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PORTFOLIO BALANCE AND IS-LM:
A MARRIAGE UNDER FIXED EXCHANGE RATES

by

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ABSTRACT

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The past fifteen years has witnessed a thorough reconsideration of the theory of international capital flows and monetary policy in open economies. Much of this work is based on the concept of portfolio balance and stock-flow equilibrium. The present paper develops a tractable way of incorporating portfolio balance into a modified IS-LM model, thereby bringing the much-used framework into line with modern thinking about financial equilibrium under fixed-exchange rates. In so doing, the interrelationship between monetary and exchange-market intervention policies is emphasized. This permits a consistent treatment of short-run financial market equilibrium and balance of payments considerations.

To illustrate the usefulness of the resulting "IS-PB" model, a balanced-budget increase in government expenditure is examined under alternative monetary stances consistent with the fixed exchange rate. The scant treatment of fiscal policy (relative to monetary and exchange rate policies) in the open-economy portfolio balance literature is thereby partially remedied.

A second application considers the effects of foreign interest rate shocks. The model accurately captures the policy choices facing countries attempting to maintain fixed exchange rates during 1981 when U.S. interest rates were forced up dramatically in an effort to bring inflation under control.

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I. Introduction and Summary

In spite of a number of well-known limitations\(^1\), the IS-LM model is widely used for short-run analysis of aggregate demand management policies in closed economies. An extended version of the model, which includes export and import expenditures as well as international capital flows, has been an important tool for examining output, interest rate, and balance of payments effects of monetary, fiscal, and exchange rate policies in open economies.

The past fifteen years, however, has witnessed a thorough reconsideration of the theory of international capital movements and monetary policy under fixed exchange rates. The concept of portfolio balance (PB) has been central to much of this recent work in international financial markets.\(^2\) In contrast to the traditional view that international capital flows depend on interest rate differentials between countries, the PB view recognizes that changes in the relative levels of domestic and foreign interest rates induce only temporary (but often large) capital flows as internationally diversified investors rebalance their portfolios. Once their desired stocks of each asset have been
obtained, capital flows cease. There is a presumption that this adjustment towards stock equilibrium in financial markets occurs quickly, in fact, virtually instantaneously due to the low transactions costs and efficient processing of new information that characterize financial asset markets. Although PB models emphasize the transitory nature of capital flows in the presence of financial disequilibrium, they also predict capital flows that continue period after period in situations when there is ongoing wealth accumulation, either in the form of domestic capital investment or current account surpluses.

Besides facilitating the understanding of international capital flows, portfolio balance has important implications for the efficacy of monetary and fiscal policies in simultaneously achieving internal and external balance. (See e.g. Mundell [1963], Grubel [1968], McKinnon [1969], Willett and Forte [1969], and Branson [1970].)

Acceptance of the PB concept for discussing international capital flows is virtually unanimous. It is, in fact, often included in undergraduate international economics textbooks. (See, e.g., Grubel [1977, Chapter 25] and Caves and Jones [1981, Chapter 20].) Furthermore, much of the more advanced work in open-economy macro under flexible as well as fixed exchange rates presumes portfolio balance. Yet the IS-LM-FE model, which is perhaps the primary teaching tool for analyzing macroeconomic policy for countries with fixed exchange rates, largely ignores these theoretical developments. ³
This paper develops a straightforward way of incorporating the modern theory of portfolio balance under fixed exchange rates into a modified IS-LM framework. In so doing, the inter-relationship between monetary and exchange market intervention policies is emphasized. The resulting "IS-PB" model provides an alternative to the widely-used IS-LM-FE model by providing an internally consistent treatment of short-run financial market equilibrium and balance of payments considerations.

In the interest of brevity, the discussion below assumes a fix-price Keynesian equilibrium. Nevertheless, an aggregate demand schedule relating price and quantity of domestic output can be derived from the IS-PB model in the same way as it is obtained in textbook treatments of the IS-LM model. This schedule can then be married to the usual aggregate supply curve to endogenize the price level.

Since our modifications to the IS-LM-FE framework concern the specification of financial market equilibrium, Section II begins by reviewing the notion of portfolio balance in an open economy. Income is treated as predetermined until Section III when the output market (the IS curve) is added to the model. Section IV illustrates the usefulness of the IS-PB model by analyzing the differing effects of balanced-budget fiscal expansion under alternative monetary policy stances which are compatible with the maintenance of a fixed exchange rate. It thereby helps remedy the scant treatment of fiscal policy (relative to monetary and exchange rate policies) in the open-economy PB literature. Section V considers the macroeconomic impact of foreign interest rate shocks on small open economies, a topic of recent concern in the world economy. Section VI
concludes with some remarks about the treatment of long-run equilibrium and the dynamic adjustment process in the PB framework.
II. Financial Market Equilibrium

Domestic residents allocate their financial wealth \((W)\) at each moment in time among three assets: domestic money \((M)\), domestic currency denominated bonds \((B)\), and foreign currency denominated bonds \((e_F)\) according to their respective nominal rates of return \((0, r, r_f)\), the level of income \((Y)\), and the predetermined covariance structure among asset returns (reflecting risk considerations):

\[(1) \quad M^d = \mathcal{A}(r, r_f, Y, W), \quad \partial W/\partial r < 0, \quad \partial W/\partial r_f < 0, \quad \partial W/\partial Y > 0, \quad \partial W/\partial W > 0,\]

\[(2) \quad B^d = \mathcal{B}(r, r_f, Y, W), \quad \partial B/\partial r > 0, \quad \partial B/\partial r_f < 0, \quad \partial B/\partial Y < 0, \quad \partial B/\partial W > 0,\]

\[(3) \quad e_F^d = \mathcal{E}(r, r_f, Y, W), \quad \partial e_F/\partial r < 0, \quad \partial e_F/\partial r_f > 0, \quad \partial e_F/\partial Y < 0, \quad \partial e_F/\partial W > 0.\]

Domestic and foreign bonds are considered imperfect substitutes à la Branson [1975], Girton and Henderson [1976], and Isard [1978] among many others. The signs of the partial derivatives in (1)-(3) are implied by assumptions that the assets are gross substitutes and that increasing the transactions demand for money causes both domestic and foreign bond demands to be reduced ceteris paribus. The derivatives satisfy the usual adding-up constraints.

