

WORKING PAPERS

ON THE DUALITY BETWEEN FIXED AND
FLEXIBLE EXCHANGE RATES

by

Ulrich Kohli

No. 48

November 1980

IN ECONOMICS

DEPARTMENT OF ECONOMICS

UNIVERSITY OF SYDNEY

ON THE DUALITY BETWEEN FIXED AND
FLEXIBLE EXCHANGE RATES

by

Ulrich Kohli

No. 48

November 1980

National Library of Australia Card Number and ISBN

0 86837 024

ON THE DUALITY BETWEEN FIXED AND FLEXIBLE EXCHANGE RATES*

Introduction

Fixed and flexible exchange rate regimes are often thought as being the mirror image - or the dual - of one another. Under a gold standard-like regime the exchange rate is fixed, and it is the responsibility of the central bank (or another official agency) to bridge any gap between private demand for and supply of foreign exchange. Unless sterilization operations are conducted simultaneously, the intervention mechanism will bear on the domestic money supply. This is in contrast with a flexible exchange rate regime where, in the absence of official trading, the role of balancing the foreign exchange market is left to the exchange rate. Changes in the money supply are not dictated by balance-of-payments considerations; hence monetary policy may be directed towards internal targets instead. A flexible exchange rate regime may therefore be characterized by an endogenous exchange rate and an exogenous money supply, while the reverse would be true in a fixed exchange rate regime. Indeed, several authors have proposed models of the balance of payments meant to describe both regimes, the only adjustment necessary to switch from one operating mode to the other being the permutation of the money supply and the exchange rate as endogenous and exogenous variables.¹

In this paper we use the term dual exchange rate regimes to designate a pair of regimes for which all real variables in the model react in identical fashion to real and monetary shocks. In a well-known article, Mundell (1964) established the asymmetrical response of real variables to fiscal and monetary shocks depending on the exchange rate regime. Mundell's result, however, rests entirely on his assumption of rigid prices; in the absence of rigidities

of any sort, the symmetry between the two versions of his model would be complete. It is our contention, however, that the duality between fixed and flexible exchange rate does generally not exist if the fixed exchange rate regime is indeed meant to be a system where the fixed parity is enforced through official interventions in the gold or in the foreign exchange market as it is the case in the gold (bullion or exchange) standard and under the Bretton Woods agreement. The symmetry only exists if the exchange rate is controlled through appropriate public debt management policies. There is a fundamental asymmetry between a flexible exchange rate regime and a system such as the gold standard, even under perfect price flexibility: in the former regime the balance of payments is necessarily always in equilibrium. This difference is far reaching, and it seems that it has not been fully appreciated in the literature. As a consequence models where the money supply is endogenous and the exchange rate exogenous may in fact be describing a regime other than the gold standard,² and models suited to explain the working of a gold standard-like regime may be unfit to describe in any meaningful way the functioning of a flexible exchange rate system.³ This indicates that the passage from fixed to flexible exchange rates is generally far from being trivial.

In this paper we use a simple model of the balance of payments, and, besides a flexible exchange rate system, we consider five types of fixed exchange rate regimes under alternative hypotheses of international capital mobility. We find that the model responds asymmetrically both in the short run and in the long run to a number of real and monetary shocks depending on the exchange rate regime.

The remainder of this paper is organized as follows. In section 1 we examine the case of a simple small open economy operating under international capital immobility. We establish the asymmetry between a gold standard-like regime and a flexible exchange rate system, and we identify the fixed exchange

rate case that can best be considered as the dual of a flexible regime. The validity of these results is verified in section 2 for the case of perfect capital mobility, and Mundell's model is re-examined in the light of our findings. Some concluding comments are offered in the last section.

1 Fixed and Flexible Exchange Rates without International Capital Mobility

1.1 The Model

In this section we examine a simple model of a small open economy operating under various exchange rate regimes in the absence of international capital mobility. We assume a single perishable commodity that is produced at home and abroad. The quantity of domestic output is exogenous (at full employment level), but the country is small enough for the rest-of-the-world excess demand for commodities to be treated as infinitely elastic. Domestic residents hold two types of assets: outside money (M) and outside bonds (B). Neither of these assets is traded internationally.

Money is issued by the central bank which holds two assets: international reserves (R) - gold, for instance - and government bonds (C). The central bank acquires reserves by intervening in the foreign exchange market, and it can vary its holdings of bonds through open market operations.

Bonds are issued by the government; they are fixed price bonds with variable yield r .⁴ The outstanding quantity of bonds ($B+C$) is offset, on the asset side, by a balancing item (negative net worth, A), and it can be varied by once and for all taxes and transfers that leave (permanent) income unchanged. Alternatively, government indebtedness could be viewed as resulting from government purchases of goods; this possibility is ignored here for simplicity as we concentrate our attention on debt management policies. We also ignore the effect of government interest payments on private income: we may think of these payments as being financed through

taxation.⁵ In what follows we focus our attention on private behaviour, but a clear understanding of public activity and of the public balance sheets is necessary for the discussion of the various exchange rate regimes; our accounting framework is summarized in table 1:

