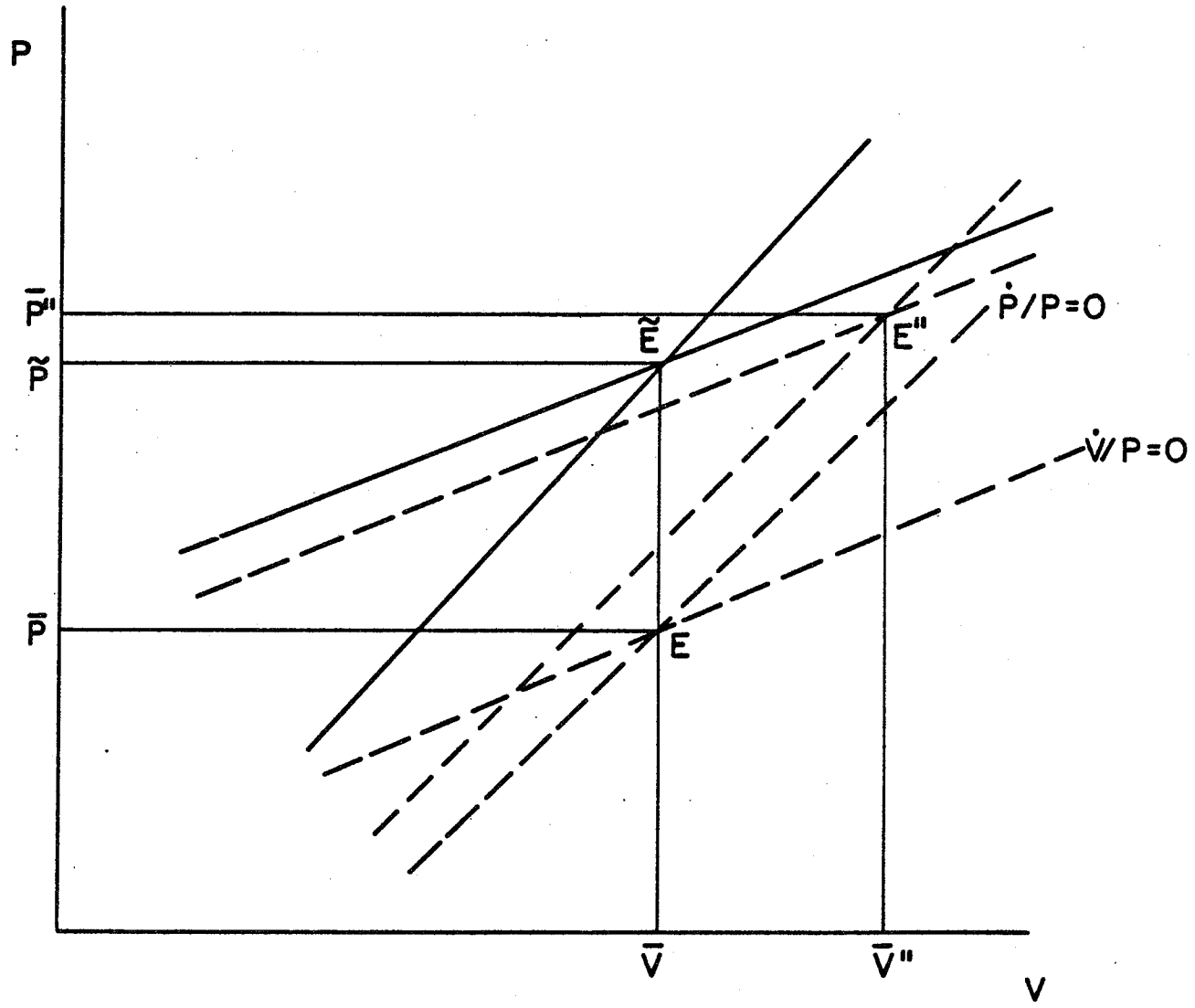

Figure 7

The condition

$$\pi_P \nu_V < \pi_V \nu_P$$

remains necessary and sufficient for saddlepoint stability. Thus, the real wealth effect leaves the stability analysis of Section II essentially unchanged. Figure 2 continues to depict the economy's dynamic behavior.