The asset demands are also functions of the exchange rate \((e)\) via its effect on income and wealth:

\[W(e) = M + B + e_F, \quad W'(e) = F \geq 0.\]

The exchange rate is kept fixed by the action of the monetary authority to be discussed in detail below. As we are not concerned with the credibility of the authority's exchange rate commitment, expectations of exchange rate changes will be ignored throughout.
In order to simplify the specification of financial equilibrium, several further assumptions are made. First, the domestic economy is small in the world market for foreign bonds so that it faces an exogenously determined foreign interest rate $r_f$. Second, it is assumed (following Branson [1976]) that domestic bonds as well as money are nontraded internationally so that foreign demands for these assets can be ignored. Finally, the commercial banking system is ignored throughout. The entire domestic money supply, $M$, is therefore high-powered money and liability of the central bank. The assets on its balance sheet consist solely of bonds, $B_c$, and foreign reserves, $R$. Thus:

\begin{equation}
M = R + B_c.
\end{equation}

Let the total supply of domestic bonds issued by the domestic government equal $B$. $B - B_c$ is then the value of domestic bonds held by the private sector. Equating the demand and supply for domestic money and bonds yields two equilibrium conditions:

\begin{equation}
M = R + B_c = f(r, r_f, Y(e), W(e)),
\end{equation}

\begin{equation}
B - B_c = b(r, r_f, Y(e), W(e)).
\end{equation}

Net demand for foreign bonds is then found by inserting the equilibrium domestic rate into (3) and may be positive or negative depending on whether the country is a net creditor or debtor. (This position is denominated in foreign currency given our simplifying assumption that domestic bonds are not held by foreigners.)
Passive Fixed Exchange Rate Policy

Although the financial market equilibrium conditions (5) and (6) have been stated, the two endogenous variables have not yet been specified. These depend on the nature of monetary policy. Several possibilities, all of which are consistent with maintaining e fixed, will be explored here. In the first case the central bank passively accepts any foreign reserve inflows or outflows in exchange for domestic money. This action, which keeps the exchange rate fixed, creates a direct link between increases in central bank reserve holdings and increases in the domestic money supply, as implied by (4). It is assumed that the central bank makes no attempt to offset this money supply effect via open market operations (i.e., selling domestic bonds to contract the money supply). Under this passive fixed exchange rate (PFER) policy, therefore, \( B_c \) and hence the total supply of domestic bonds to the private sector, \( B - B_c \), are exogenous. Changes in the domestic money supply are endogenously determined by the accumulation of foreign exchange reserves.

If, for example, there is an exogenous change in the private sector's demand for money at the current level of wealth, it can be satisfied by private sales of foreign-currency denominated bonds in the world market. The central bank passively supplies domestic money in exchange for the foreign currency that domestic residents receive from this transaction so as to keep the exchange rate from appreciating.

Under PFER policy the domestic interest rate adjusts to equate the supply and demand for domestic bonds in (6). The equilibrium interest rate can be substituted into (5) to determine the endogenous level of money holdings. The momentary equilibrium level of the
Figure 1: The Bond Market Equilibrium Locus and Iso-Money Demand Loci

Figure 2: An Expansionary Open Market Operation under Passive Fixed Exchange Rate (PFER) Policy
domestic interest rate that clears the bond market (6) at each level of income is given by the BD locus in Figure 1. Higher levels of income reduce the demand for domestic (and foreign) bonds ceteris paribus, because the transactions demand for money rises. Hence the domestic interest rate must rise as income is increased if the bond market is to remain in balance. Therefore the BD curve must slope upwards to the right.

In a closed economy with only two assets (money and bonds), the BD curve in Figure 1 would be identical to the standard LM curve, which indicates money market equilibrium, due to the wealth constraint.

In the present three-asset context, however, the LM and BD curves are distinct. Furthermore, both will not be relevant simultaneously during the international adjustment process under a fixed exchange rate regime. The BD curve indicates bond market equilibrium under the PFER policy assumption which makes the domestic bond supply exogenous from the private sector's point of view.

The money supply is endogenous, as described above. Hence it is meaningless to graph an LM curve—equation (5)—as if M was fixed under PFER policy where M adjusts endogenously to equal money demand. It is, of course, possible (and useful) to graph iso-money-demand curves. There's a whole map of them. These curves denoted by $M^d_0$, $M^d_1$, $M^d_2$, etc., in Figure 1 indicate (r,Y) combinations that yield constant demands for money balances. The iso-money-demand curves are steeper in slope than the BD curve under the assumption of gross substitutability (and $\partial f/\partial Y \leq 0$).