The backbone of the model is as follows:

$$M/p = \ell(\bar{y}, r, w) \quad \ell_y \geq 0, \ell_r < 0, 0 < \ell_w < 1 \quad (1.1)$$

$$B/p = k(\bar{y}, r, w) \quad k_y = -\ell_y, k_r = -\ell_r, k_w = 1 - \ell_w \quad (1.2)$$

$$w = (M + B)/p \quad (1.3)$$

$$M = R + C \quad (1.4)$$

$$z = z(\bar{y}, r, w) \quad 0 < z_y < 1, z_r \leq 0, z_w > 0 \quad (1.5)$$

$$t = \bar{y} - z \quad (1.6)$$

$$p = e\bar{p}^* \quad (1.7)$$

where $\ell_y = \partial \ell(\cdot) / \partial y$, and similarly for the other partial derivatives. p (p^*) is the domestic (foreign) price, r is the rate of interest, y is real income (output), z is absorption, t is the balance of trade, w is real wealth, and e is the exchange rate. As indicated earlier, M and B are the (beginning-of-period) stocks of money and privately-held bonds. Throughout this paper we adopt a beginning-of-period view of asset market equilibrium: $\ell(\cdot)$ and $k(\cdot)$ thus represent beginning-of-period demands.⁶ Asset market equilibrium conditions are given by (1.1) and (1.2); portfolio holders must choose at the start of every period to hold their wealth in the form of either money or bonds,⁷ hence the derivative conditions in (1.2). In addition, in view of (1.3), it is clear that one of (1.1) and (1.2) is redundant: we may choose to omit (1.2) for instance. (1.4) shows that money can be decomposed into an international reserve component and a domestic asset component (domestic

credit). Absorption is determined by (1.5), the balance of trade is defined in real terms by (1.6), and (1.7) reflects purchasing power parity. Income and foreign prices are exogenous, and real wealth, absorption, the balance of trade, the rate of interest and the domestic price are endogenous; the money supply, given by technical relationship (1.4), is formally endogenous as well. Treatment of the remaining variables (R , C , B and e) depends on the exchange rate regime.

1.2 The Gold Standard

We first examine the case of a gold standard (GS) or similar regime. The exchange rate, the supply of privately-held bonds (B) and domestic credit (C) are exogenous. In addition, international reserves (R) must be considered constant in the short run; since bonds are not traded internationally (no capital mobility), international reserves cannot vary instantaneously: the international component of the money supply can only change over time as the result of a trade disequilibrium. Hence version GS of the model consists of six independent equations (1.1, 1.3 - 1.7) which determine the short-run values of the six endogenous variables (M , r , z , w , t , p). The price level is determined by the purchasing power parity condition, and the rate of interest can be viewed as being determined in the money (alternatively the bond) market; the remaining variables are determined in an obvious way.

Starting from an arbitrary position (i.e. with arbitrary R , B and C), balanced trade would be fortuitous. Instead one may expect a trade disequilibrium requiring official interventions in the foreign exchange market (since the capital account is nil). Consequently, international reserves will be varying over time; resulting interest and wealth effects, however, will bring absorption in line with income eventually: the economy will then have reached a long-run equilibrium characterized by balanced trade. The long-run equilibrium values of all variables can be obtained directly by

treating international reserves as endogenous, and by adding to the model the constraint that trade must be balanced:

$$t = 0. \quad (1.8)$$

The model just described is a meaningful model of the balance of payments under a gold standard-like regime. It shows how trade need to be balanced in the short run, but that an initial disturbance will eventually be overcome by an international re-distribution of wealth as emphasized by the monetary approach to the balance of payments.⁸

1.3 Indirect Fixed Exchange Rate Regimes

The gold standard is only one of the five fixed exchange rate regimes that we examine in this paper. In general, for the exchange rate to remain constant one requires official action to suppress any divergence between demand for and supply of foreign exchange that might appear at the chosen parity. This can be done in a number of ways: i) directly, by stepping into the market, and ii) indirectly, by taking appropriate policy measures to shift one or both the demand and supply schedules. Interventions of the first type have just been examined; we now turn our attention to the second way of enforcing a fixed parity. There is obviously a wide range of policies that can be applied to shift the excess demand for foreign exchange. We need only think of foreign exchange controls, trade controls, monetary measures, and fiscal policy. In what follows we only consider monetary and fiscal interventions; even then, however, our simple model enables us to identify several forms of monetary and fiscal policy. Specifically, we examine four ways of indirectly implementing a fixed exchange rate regime: i) domestic credit management (DC), ii) open market operations (OMO), iii) pure fiscal policy (FP), and iv) equiproportionate changes in the supply of money and bonds (M/B).

The government can increase the volume of domestic credit through transfers to the public financed by sales of bonds to the central bank for an equivalent amount. The increase in C is matched by an increase in the balancing item (A) in the government's balance sheet, and by an increase in the money supply; for the private sector it amounts to a straight increase in cash balances, i.e. ceteris paribus an increase in wealth.⁹ In a fixed exchange rate regime of variety DC the policy makers must control the money supply through variations in its domestic component to maintain balance-of-payments equilibrium at the chosen parity. International reserves and the stock of privately-held bonds are exogenous, but domestic credit is endogenous in the short run as well as in the long run.

An open market operation involves a purchase (or sale) of bonds by the central bank from (to) the private sector. The central bank's balance sheet will show a simultaneous increase in holdings of government bonds and in the money supply. From the private sector's viewpoint, it means a variation in cash balances accompanied by an offsetting change in bond holdings. For given price, wealth is not affected by the operation. In a fixed exchange rate regime of the OMO variety, it is the task of the central bank to maintain the fixed parity by appropriate open market operations. Domestic credit and the stock of privately-held bonds are endogenous in the short run as well as in the long run, but the following must hold:

$$B + C = \bar{A}, \quad (1.9)$$

i.e. the asset side of the government's balance sheet is not affected by open market operations.