However, our previous conclusion that expansionary monetary policy must lead in the long run to a fall in the price level must be modified once we introduce a wealth effect. The possibility of a long-run increase in the price level is shown to exist in the Appendix; it arises because the loss of wealth accompanying a deficit now curtails absorption directly, so that long-run equilibrium is consistent with a lower interest rate and larger service surplus than before the disturbance. When this occurs, absorption must actually be higher in the new stationary state, and the requirement of goods-market equilibrium then entails a higher price level.

In addition, the existence of a link between real wealth and spending forces us to reverse the conclusion of Section IV that a monetary policy aimed at price level stability is not feasible in the long run. Neutralization of inflationary disturbances may now become possible.

We found in Section IV that a policy of pegging the domestic price level through monetary measures alone can never bring the economy to a position of long-run equilibrium once external balance has been disturbed. The problem arose because the implied change in wealth only accentuated the external imbalance through its effect on the flow of interest payments, while the policy of price-level constancy precluded the terms-of-trade and interest-rate

ting, the growth of wealth associated with the current surplus has a direct effect on spending that reinforces the effect of the service account. Thus, the interest rate may rise quickly enough to eliminate the current surplus over time through its effect on the net inflow of interest payments. When this is the case, neutralization succeeds in the long run.[18]

If neutralization is possible, assigning to monetary policy the task of maintaining internal balance becomes a viable option. But, just as was the case in the earlier income-expenditure framework, pegging the price level in the face of a current surplus entails steadily rising interest rates, and policy makers concerned about growth will not be indifferent to this fact. Moreover, the "reward" for successfully resisting the effects of a monetary impulse abroad that raises foreign prices is a permanent deterioration in the terms of trade. Though these factors may limit the willingness of policy makers in surplus countries to sterilize, policy makers in deficit countries, for the same reasons, have strong incentives to impede the adjustment process by preventing downward movements in the domestic price level. Under these circumstances, a system of fixed exchange rates possesses a definite inflationary bias.

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[18] The issues of neutralization and the long-run price-level effect of open-market policy are, of course, closely related. Indeed, neutralization is possible if and only if expansionary monetary policy leads to a higher long-run price level. Returning to Figure 6, we recall that monetary expansion shifts both schedules to the left, but can cause a rise in the long-run price level only when the external balance schedule shifts farther than the internal balance schedule. But this also means that if the monetary authority is holding the price level steady in the face of an external surplus, the $\dot{V}/P = 0$ locus will travel rightward more swiftly than the $\dot{P}/P = 0$ locus as D increases, eventually crossing it at the target price level $\bar{P}$. A formal proof is given in the Appendix.

currency members cannot neutralize the price-level effects of one-shot inflationary impulses emanating from soft-currency members, and resort to revaluation, confidence in the fixity of exchange rates will wane rapidly. The ensuing speculative capital movements will force policy makers to choose between a regime of floating exchange rates and the imposition of costly capital controls.

But as we have seen, the feasibility of such neutralization is an empirical matter, linked to the influence of wealth on spending and other factors. More reliable evidence on these issues must be obtained before policy makers can appreciate the long-run effects of their monetary measures under a regime of fixed exchange rates.

Appendix

This appendix makes explicit the algebra underlying the assertions in the text concerning the effect of open-market policy on the internal and external balance schedules.

We first deal with the model of Section III, in which wealth exerts no direct influence on spending, and derive the result that open-market expansion (a decrease in D) shifts both the internal and external balance loci to the left, but shifts the internal balance locus farther, so that long-run equilibrium is characterized by a price level lower than the initial one.

The shift in the internal balance schedule is π_D/π_V, while that of the external balance schedule is ν_D/ν_V. Differentiating, we see that

$$\pi_D = [E_1\alpha_r\rho_D + PE_2\rho_D]/PE_2 > 0, \quad \nu_D = \alpha_r\rho_D/P < 0.$$

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