*Iso-foreign-bond* curves could also be drawn based on equation (3). They would be negatively sloped in the (r,Y) space as $\partial f/\partial r$ and $\partial f/\partial Y$ are both negative.
To elaborate on the iso-asset-demand curves, suppose current wealth is predetermined. The $BD_0$ curve indicates possible bond market equilibrium points when the bond supply exogenously fixed at $B - B_c$ by the central bank. Given $Y_0$ in Figure 2, the market-clearing interest rate would be $r_0$. Passing through the point $E_0$ are two other curves. The $M^d_0$ curve indicates $(r, Y)$ combinations that yield the same demand for money as that prevailing when $r = r_0$ and $Y = Y_0$; i.e. $M^d_0 = M^d(r_0, \bar{r}_f, Y_0, W_0)$. The second curve is the iso-foreign-bond curve $eF^d_0$ along which the domestic demand for foreign bonds is constant at the level attained when $(r, Y) = (r_0, Y_0)$, i.e. $eF^d_0 = F(r_0, \bar{r}_f, Y_0, W_0)$. The three curves $BD_0$, $M^d_0$ and $eF^d_0$ necessarily intersect at $(r_0, Y_0)$ due to the wealth constraint.

What happens if the domestic bond supply is contracted by an expansionary open market operation? First, the $BD$ curve shifts downwards indicating that the domestic interest rate must fall if the private sector is to be enticed to sell bonds to the central bank. The new equilibrium $E_1$ (holding income constant at $Y_0$ until Section III) lies below the initial iso-foreign-bond line $eF_0$. This tells us that domestic holdings of foreign assets have risen; a drop in $r$ causes portfolio substitution towards foreign assets. Furthermore, to obtain these additional foreign assets the private sector must first purchase foreign exchange from the central bank. The portfolio shift, therefore, causes a transitory official settlement deficit.

The new equilibrium $E_1$ also lies below the initial iso-money locus, indicating a rise in money demand. Part of the initial policy-induced increase in the money supply is willingly held due
to the resulting drop in $r$. Private investors eliminate any remaining excess supply of money by converting it into foreign exchange and buying foreign bonds. Hence, the official reserve loss.

Algebraically, the open market operation causes an interest rate decline obtained from (6):

\[
\frac{dr}{dB_c} = \frac{-1}{\partial b/\partial r} < 0 .
\]

The resultant changes in money demand and hence the equilibrium money supply are found by differentiating (5) and employing (7):

\[
\frac{dM}{dB_c} = \frac{\partial f}{\partial r} \frac{dr}{dB_c} > 0 .
\]

The assumption of gross substitutability in the domestic asset demand functions insures that $\partial b/\partial r > |\partial x/\partial r|$ and $\partial b/\partial r > |\partial f/\partial r|$. Thus the open market operation causes a less than dollar for dollar increase in the money supply after accounting for the central bank intervention in the foreign exchange market (necessitated by the private capital outflow):

\[
0 < \frac{dM}{dB_c} = \frac{-\partial x/\partial r}{\partial b/\partial r} < 1 .
\]

The increase in domestic demand for foreign assets as the domestic interest rate falls is found by differentiating (3) and using (7):

\[
0 < \frac{d(eF)}{dB_c} = \frac{\partial f}{\partial r} \frac{dr}{dB_c} = \frac{-\partial f/\partial r}{\partial b/\partial r} < 1 .
\]
Assuming financial markets clear instantaneously, the increased demand for foreign bonds shows up as a temporary capital account deficit, which is smaller in magnitude than the expansionary open market operation that induced it. That is, the short-run "capital offset coefficient" of an expansionary open market operation under PFER policy is less than unity. It approaches unity as domestic and foreign bonds become closer substitutes. The immediate reserve loss experienced by the central bank is necessarily equal to the instantaneous capital outflow. This is easily verified using (9) and (4):

\[
-1 < \frac{dR}{dB} = -1 + \frac{dM}{dB} = -(1 + \frac{3f/3r}{3b/3r}) = \frac{3f/3r}{3b/3r} < 0.
\]

In contrast to the conclusion of simple monetary models, an open market operation need not induce an equal and offsetting reserve loss so that the money supply remains unchanged in the short run. This result is only obtained when all arguments of the (nominal) money demand function are assumed to be unaffected by monetary policy. If domestic and foreign bonds are not perfect substitutes and interest rates affect money demand, this will certainly not be the case. In general, an open market expansion causes a less than equal outflow of reserves when the central bank adheres to a PFER policy.

The fact that the impact (or stock-shift) effect of exogenous shocks on domestic holdings of foreign bonds (10) must exactly equal the change in the central bank's official reserves (11) makes it easy to determine graphically the effects on the official settlement balance. Just compare the new short-run equilibrium to the initial iso-foreign-bond locus. For example, \( E_1 \) in Figure 2 lies below the \( eF_0 \) locus.
indicating that foreign bond demand has risen. Central bank reserves must therefore have fallen. This technique works regardless of the monetary policy regime being considered, as we will see below.

The graphical apparatus for discussing PFER policy can now be summarized. The bond market equilibrium locus -- the BD curve in Figure 2 -- is used when analyzing the effects of exogenous shocks on the domestic interest rate. Once the interest rate effect has been determined, the implications for equilibrium holdings of money and foreign assets can be reasoned out with the help of the iso-money curves and iso-foreign-bond curves. These curves aid in determining the one-time stock-shift effects of various policy changes on the domestic money supply and capital account respectively. Ongoing flow effects on the capital account due to wealth accumulation, however, have been ignored up to this point (but see below). Thus the analysis is most appropriately thought of as analysis of "short-term" capital flows—that is, capital flows which respond to changing economic variables in the short run, regardless of the expected duration of the foreign investment. 6

Orthodox Neutral Monetary Policy

A second monetary policy stance that provides an alternative interpretation of the portfolio balance conditions (5) and (6) is the case where the monetary authority has a money supply target. It automatically conducts open market purchases or sales of domestic bonds to keep the domestic money supply as well as the exchange rate fixed as the economy is buffeted by private portfolio shifts and real output shocks. James Meade called this orthodox neutral monetary policy.
It is now widely recognized (see Mundell [1963]) that the dual objectives of controlling the domestic money supply and pegging the exchange rate are incompatible if perfect substitutability of domestic and foreign bonds (often referred to as perfect capital mobility) is assumed. The same result emerges if the interest elasticity of money demand is zero.