Pure fiscal policy involves transfers to the public financed by the floating of bonds to the private sector. Technically (and in practice) it can be viewed as the combined effect of a domestic credit expansion accompanied by a sale of bonds of equal magnitude in the open market by the central bank,

but conceptually it is of course a very elementary policy. The net effect on the central bank's balance sheet is nil; the private sector experiences a windfall increase in its bond holdings, and, ceteris paribus, an increase in wealth. The government's balance sheet shows a simultaneous increase in A and in C. In a fixed exchange rate regime of variety FP the stock of privately-held bonds is endogenous in the short run as well as in the long run, but both components of the money supply are exogenous.

The last policy we examine involves transfers to the public financed by newly printed money and sales of bonds to the private sector such as to keep the structure of the public debt constant, i.e. maintaining a fixed ratio between money and privately-held bonds. This leads to an increase in the liabilities of the central bank and in its holdings of government bonds. The net effect on the government's balance sheet is an increase in all three items (A, B and C), although if international reserves are non-zero the changes are not equiproportionate. For the private sector policy M/B leads to an equiproportionate increase in holdings of money and bonds, and hence, other things equal, to an increase in wealth. In a fixed exchange rate regime of variety M/B domestic credit and the supply of privately-held bonds are endogenous in the short run as well as in the long run subject to:

$$M/B = \alpha \quad \alpha > 0. \quad (1.10)$$

This ensures that the composition of wealth remains constant over time.

It is evident that the four indirect exchange rate regimes that we consider do not all rely on the same mechanisms to maintain external equilibrium. Version OMO relies mainly on interest rate effects, while versions DC, FP and M/B all emphasize wealth effects. Table 2 summarizes the treatment of the four key variables (C, R, B and e) according to the exchange rate regime. Before we examine the working of the indirect fixed exchange rate regimes, one more point must be noted: in all four regimes

policy is directed at equilibrating the balance of payments for the selected exchange rate; with the balance of payments in equilibrium at all times, and with neither money nor bonds traded internationally, trade must necessarily be balanced, i.e. (1.8) always holds.

Consider now fixed exchange rate regime DC. The model consists of equations (1.1) and (1.3) - (1.8). y , p^* , e , B and R are exogenous, and the seven independent equations determine the equilibrium values of p , r , w , z , M , t and C . These values are valid in the short run as well as in the long run, i.e. regardless of the starting position, the economy always instantaneously moves to a stationary equilibrium with balanced trade.

The description of fixed exchange rate regime OMO is given by (1.1) and (1.3) - (1.9), with p , r , w , z , M , B , C and t endogenous. For given y , p^* , e and R the economy also moves instantaneously to a stationary equilibrium. The interest rate can be viewed as equilibrating the trade account given the exchange rate and wealth, and the open market policy must ensure that portfolio equilibrium obtains at this rate of interest.

When the model operates under regime FP, it is given by (1.1) and (1.3) - (1.8), but, in contrast with regime DC, with B rather than with C endogenous; long-run equilibrium also obtains instantaneously.

If the exchange rate is controlled by equiproportionate changes in the supply of money and bonds (regime M/B), the model is described by (1.1), (1.3) - (1.8) and (1.10), in the short run as well as in the long run. These eight independent equations determine the equilibrium values of p , r , w , z , M , B , C and t . Once more long-run equilibrium obtains in the short run.

We thus find that our model is of little interest for balance-of-payments theory when it operates under any of the indirect fixed exchange rate regimes since it predicts that the economy is always in long-run equilibrium with balanced trade. As we will see in the next section, the assumption of no international capital mobility bears heavily on this property of the model.

1.4 Flexible Exchange Rate Regime

Under flexible exchange rates the central bank does not intervene in the foreign exchange market, and it lets the rate be determined by private demand for and supply of foreign exchange. Monetary policy can be assigned to internal targets, and B , C and R are exogenous in the short run as well as in the long run. The balance of payments is always in equilibrium, and since the capital account is nonexistent, trade must be balanced at all times. The model is given by (1.1) and (1.3) - (1.8), with p , r , w , z , M , t and e endogenous. For given B , C , R , y and p^* it is clear that equilibrium is stationary; hence in this model and under flexible exchange rates the economy is always in long-run equilibrium, a proposition of little interest for balance-of-payments theory.

1.5 The Duality between Fixed and Flexible Exchange Rates

Of the six exchange rate regimes examined here, only one - the gold standard - is capable of conferring some interest to the model of subsection 1.1. This reveals the asymmetry that exists between the gold standard and a flexible exchange rate regime. Starting from a long-run equilibrium position, a real shock (e.g. a change in income) or a monetary shock (e.g. a change in foreign prices) would be accommodated instantaneously under a flexible exchange rate, but would generally throw the economy out of long-run equilibrium under the gold standard with the subsequent adjustment process possibly extending over a considerable amount of time.