In the absence of perfect substitutability, both the money supply and the exchange rate can indeed be fixed by domestic authorities. To see this, consider (5) and (6) where \( M \) is fixed by carrying out foreign exchange operations (i.e., adjusting central bank holdings of \( R \) and \( B_c \)) as required. With \( M \) policy determined, the money market (rather than the bond market) equilibrium condition in (5) determines the domestic interest rate. The resulting level of central bank's domestic bond holdings can be determined from (6) by inserting the equilibrium \( r \) from (5):

\[
B_c = B - b(r, r_f, Y, W)
\]

Given \( B_c \) and the policy-determined level of \( M \), the central bank's foreign asset position is determined by (4).

To illustrate momentary equilibrium in the financial markets under orthodox neutral monetary (ONM) policy, the standard LM curve is graphed in Figure 3. The bond supply to the private sector is now endogenously determined via (12), so the BD curve of the previous section must now be replaced by a whole map of iso-domestic bond demand curves. One of these coincides with the BD curve in Figure 1. Gross substitutability implies that the BD curve under the PFER policy regime is flatter than
Figure 3: An Expansionary Open Market Operation under Orthodox Neutral Monetary (ONM) Policy
the LM curve used to depict portfolio balance under ONM policy, provided the asset demand functions in (1)-(3) are invariant under changes in monetary policy regime.

Through appropriately balanced open-market and foreign-exchange-market operations, the monetary authority can move the domestic money supply to a new target level and still maintain its official exchange rate. An open market purchase of domestic bonds will drive down the domestic interest rate relative to the foreign rate, thereby inducing portfolio substitution towards foreign bonds by the private sector. An incipient depreciation of the exchange rate is thereby created which the central bank counters by selling some of its foreign assets for domestic bonds to meet private portfolio demands. This is called sterilized intervention. If the central bank can provide the quantity of foreign bonds demanded by the private sector (or the foreign currency needed to buy them) in exchange for domestic bonds, the exchange rate will remain unchanged. Obviously the size of the central bank's portfolio relative to that of the private sector affects the feasibility of this policy. It suggests that relatively large foreign asset holdings may be required by a central bank interested in pursuing orthodox neutral monetary (ONM) policy. Furthermore, the required size of official transactions involving domestic and foreign bonds becomes larger and larger as the two types of bonds become closer substitutes. This may explain why countries often resort to exchange controls on capital transactions in an attempt to achieve greater monetary control without adjusting the exchange rate applicable for current account transactions. The capital controls, in
effect, make domestic and foreign bonds less substitutable thereby facilitating short-run control over the money supply.

The effect of an open market operation under OOFM policy can be analyzed graphically and algebraically, as was done for PFER policy. An increase in money supply brought about by selling bonds again leads to a fall in the domestic interest rate as the LM curve shifts to the right to LM₁ in Figure 3. The interest rate must decline until money demand increases by the amount of the desired increase in the money supply target:

\[
\frac{dr}{dM} = \frac{1}{\beta L/\beta r} < 0
\]

The money expansion causes a greater than equal reduction in the private demand for domestic bonds after accounting for the sterilized intervention which must follow the initial open market operation to prevent an unwanted (by the monetary authority) fall in the money supply as residents purchase foreign assets:

\[
\frac{dD}{dM} = \frac{\beta b/\beta r}{\beta L/\beta r} < -1
\]

The net increase in the private sector's foreign asset position is:

\[
0 < \frac{d(eF)}{dM} = \frac{\beta f/\beta r}{\beta L/\beta r}
\]

These results can be seen graphically in Figure 3. The new momentary equilibrium at E₁ is to the left of the initial iso-foreign-bond line eF₀. Hence private domestic holdings of foreign assets have risen, implying a transitory official settlements deficit. Furthermore, E₁ is to the right of BD₀ indicating that private holdings of domestic bonds have fallen as a result of the open market expansion and subsequent sterilized intervention.
Note that the capital offset coefficient is again positive. In fact, it may now exceed unity. It can be shown that if the initial open market expansions under a PFER policy and an ONM policy are assumed to be the same size, the capital offset is larger under the latter policy regime. (Compare (10) and (15)). That is, ONM policy causes an open market operation to have a larger effect on the domestic interest rate and hence domestic holdings of foreign bonds than it would have under a PFER regime of no sterilization. The reason for this is intuitively clear. Under PFER policy, part of the initial increase in the monetary base is lost as a result of induced capital outflows. There is, by assumption, no attempt to offset this loss. Under ONM policy on the other hand, the open market operation must be accompanied by substantial sterilized intervention so as to drive the domestic interest rate down far enough that the entire increase in the money stock is willingly held.