What is the dual of a flexible exchange rate regime? As indicated in the introduction, by dual exchange rate regimes we mean a pair of regimes for which all real variables in the model react in identical fashion to real and monetary shocks. It is clear from our earlier results that if a dual to the flexible exchange rate case exists among the regimes we have examined, it must be one of the indirect fixed exchange rate regimes. Consider the flexible

exchange rate case; the model of equations (1.1) - (1.8) can be reduced to:

$$(R + C)/(e\bar{p}^*) = \ell[\bar{y}, r, (R + C + B)/(e\bar{p}^*)] \quad (1.11)$$

$$\bar{y} - z[\bar{y}, r, (R + C + B)/(e\bar{p}^*)] = 0. \quad (1.12)$$

Inspection of (1.11) - (1.12) reveals that an equiproportionate increase in the supply of money ($R+C$) and bonds (B) leads to an increase in the exchange rate (a devaluation) in the same proportions, and leaves the values of all real variables (z, r, w) unchanged. The model is neutral to the monetary shock just described. It can easily be seen from (1.11) - (1.12) that an increase in foreign prices is neutral as well, but this is not true for other monetary or real shocks.¹⁰ Of interest is an exogenous change in real income. It can easily be shown that an increase in y does not only lead to an appreciation of the exchange rate and to a fall in domestic prices, but also to an increase in wealth, absorption, and the rate of interest.¹¹

Consider now the indirect fixed exchange rate regimes, and examine the effect of a devaluation (an increase in e). It is apparent from (1.11) - (1.12) that this shock does generally have real effects (e.g. the interest rate changes), unless the money supply and the stock of privately-held bonds are increased in the same proportions as the exchange rate. Thus in this model devaluations are non-neutral under all fixed exchange rate regimes except regime M/B. Another monetary shock that we may consider is a change in foreign prices. This shock was found neutral under flexible exchange rates; it is visible from (1.11) - (1.12) that a change in p^* is neutral under fixed exchange rates only if it is offset by an equiproportionate variation in the supply of money and bonds. If the exchange rate regime is of variety GS or OMO, wealth necessarily decreases as a result of a rise in p^* , and (1.11) indicates that for unchanged interest and wealth, an expansion of domestic credit (supply of bonds) necessarily leads to excess supply (demand) in the money market. Alternatively we may examine a real shock,

e.g. an increase in income; it is clear that the appreciation of the exchange rate that we detected in the flexible exchange rate regime case can be avoided by appropriate increases in B and/or C. In addition, if the supply of money and the supply of bonds are increased in the same proportions as $1/e$ would have, both the real money supply and real wealth take the same values as in the flexible exchange rate case and hence the rate of interest must be the same as well.

Looking at equations (1.11) - (1.12), we can observe that the model always yields the same equilibrium values for all real variables, whether e is left endogenous with C and B constant, or whether e is fixed with C and B endogenous subject to (1.10). The discussion in this section has shown that in this model the dual of a flexible exchange rate regime is a regime where the exchange rate is fixed through equiproportionate variations in the supply of money and bonds, without official interventions in the foreign exchange market. We have found, however, that our model is unable to explain short-run balance-of-trade disequilibria in all but one exchange rate regime; hence it is of limited interest for balance-of-payments theory. This restrictive feature of the model has actually been useful by exposing more forcefully the asymmetry between the gold standard and the flexible exchange rate regimes, but it must now be relaxed.¹² This is done in the next section where we verify that our results also hold when we allow for international capital mobility.

2 Fixed and Flexible Exchange Rates under Perfect Capital Mobility

We have seen that the model of section 1 gives a meaningful representation of the balance of payments when it operates under a gold standard or similar regime, but that it is devoid of interest under flexible or indirectly fixed exchange rates. Where does this asymmetry stem from? The weakness of the model of section 1 results from the necessity for trade to be balanced at all

times if official interventions in the foreign exchange market are ruled out: since neither money nor bonds are traded internationally there is no way to finance a trade disequilibrium. The home country and the rest of the world are then little more than a pair of closed economies. In order to get a meaningful model of the balance of payments, and to be able to explain short-run trade deficits or surpluses, it is necessary to allow for transfers of wealth from one region to the other. Such a possibility does not exist under flexible exchange rates or under any of the indirect fixed exchange rate regimes if asset markets are segregated, but it always exists in a gold standard-like regime: official interventions in the foreign exchange market in effect allow residents of one country to trade money for commodities with residents abroad. To provide for such a wealth transfer mechanism under all exchange rate regimes one should allow for international capital mobility. We continue to assume that domestic money and domestic bonds are held by domestic residents only, but we now allow domestic residents to hold foreign bonds as well. We assume that foreign bonds can be freely traded, and that the home country is sufficiently small for the foreign interest rate to be considered exogenous. ¹³

The model of equations (1.1) - (1.7) needs some modifications associated with the addition of the extra asset. We now have:

$$M/p = l(\bar{y}, r, \bar{r}^*, w) \quad l_y \geq 0, l_r < 0, l_{r^*} < 0, 0 < l_w < 1 \quad (2.1)$$

$$B/p = k(\bar{y}, r, \bar{r}^*, w) \quad k_r > 0, 0 < k_w < 1 \quad (2.2)$$

$$eB^*/p = k^*(\bar{y}, r, \bar{r}^*, w) \quad k_y^* = -l_y - k_y, k_r^* = -l_r - k_r, \quad (2.3)$$

$$k_{r^*}^* = -l_{r^*} - k_{r^*} > 0, k_w^* = 1 - l_w - k_w > 0$$

$$w = (M + B + eB^*)/p \quad (2.4)$$

$$M = R + C \quad (2.5)$$

$$z = z(\bar{y}, r, \bar{r}^*, w) \quad 0 < z_y < 1, z_r < 0, z_{r^*} < 0, z_w > 0 \quad (2.6)$$

$$t = \bar{y} - z \quad (2.7)$$

$$p = e\bar{p}^* \quad (2.8)$$

B^* is the stock of foreign bonds in the hands of (private) domestic residents, r^* is the foreign rate of interest, and $k^*(\cdot)$ is the domestic demand for foreign bonds. (2.3) sets the domestic demand for foreign bonds equal to the available stock; foreign bonds are counted in wealth (eq. 2.4), and the foreign interest rate is included in the absorption and asset demand functions. We assume in (2.1) that domestic and foreign bonds are substitutes for money. In addition, it is reasonable to assume $k_{r^*}^*$ and k_w^* positive; the other restrictions in (2.3) are implied by the balance sheet identity. One of the asset market equilibrium conditions is again redundant; we may choose to omit (2.3) for instance.