Interest Rate Management Policy

A final monetary policy stance, which has been important historically for many countries—particularly before the late 1970s, is the policy of intervening in the financial markets to maintain a domestic interest rate target. An Interest Rate Management (IRM) policy, which Meade referred to as Keynesian neutral monetary policy, is only feasible for small countries if there is imperfect substitutability of domestic and foreign bonds. Otherwise domestic interest rates would be unalterably linked to foreign or "world" interest rates regardless of the actions of domestic authorities. In the past many countries (e.g., the U.K. prior to 1975) have used capital controls to facilitate IRM.
Examining (5) and (6), it is clear that the central bank's holdings of foreign reserves, domestic bonds, and hence the domestic money supply are all endogenous under IRM policy. $B_c$ is obtained from (6) by setting $r$ equal to the target level $\bar{r}$:

$$B_c = B - b(\bar{r}, r_F, Y, W) .$$

$M$ and $R$ are then obtained from (5) and (4) respectively:

$$M = z(\bar{r}, r_F, Y, W) ,$$

$$R = z(\bar{r}, r_F, Y, W) - B_c .$$

The portfolio balance line in $(r, Y)$ space is horizontal at $r = \bar{r}$ in the case of an IRM policy. Provided domestic and foreign bonds are not perfect substitutes $\bar{r}$ need not equal $r_F$. The iso-foreign-bond curves are again useful for determining the impact effect of policy changes on domestic holdings of foreign bonds and the central bank's official reserves. Both iso-money and iso-bond curves are relevant because both asset supplies are now endogenous.
III. Goods Market Equilibrium

The open-economy version of the Keynesian model typically assumes that two types of goods are purchased by domestic residents: (1) domestic output, some of which is exported and (2) importable goods which are not produced locally. All prices are predetermined in the fix-price Keynesian environment of the standard IS-LM model. The supply of imports is infinitely elastic at the prevailing foreign-currency price, implying that the domestic economy is "small" relative to the size of the world market for importables. On the other hand, the country is assumed to be large in the world market for domestic output, so that foreign demand for exports $X$ is finite at the fixed domestic currency price. Total domestic output $Y$ is determined by aggregate world demand for domestic goods at prevailing prices:

$$Y = C(r, r_F, Y-T, W) + I(r, r_F) + G + X - IM(r, r_F, Y-T, W)$$

where $C$ is total domestic consumption expenditure on domestic and foreign goods, $I$ is total domestic investment expenditure, $G$ is government expenditure on domestic output, $IM$ is total domestic expenditure on imports, and $X$ is foreign demand for exports.

Equation (19) is, of course, the standard IS curve. Given the predetermined amount of wealth and the foreign interest rate at each moment in time, the domestic interest rate $r$ and national income $Y$ are simultaneously determined by flow equilibrium in the goods market—the IS curve—and "momentary" stock equilibrium in the financial markets. The latter is represented by a portfolio balance line, whose slope and interpretation depend on the monetary policy stance, as discussed in Section II.
IV. Fiscal Policy in a Portfolio Balance Model

Much of the short-run portfolio balance literature on the conduct of monetary policy under fixed exchange rates focuses almost entirely on the financial markets to the exclusion of real considerations including fiscal policy. The IS-PB framework developed in the paper is ideally suited for analyzing the effects of fiscal policy under alternative monetary policy regimes in the context of the modern portfolio balance framework.

For simplicity only a balanced-budget fiscal expansion is considered. That way private asset supplies do not grow over time due to government deficit financing. Because the IS-LM model is designed to analyze short-run equilibrium only, it will also be assumed that private saving and investment have only negligible effects on private wealth and the capital stock respectively. Thus all wealth effects and growth are ignored.

Fiscal Expansion Under Passive Fixed Exchange Rate Policy

A balanced-budget increase in government expenditure is shown by a rightward shift of the IS curve in Figure 4. Assuming for the time being that the monetary authority follows a PFER policy, the economy moves along the BD curve from $E_0$ to $E_1$ as income responds to the increase in government expenditure. Because the BD curve is flatter than the initial iso-money curve $M^d_0$, $E_1$ must lie to the right of the $M^d_0$ curve indicating a net increase in money holdings (relative to $E_0$). That is, the increased transaction demand for money brought about by the fiscal expansion unambiguously dominates the reduction in money demand attributable to the higher interest rate. Under PFER policy this net increase in money demand is accommodated by
Figure 4: Balanced-Budget Fiscal Expansion under Passive Fixed Exchange Rate (PFER) Policy
the central bank through its foreign exchange market intervention. Domestic residents act to reduce their foreign bond holdings when the domestic interest rate and income rise. In so doing they acquire foreign money which they sell to the central bank. The central bank must accept this inflow of reserves, implying an immediate balance of payments surplus, in order to keep the domestic currency from appreciating.

The fact that $E_1$ is to the right of the initial iso-foreign-bond line, $eF_0$, emphasizes that domestic holdings of foreign bonds have in fact declined. The central bank gains an equal amount in foreign reserves due to this stock-shift effect, implying a transitory balance of payments surplus on an official settlements basis. (There will also be an ongoing flow effect on foreign reserves if a current account imbalance develops, as will be discussed in Section VI below.)

Fiscal Expansion Under Orthodox Neutral Monetary Policy

To see how the effects of fiscal policy would change if the monetary authorities follow an ONM policy, consider Figure 5. The LM curve replaces the BD curve in depicting portfolio balance. Fiscal expansion moves the economy gradually from $E_0$ to $E_2$ (rather than $E_1$, as it did under a PFER policy).

Recalling that the $Bd_0$ iso-bond curve in Figure 5 would be the BD curve representing portfolio balance under PFER policy, it is easy to compare the effects of fiscal expansion under ONM policy. Income rises less and the domestic interest rate rises more under the ONM policy regime. The short-run capital inflow in this case may be either
Figure 5: Balanced-Budget Fiscal Expansion under Orthodox Neutral Monetary (ONM) Policy
greater or smaller than it was under PFER policy. It depends whether the iso-foreign-bond locus that goes through point $E_1$, the new equilibrium under PFER policy, lies above or below the iso-foreign-bond locus that goes through $E_2$, the new equilibrium under ONM policy. This in turn depends on the relative slopes of the iso-foreign-bond curves and the IS curve.