The model is of interest of its own right, and it can be used to obtain short-run and long-run comparative statics results for a large variety of shocks. We limit our attention, however, to the working of the model under alternative exchange rate regimes. In a gold standard-like regime, equations (2.1) - (2.2) and (2.4) - (2.8) give the short-run configuration of the model. y , p^* , r^* and e are of course exogenous; B is exogenous as well, but it is no longer true that R must be constant in the short run: under perfect capital mobility, it is at all times possible for domestic residents to sell (buy) foreign bonds abroad, and oblige the central bank to intervene in the foreign exchange market and to supply (absorb) domestic currency in the desired amounts. This is a case of asset substitution which, we assume, can take place instantaneously. Both R and B^* are therefore endogenous subject to the restriction:

$$R + \bar{e}B^* = R_0 + \bar{e}B_0^* \quad (2.9)$$

where the subscripts indicate initial values. The eight independent equations (2.1) - (2.2) and (2.4) - (2.9) determine the short-run values of all endogenous variables (p , r , w , z , M , R , B^* and t). Starting from an arbitrary position trade will generally not be balanced, leading to an accumulation or a decumulation of wealth over time. In the long run (2.9) need not hold, but trade must be balanced instead (eq. 1.8). The long-run equilibrium values of all variables can therefore be calculated directly from (2.1) - (2.2), (2.4) - (2.8) and (1.8). We have again a meaningful model of the balance of payments where long-run equilibrium need not obtain instantaneously, wealth being fixed in the short run. Note that this model is somewhat more interesting than the model of section 1 (version GS) since it allows for instantaneous portfolio shifts, i.e. changes in portfolio composition that do not require an act of saving. The model (2.1) - (2.8) is also able to draw the distinction between the balance of trade and the balance of payments: the capital account is given by the variation in the stock of domestically-held bonds from one period to the other.¹⁴

We now turn to the four indirect fixed exchange rate regimes. Consider regime DC. p^* , r^* , y , e , B and R are exogenous in the short run as well as in the long run. C is endogenous at all times, but because foreign bonds are the only asset which is traded internationally B^* is fixed in the short run: it can only vary over time as the counterpart of a balance-of-payments disequilibrium. Equations (2.1) - (2.2) and (2.4) - (2.8) determine the short-run values of all endogenous variables (p , r , w , z , M , C and t). There is no need for trade to be balanced in the short run, but long-run equilibrium requires (1.8), and B^* must be treated as endogenous. Since the balance of payments is necessarily nil at all times (in the absence of official interventions in the foreign exchange market) the capital account is equal to minus the balance of trade.

If the fixed parity is enforced through open market operations B^* is fixed in the short run, but B and C are endogenous subject to (1.9). The short-run description of the model is given by (2.1) - (2.2), (2.4) - (2.8) and (1.9) with p, r, z, w, M, B, C and t endogenous. Long-run equilibrium is characterized by (1.8) with B^* becoming endogenous.¹⁵

Fixed exchange rate regime FP is symmetrical to DC: all that is needed is to interchange money and bonds. We find again that trade need not be balanced in the short run.

Consider next the case where the fixed parity is maintained through equiproportionate changes in the supply of money and bonds (operating mode M/B). (2.1) - (2.2), (2.4) - (2.8) must be completed by addition of (1.10). These eight equations determine the short-run equilibrium values of p, r, w, z, M, B, C and t . B^* , which is fixed in the short run, becomes endogenous in the long run, and (1.8) then closes the model.

We finally examine the working of a flexible exchange rate regime. y, p^*, r^*, R, B and C are exogenous. In the short run B^* is exogenous as well, and (2.1) - (2.2) and (2.4) - (2.8) serve to determine the short-run equilibrium values of p, r, w, z, M, e and t . In the long run B^* is endogenous, but (1.8) once more applies. The treatment, in the short run and in the long run, of the key variables for all six exchange rate regimes is summarized in table 3.

For all exchange rate regimes examined here the model of this section gives a meaningful representation of the balance of payments in the sense that it does not require long-run equilibrium to obtain at all times. Instead the balance of trade (and the capital account) may remain out of equilibrium for some time thus adding a dynamic dimension to the model. While this is true for all six exchange rate regimes, there subsists an asymmetry between the gold standard and all other regimes, although it is not as dramatic as in the case of the model of section 1. We have already noted that model (2.1) - (2.8)

allows for instantaneous substitution between domestic assets and foreign assets under the gold standard; this possibility does not exist under the alternative exchange rate regimes.¹⁶ Under flexible exchange rates, or in any of the indirect fixed exchange rate regimes, holdings of foreign bonds can only vary over time as the result of an act of saving (or dissaving). The asymmetry again stems from the fact that under a gold standard-like regime money can effectively be transferred from residents of one country to residents of the other country.¹⁷ Under the gold standard, the official intervention mechanism thus equips model (2.1) - (2.8) with a second international asset. In order to account for the possibility of international asset substitution under all exchange rate regimes one would have to allow for at least one additional asset, but even then the gold standard would generally retain its distinctive feature by providing for one extra avenue for international transfers of wealth. This discussion reveals that if there is a dual of the flexible exchange rate system among the regimes examined here, it must again be one of the indirect fixed exchange rate regimes.