The central bank's foreign reserve holdings rise due to private portfolio rebalancing as the economy moves from $E_0$ to $E_2$. This official settlements surplus is indicated by the fact that $E_2$ lies above the initial iso-foreign-bond locus.

**Fiscal Expansion Under Interest Rate Management Policy**

The case of IRM policy is most straightforward because the interest rate remains unchanged. The fiscal expansion increases national income from $Y_0$ to $Y_3$ in Figure 6. Income rises by a greater amount than it did under either the PFER or ONM policy regimes. The interest rate pegging objective of the monetary authority leads it to accommodate expansionary fiscal policy with an expansion in the domestic money supply. That the money supply does, in fact, rise is obvious from the diagram: $E_3$ lies to the right of the initial iso-money curve $M_0^d$. The fact that $E_3$ also lies to the right of both iso-bond curves $B_0^d$ and $eF_0^d$ indicates that domestic holdings of both domestic and foreign bonds have fallen. More wealth has to be held in the form of money to meet the higher transactions demand. $E_3$ to the right of $eF_0^d$ also indicates that official reserves have risen—but not necessarily more than they would have under the other two monetary stances. It again depends on the slopes of the iso-foreign-bond curves.
Figure 6: Balanced-Budget Fiscal Expansion under Interest Rate Management (IRM)
Summary of Fiscal Policy Effects

The effects of fiscal expansion under ONM, PFER and IRM policies can now be summarized. Orthodox neutral monetary policy—which implies complete sterilization of foreign reserve flows—causes fiscal policy to be less effective in altering GNP than it would be under either the PFER of IRM policy regimes. The increase in the domestic interest rate is greatest under ONM policy, followed by PFER and then IRM policies. Both the increased income and higher domestic interest rate cause capital inflows. Thus fiscal expansion unambiguously causes an official settlements surplus in the short run in all three cases. The relative sizes of these capital flows under alternative monetary policy regimes cannot be assessed a priori as it depends on the relative sensitivity to capital flows to the two factors. There is no question, however, that higher domestic interest rates inhibit real capital investment in the domestic economy. This crowding-out effect is reduced if the monetary authority follows a PFER policy (or, better yet, an IRM policy), which allows the domestic money supply to respond in an equilibrating way to external payments disequilibria. All in all, it appears that the efficacy of (balanced-budget) fiscal expansion in achieving internal balance objectives (i.e. altering GNP) is increased if the monetary authority adopts an IRM or PFER operating rule rather than on ONM policy stance.

One thing the foregoing analysis makes clear is that the interdependence between monetary and fiscal policies should certainly not be ignored when formulating macroeconomic policy in an open economy. This is true even in the context of balanced-budget fiscal expansions discussed here where the issue of financing the fiscal deficit does not arise. In an open economy with a fixed exchange rate, the operating
procedures of the central bank inevitably affect the efficacy of fiscal policy. Hence the potential gains from coordinated fiscal and monetary policies should not be underestimated.
V. Foreign Interest Rate Shocks

International monetary affairs in 1981, when tight U.S. monetary policy raised domestic interest rates to record highs in real as well as nominal terms, brought out vividly the growing interdependence among the monetary policies of the major industrial nations. In light of this experience, it is interesting to use our model to analyze what happens when a small open economy is subjected to a dramatic rise in foreign interest rates. Here the cases of PFER policy (i.e. no sterilization) and ONM policy (i.e. complete sterilization) will be compared to see which policy regime best characterizes the macroeconomic effects that were actually observed during the 1981 period of tight U.S. monetary policy. Many of the major industrial countries had managed exchange rates rather than fixed rates as assumed here, but that need not detain us. Our purpose is merely to illustrate the importance of alternative domestic monetary policy stances in the face of foreign interest rate shocks using the IS-PB model.

First consider ONM policy depicted by the usual LM curve, as this policy stance corresponds most closely to that employed in standard textbook analyses. The exogenous rise in the foreign interest rate shifts the LM curve downwards to the right in Figure 7. That is, at each level of income the domestic interest rate must fall, following the rise in the foreign rate, if money demand is to remain unchanged.

The IS curve may shift leftward somewhat as $r_f$ rises to the extent that domestic aggregate demand depends negatively on $r_f$ in addition to $r$. Assuming that the shift in the IS curve is small relative to the LM shift yields the conclusion that domestic income rises following the exogenous increase in the foreign interest rate
Figure 7: A Foreign Interest Rate Shock Under ONM Policy
and vice versa. Regardless of the relative magnitudes of the two shifts, the domestic interest rate unambiguously falls as the foreign rate rises. The latter result stands in sharp contrast to what happened in most countries during 1981, namely domestic interest rates were pulled up—but typically by a smaller percentage amount—as U.S. rates rose.

Why does the domestic interest rate fall as the foreign interest rate increases when the monetary authority follows ONM policy? The explanation is straightforward. Domestic investors want to increase their foreign bond holdings ceteris paribus by selling off domestic-currency bonds and money as $r_f$ rises. Under ONM policy, however, the central bank must keep the domestic money supply from falling in spite of the official reserve loss caused by capital outflows. Hence it must buy domestic bonds, thereby driving down the domestic interest rate, until domestic residents willingly hold the initial supply of money in spite of the higher foreign interest rate.

As one might expect, the need to drive down the domestic interest rate to maintain the monetary target causes the equilibrating capital outflows to be larger and exacerbates the central bank's reserve loss. To depict the reserve loss diagramatically, note that the initial iso-foreign-bond locus $eF_0$ shifts upwards when $r_f$ is increased as shown in Figure 7. The new equilibrium $E_1$ lies below the iso-foreign-bond locus $eF(r_f')$ drawn for the new higher foreign interest rate $r_f'$. Thus there is a fall in the central bank's foreign reserves. The further $E_1$ lies from the $eF(r_f')$ locus, the greater is the reserve loss resulting from the central bank's action to keep the
money supply unchanged by driving down the domestic interest rate as the foreign interest rate rises.

Now let us briefly consider the case of PFER policy. The BD curve in Figure 8 now depicts portfolio balance. It shifts upwards to the left as the foreign interest rate rises; that is, it takes a higher domestic interest rate at each level of income to keep the demand for domestic bonds constant.

Combining the leftward shift of the BD curve with the leftward shift of the IS curve (explained above), it is seen that domestic income unambiguously falls in the PFER policy case. Assuming the IS shift is small relative to that of the BD locus, the domestic interest rate will rise sympathetically with the foreign rate. This prediction of falling national income accompanied by rising domestic interest rates is roughly consistent with the stylized facts in 1981, although there may well have been other contributing causes for the worldwide economic downturn besides rising U.S. interest rates.

Our model clearly shows that the macroeconomic impact of a rising foreign interest rate varies dramatically under the two monetary policy stances. Under OIM policy, we expect rising domestic income accompanied by a fall in the domestic interest rate. Under PFER policy, on the other hand, we should see a drop in income and a positive correlation between domestic and foreign interest rates. Casual empiricism suggests that the latter scenario comes closer to describing what actually happened in 1981 in the OECD countries.
Figure 8: A Foreign Interest Rate Shock under FFER Policy
VI. The Current Account and Long-Run Equilibrium

Up to this point nothing has been said about the current account of the balance of payments:

\[(20) \quad CA = \dot{W} = X - \text{IM}(r, r_f, Y - T, W) + r_f \cdot \text{ef}(r, r_f, Y, W).\]

For analyzing the short-run effects of various economic disturbances on CA, it is useful to graph the locus of \((r, Y)\) points where external balance prevails. Although the current account worsens when income rises (both through the positive propensity of import and the negative effect on total earning on foreign asset holdings), an increase in the domestic interest rate has ambiguous effects. On one hand it chokes off import expenditure thereby improving the trade balance. On the other hand, it causes portfolio substitution away from foreign assets thereby reducing foreign interest income (assuming the country is a net creditor so that \(F > 0\)). Figure 9 graphs the \(CA = 0\) locus \(^{14}\) for the case where the trade balance effect dominates the service account effect, i.e. \(|\text{er}_f \partial \text{ef} / \partial r| < |\partial \text{IM} / \partial r|\) in (20).

Whenever the current account is in surplus, there is a net accumulation in foreign assets so wealth is rising (\(\dot{W} > 0\)). Similarly, whenever there is a current account deficit, wealth is declining (\(\dot{W} < 0\)). The remainder of this paper indicates briefly how current account imbalances affect the adjustment path of the economy as the concomitant wealth accumulation shifts the various curves in the IS-PF model. The directions of these shifts over time are easily reasoned out, but the analysis is admittedly informal and nonrigorous in that it makes no attempt to mathematically characterize the adjustment path to the steady state. \(^{15}\)
Suppose the economy initially has a current account surplus, as shown in Figure 9 where the short-run equilibrium $E_o$ lies to the left of the $CA = 0$ curve. As wealth accumulation occurs over time, the demands for both domestic output and imports rise. The former causes the IS curve to shift to the right; the latter causes the $CA = 0$ curve to shift to the left provided the positive effect of wealth on import demand is larger than the effect on the service account as foreign asset holdings rise.\(^{16}\)

Asset demands also increase as wealth rises via the current account. It is easy to show that the adjustment path of the economy depends on the policy stance of the monetary authority. Consider the case of PFER policy. Given that the monetary authority undertakes no open market operations to sterilize reserve inflows under this policy stance, the growth in wealth creates an excess demand for domestic bonds. At each level of income, the interest rate needed to maintain bond market equilibrium is reduced. Thus, the BD curve must shift slowly to the right as long as the current account surplus prevails. The short-run equilibrium point $E_o$ at the intersection of the IS and BD curves continues to shift rightward until it meets the (leftward moving) $CA = 0$ locus at point $E_{o\infty}$ on the diagram. At that point the international adjustment process whereby the current account surplus is gradually dissipated is complete.

Under CNM policy where complete sterilization prevails, the adjustment towards current account balance may be more protracted. The LM curve used to depict portfolio balance under CNM policy shifts upwards to the left as wealth accumulation associated with the current account surplus occurs. Examining Figure 10, it can be seen that, at least initially, the short-run equilibrium $E_o$ may move away from
Figure 9: Current Account Imbalance and the Adjustment Process under PFER Policy

Figure 10: Current Account Imbalance and the Adjustment Process under ONM Policy
rather than towards the $CA = 0$ locus. The domestic interest rate rises throughout the adjustment process. This tends to increase capital inflows, necessitating increased intervention in the financial markets by the central bank if the money supply is to remain unchanged. In an environment with high capital mobility and close substitutability among domestic and foreign bonds, ONM policy may not be sustainable for prolonged periods of time. For certain parameter values, the adjustment process will be dynamically unstable if the central bank continues futile attempts to sterilize foreign reserve inflows. This could occur, for example, if wealth-accumulation shifts the LM curve to the left faster than it shifts the IS curve to the right and the $CA = 0$ curve to the left. The interest rate would rise without limit; GNP would decline. This potential for instability when the central bank attempts to sterilize reserve inflows and outflows has been recognized in the literature. The IS-PB model provides a simple way of illustrating this possibility.