Under flexible exchange rates the model can be collapsed into the following three equations:

$$(R + C)/(e\bar{p}^*) = \ell[\bar{y}, r, \bar{r}^*, (R + C + B + eB^*)/(e\bar{p}^*)] \quad (2.10)$$

$$B/(e\bar{p}^*) = k[\bar{y}, r, \bar{r}^*, (R + C + B + eB^*)/(e\bar{p}^*)] \quad (2.11)$$

$$t = \bar{y} - z[\bar{y}, r, \bar{r}^*, (R + C + B + eB^*)/(e\bar{p}^*)]. \quad (2.12)$$

(2.10) - (2.12) can be used to determine the equilibrium values of e , r and t in the short run, and of e , r and B^* in the long run (setting $t = 0$). The values of the other endogenous variables can be obtained in an obvious way from the remaining equations of the model. From (2.10) - (2.12) it can easily be seen that starting from an arbitrary equilibrium position (short-run

or long-run) an equiproportionate change in the supply of money ($R+C$) and the stock of privately-held bonds (B) has no effect on any of the endogenous real variables (r , t or B^*) if offset by an equiproportionate change in the exchange rate; the shock just described is neutral under flexible exchange rates. Similarly, a change in the foreign exchange parity leaves any equilibrium undisturbed if it is accompanied by an equiproportionate change in the supply of money and bonds. This finding again points out at the duality between a flexible exchange rate system and a fixed exchange rate regime of type M/B. Any shock, whether real or monetary, even if it does have real effects, will lead to the same short-run and long-run equilibrium values for all real magnitudes, whether the exchange rate is left free to vary, or whether it is held constant with the supply of money and the stock of privately-held domestic bonds maintained in fixed proportions.

We should emphasize that we have established the asymmetry between a gold standard-like regime and a flexible exchange rate system without assuming rigidities of any sort. If prices are inflexible, it is well known that fixed and flexible exchange rate regimes yield asymmetrical results.¹⁸ It is clear also that price flexibility is essential in establishing the duality between a flexible exchange rate system and a fixed exchange rate regime of the M/B variety.

Models that treat the money supply as endogenous under fixed exchange rates often describe a regime of the DC or M/B variety rather than a system such as the gold standard.¹⁹ This is because under a gold standard the money supply is either fixed in the short run (in the absence of international capital mobility), or endogenous but subject to a constraint such as (2.9) (under perfect capital mobility). It is instructive to examine Mundell's (1964) model in this respect. Mundell's model is somewhat more complicated than ours because it describes the home economy as well as the rest of the world, but this need not concern us. Other distinguishing features of Mundell's

model are that home and foreign commodities are not perfect substitutes for each other, that output is endogenous, and that prices are assumed constant. Mundell does not consider domestic bonds; hence no distinction can be made between fixed regimes DC and M/B. In addition, wealth is not included in the demand for money and the absorption functions; this implies that for given interest and income domestic residents are willing to hold any amount of foreign bonds, and hence it makes no difference, as far as the equilibrium of the model is concerned, whether or not variations in the stock of money are accompanied by changes in the supply of foreign bonds: it is therefore not possible to distinguish regime DC from regime GS.²⁰ A consequence of the exclusion of wealth from the analysis is that the model lacks any kind of internal dynamics; any short-run equilibrium perpetuates itself, i.e. the economy moves instantaneously into a "pseudo long-run equilibrium", a stationary equilibrium where balanced trade would be fortuitous. While the fixed exchange rate regime of Mundell's model can be interpreted as of either the GS or the DC type, duality with the flexible exchange rate regime does not obtain because of the assumption of price rigidity.

3 Concluding Remarks

Using two simple models we have established the fundamental asymmetry that exists between a gold standard-like regime and a flexible exchange rate system. The asymmetry exists even in the absence of rigidities of any sort. The official intervention mechanism allows in effect for the international transfer of money; this possibility is inherent to the gold standard system, but it might not exist in an alternative regime. As a consequence a trade disequilibrium can always be financed in a gold standard-like regime, even if capital is immobile internationally. Under flexible exchange rates, however, some form of international capital mobility is a necessary condition for the existence of short-run trade disequilibria.

The dual of a flexible exchange rate system is a fixed exchange rate regime where the parity is maintained through equiproportionate changes in all components of wealth which are denominated in domestic currency (money and bonds here). These changes are assumed to take the form of once and for all transfers and taxes. Variations in net government expenditures on goods and services have not been considered here, but they would of course be of interest as well. It would be necessary, however, to take the corresponding once for all shifts in the absorption function into account. It can easily be seen that an equiproportionate increase in the supply of money and bonds used to finance once for all government purchases of commodities rather than transfers would generally have real short-run effects.

We have considered four types of indirect fixed exchange rate regimes. In a deterministic world with perfect information it is indeed possible to fix the exchange rate through policies such as the ones examined here. It is clear though, that such precision might not be achieved in reality, just as most other macroeconomic objectives are usually not exactly met. Expectations could probably be usefully built into the analysis, since they might have a stabilizing effect if the exchange rate policy is announced. It might be appropriate, however, to refer to the four indirect exchange rate regimes as regimes as managed float rather than as rigidly fixed exchange rate systems. To this one might add that there are few examples of rigidly fixed exchange rates, even in gold standard-like regimes where the price of foreign exchange is typically allowed to fluctuate within a narrow band set by the official intervention points.