The preceding discussion of the international adjustment process suggests that current account surpluses will create a flow demand for additional foreign bonds over time. The proportion of wealth invested in foreign bonds will, of course, change depending on the (endogenous) time paths of $r$ and $Y$. These time paths will not be formally analyzed here.\textsuperscript{17} It should be clear, however, that they will depend critically on the stance of the monetary authorities during the adjustment period, as did the impact analysis discussed in previous sections of this paper.
How important are these financial market "flow" effects of wealth accumulation (associated with current account imbalances) when analyzing the short-run effects of various policy changes as the IS-LM model purports to do? Branson [1970] has suggested that stock-shift effects, which capture the reallocation of the existing stock of wealth at the time of a policy change, will dominate the flow effects. The latter only involve the appropriate portfolio allocation of new saving. Branson estimates this flow to be roughly 10 percent of the total stock of wealth in the impact period following a policy change. This leads him to conclude that under reasonable assumptions the ratio of the initial flow effect to the stock-shift effect is about 1:10. This certainly supports the emphasis in Sections II-V of the present analysis on momentary financial market equilibrium for the purposes of short-run policy analysis. Of course, the stock-shift effect is a one-time event; flow effect continues period after period, albeit with decreasing magnitude, until long-run equilibrium is achieved. Unfortunately the IS-PB framework (like the standard IS-LM model) is not well suited for a complete analysis of ongoing flow effects on asset markets and the equilibrating mechanisms that eventually bring the external accounts to the long-run steady state. Nevertheless, these effects can at least be incorporated informally by showing how the various curves shift over time as wealth is accumulated.

In conclusion, the IS-PB model developed here has the major advantage of dealing with short-run financial markets equilibrium in a way that is consistent with modern notions of portfolio balance and stock equilibrium. This should increase the model's value as a pedagogic device considerably by making it compatible with recent research on international financial markets.
FOOTNOTES

* I wish to thank Anne Krueger, Oliver Landmann, and José Vinals for helpful comments.

1. See e.g. Christ (1968), Silber (1970), Blinder and Solow (1973).

2. See, e.g., Branson (1970), Girton and Henderson (1970), Grubel (1968), McKinnon (1969), and the useful surveys by Bryant (1975) and Myhrman (1976) for other references.

3. The Kindleberger and Lindert (1978) textbook, for example, explicitly assumes that "international capital flows not stocks lent and borrowed depend on the level of the interest rate at home and abroad" (p. 351, emphasis in the original). Apologetically, they note that "this is not fully satisfactory, since it is more likely that a given set of interest rates in this and other countries will cause an adjustment of stocks of lending or borrowing that will cease unless total wealth continues to grow" (p. 351).

4. Obviously the same financial equilibrium model can be used to analyze flexible exchange rate regimes. See, e.g. Girton and Henderson (1976) and Isard (1978); there are many others.

5. Caution must be exercised in analyzing exogenous foreign interest rate shocks as we do below, however, because the iso-foreign-bond curve shifts in this case.

6. This definition of short-term capital flows, of course, differs from the one employed in balance of payments accounting. There, "short term" applies to investments which mature in less than one year; "long-term" capital flows involve assets with a maturity date more than one year regardless of investors' motives. The present definition of short-term capital flows seems more appropriate for analytical purposes. What is relevant for macro-economic policy analysis is not the expected duration of the investment but whether international capital flows occur immediately or only gradually over time following a policy change or economic disturbance.

7. Even if money demand is interest elastic, the central bank can affect the monetary base through open market operations if income includes interest payments on domestic bonds.

8. The central bank's foreign exchange reserves may be held either in the form of foreign money or interest bearing assets. This complication is unimportant as long as the domestic economy has no effect on foreign interest rates, as assumed here.

9. As domestic and foreign bonds become closer substitutes the iso-bond curves become flatter as do the iso-foreign-bond curves. In the limit where the assets are perfect substitutes, the two maps both collapse to a single horizontal curve at the prevailing foreign interest rate.
10. Allowing for some domestic production of importables is straightforward, but irrelevant for the purposes of this paper.

11. Two things should be noted about (19). First, current output depends on the predetermined level of wealth $W$, via its positive influence on household expenditures on domestic goods. This will be important in our later discussion of the international adjustment process whereby current account balance is ultimately restored. Second, it has been assumed that both consumption (and hence saving) and investment depend on the domestic as well as the foreign interest rate.

12. Isard (1978) mentions the scant treatment given to fiscal policy in flexible exchange rate models based on portfolio balance also.


14. The CA = 0 curve differs from the FE (or sometimes BP) curve in the standard open economy IS-LM model in that the FE curve indicates $(r,Y)$ combinations where the official settlement balance not the current account is zero. The FE curve incorporates the capital account by assuming that international capital flows, rather than the equilibrium stock holdings of foreign assets, depend on the level of interest rates at home and abroad. This treatment obscures the important distinction between stocks and flows emphasized in the portfolio balance literature.

15. The relevant stock-flow considerations that must be incorporated into intermediate and long-run analyses have been discussed in the literature. The effects of fiscal deficit finance have been incorporated into open-economy models by McKinnon and Oates (1966), McKinnon (1969), and Turnovsky (1976) among others, but they are ignored by the IS-LM framework. Kouri (1976), Lapan and Enders (1978), Dornbusch and Fischer (1980) among others emphasize that current account imbalances imply an international redistribution of wealth and concomitant effects on expenditure patterns.

16. It is now recognized that stability problems may arise if the condition (that the trade balance effect outweigh the service account effect of a change in wealth) is not satisfied. Textbook analyses, it might be noted, typically ignore the service account altogether; this would make the CA = 0 locus vertical. They also ignore the wealth accumulation effects on imports, implying that the CA = 0 would not shift during the adjustment process either.

17. A formal analysis in a full-employment version of the PB model is presented in Cuddington (1981).
REFERENCES