FOOTNOTES

- * I wish to thank, without implicating, E. Kiernan, G. Mills and A.J. Phipps for a number of useful comments on an earlier draft of this paper.
1. See Mundell (1964) and Bilson (1978) for example.
 2. This applies to Bilson (1978) for instance.
 3. Dornbusch's (1973) model is a good example.
 4. Alternatively one could consider perpetuities with price $1/r$. This would allow for the effect of changes in interest on wealth (the Metzler effect); this, however, would necessitate allowance for central bank capital gains or losses.
 5. Interest payments by the government to the central bank may be ignored if one assumes that the profits of the central bank are transferred to the government.
 6. See Foley (1975) and Kohli (1980).
 7. The "balance sheet identity"; see Foley (1975).
 8. See Johnson (1972) for instance.
 9. This process is similar to the "helicopter" mechanism of monetary creation; the operation is assumed reversible. It is a matter of semantics whether this policy ought to be considered as pure monetary policy, or as a combination of fiscal and monetary policy.
 10. Our condition for neutrality is analogous to Patinkin's condition (1965, p.445 for instance).
 11. A wealth elasticity of the demand for money around unity is assumed here.
 12. Note, however, that this model is somewhat more general than other models found in the literature; see Dornbusch (1973) for example.
 13. The financial part of this model is similar to Genberg and Kierzkowski (1976). For simplicity we ignore the effect of international interest payments; alternatively we could assume that the additional asset (B^*) is foreign money with a zero return. The assumption that domestic assets are not traded internationally is a convenient one for it enables us to omit the rest of the world from our model; although this assumption does result in asymmetrical treatment of the home economy and of the rest of the world, it is probably a reasonable hypothesis for a small open economy whose currency is little used in international transactions.
 14. In general we may expect a balance-of-trade deficit to be accompanied by an outflow of capital as well as by a balance-of-payments deficit: this follows from the assumption that ℓ_w , k_w and k_w^* are all positive, but less than one.

15. We could also examine the case of open market operations in foreign bonds. Except for the central bank's balance sheet this case is similar to the gold standard regime.
16. Note, however, that under regime OMO domestic asset substitution is generally possible.
17. The same is obviously true if gold is used as the domestic and the foreign currency as it is the case under the gold specie standard.
18. See Mundell (1963) for instance.
19. See Bilson (1978) for example.
20. Private wealth would differ according to the regime, but this does not bear on the equilibrium values of the other variables in the model.

TABLE 2

Treatment of Key Variables for Alternative Exchange Rate Regimes
(No International Capital Mobility)

Regime	e	R	C	B
Flexible	N	X	X	X
Gold Standard (GS)	X	X^1/N	X	X
Domestic Credit (DC)	X	X	N	X
Open Market Operations (OMO)	X	X	N	N^2
Pure Fiscal Policy (FP)	X	X	X	N
Fixed Public Debt Structure (M/B)	X	X	N	N^3

e = exchange rate

R = international reserves

C = domestic credit

B = stock of privately-held bonds

N = endogenous treatment

X = exogenous treatment

Notes: 1. in the short run only

2. subject to $B + C = \bar{A}$

3. subject to $M/B = \alpha$

TABLE 3

Short-run and Long-run Treatment of Key Variables

for Alternative Exchange Rate Regimes

(Perfect International Capital Mobility)

Regime	e	R	C	B	B*
Flexible	N/N	X/X	X/X	X/X	X/N
Gold Standard (GS)	X/X	N/N	X/X	X/X	N ¹ /N
Domestic Credit (DC)	X/X	X/X	N/N	X/X	X/N
Open Market Operations (OMO)	X/X	X/X	N/N	N ² /N ²	X/N
Pure Fiscal Policy (FP)	X/X	X/X	N/N	N/N	X/N
Fixed Public Debt Structure (M/B)	X/X	X/X	N/N	N ³ /N ³	X/N

The table indicates short-run/long-run treatment

e = exchange rate

R = international reserves

C = domestic credit

B = stock of privately-held bonds

B* = stock of foreign bonds held by domestic residents

N = endogenous treatment

X = exogenous treatment

Notes: 1. subject to $R + eB^* = R_0 + eB_0^*$

2. subject to $B + C = \bar{A}$

3. subject to $M/B = \alpha$

REFERENCES

- Bilson, J.F.O. (1978), "The Current Experience with Floating Exchange Rates: An Appraisal of the Monetary Approach", American Economic Review, Papers and Proceedings 68, 392-397.
- Dornbusch, R. (1973), "Devaluation, Money and Nontraded Goods", American Economic Review 63, 871-880.
- Foley, D.K. (1975), "On the Specification of Asset Equilibrium in Macroeconomic Models", Journal of Political Economy 83, 303-324.
- Genberg, H. and H. Kierzkowski (1976), "Sectoral Effects of Macroeconomic Policies under Flexible Exchange Rates", GIIS-Ford Foundation Discussion Paper No. 11, Graduate Institute of International Studies, Geneva.
- Johnson, H.G. (1972), "The Monetary Approach to Balance-of-Payments Theory", in Further Essays in Monetary Theory (London: Allen & Unwin).
- Kohli, U.R. (1980), "Beginning- and End-of-Period Specifications of Asset Market Equilibrium in Balance-of-Payments Theory", Working Papers in Economics, No. 38, Department of Economics, University of Sydney.
- Mundell, R.A. (1963), "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates", Canadian Journal of Economics and Political Science 29, 475-485.
- Mundell, R.A. (1964), "A Reply: Capital Mobility and Size", Canadian Journal of Economics and Political Science 30, 421-431.
- Patinkin, D. (1965), Money, Interest, and Prices, 2nd. ed., (New York: Harper and Row).

WORKING PAPERS IN ECONOMICS

- * 1 I.G. Sharpe A Framework for Analysis of the Money Supply Process in Australia
- * 2 I.G. Sharpe & R.G. Walker Asset Revaluation and Stock Market Prices
- * 3 N.V. Lam Incidence and Stabilization Impact of Tin Export Taxation in West Malaysia
- * 4 V.B. Hall & M.L. King Inflationary Expectations in New Zealand: A Preliminary Study
- * 5 A.J. Phipps Strike Activity and Inflation in Australia
- * 6 N.V. Lam Incidence of the Rice Export Premium in Thailand
- * 7 I.G. Sharpe Secondary Reserve Requirements, the Monetary Base and the Money Supply in Australia
- 8 P. Saunders Labour Demand Functions and the Quasi-Fixity Hypothesis: Some Empirical Results for U.K. Manufacturing Industries, 1963-1974
- 9 W.P. Hogan Economic Strategies for Recovery
- 10 T.P. Truong Asset Revaluation and Share Prices: A Study using the M.S.A.E. Regression Technique
- 11 S. Kim Instability of Primary Exports, Income Stabilization Policies and Welfare
- *12 I.G. Sharpe & P.A. Volker Institutional Change, Specification Error, Inflation and the Stability of the Demand for Money Function in the United States, 1901-1974
- *13 I.G. Sharpe & P.A. Volker The Impact of Institutional Changes on the Australian Short-Run Money Demand Function
- *14 W.P. Hogan The Connections Between Foreign Trade and Economic Development: An Empirical Study
- *15 F. Gill The Case of the Black Exodus from the Southern U.S., 1910-1970: Some Lessons for Theory and Applied Theory
- *16 A.J. Phipps The Impact of Wage Indexation on Wage Inflation and Strike Activity in Australia
- *17 V.B. Hall Pricing Behaviour in Australia: A Data Evaluation Study
- *18 I.G. Sharpe Australian Money Supply Analysis: Direct Controls and the Relationship Between the Monetary Base, Secondary Reserve and the Money Supply
- *19 L. Haddad Economic Systems: Towards a New Classification
- 20 G. Lewis A Strategy for Winning at Roulette

- 21 R.L. Brown A Test of the Black and Scholes Model of Option Valuation in Australia
- *22 V.B. Hall Pricing Behaviour in Australian Manufacturing Industry: Hypothesis Testing 1955-1956 to 1967-1968
- *23 I.G. Sharpe & P.A. Volker The Selection of Monetary Policy Instruments: Evidence from Reduced Form Estimates of the Demand and Supply of Money in Australia
- *24 V.B. Hall Excess Demand and Expectations Influences on Price Changes in Australian Manufacturing Industry
- *25 I.G. Sharpe & P.A. Volker The Tradeoff Between Improved Monetary Control and Market Interest Rate Variability in Australia: An Application of Optimal Control Techniques
- *26 Evan Jones with the assistance of Mary MacDonald An Examination of Earnings Differentials in Australian Manufacturing Industry
- 27 W.P. Hogan Questions on Structural Adjustment Policies
- 28 P. Saunders Price and Cost Expectations in Australian Manufacturing Firms
- 29 W.P. Hogan, I.G. Sharpe & P.A. Volker Regulation, Risk and the Pricing of Australian Bank Shares 1957-1976
- 30 W.P. Hogan Quicksands of Policy-Making
- 31 C. Emerson Taxing Natural Resources Projects
- 32 R.W. Bailey, V.B. Hall & P.C.B. Phillips A Small Model of Output, Employment, Capital Formation and Inflation, applied to the New Zealand Economy
- 33 W.P. Hogan Eurofinancing: Currencies, Loans and Bonds
- 34 S. Adei The Growth of Foreign Investment and Economic Nationalism in Post Independence Ghana: 1957-1975
- 35 W.P. Hogan The 40 Per Cent Investment Allowance
- 36 W.P. Hogan Controlling Eurofinance Markets
- 37 R.T. Ross Disaggregate Labour Supply Functions for Married Women: Preliminary Estimates for New Zealand
- 38 U.R. Kohli Beginning- and End-of-Period Specifications of Asset Market Equilibrium in Balance-of-Payments

- 39 G. Mills Government Incentive Contracts with Private Companies: Some Lessons from the Channel Tunnel
- 40 C.G.F. Simkin Closer Economic Relations Between Australia and New Zealand
- 41 U.R. Kohli Relative Price Effects and the Demand for Imports
- 42 W.J. Merrilees Alternative Models of Apprentice Recruitment: with Special Reference to the British Engineering Industry
- 43 P. Saunders Price Determination in Australian Manufacturing Firms: A Cross-Section Study
- 44 W.P. Hogan Immigration Policies and Issues
- 45 W.J. Merrilees Labour Market Segmentation in Canada: A Translog Approach
- 46 W.J. Merrilees Pricing Strategies in the Newspaper Industry
- 47 J.L. Whiteman The Micro-Foundations of Layoffs and Labour-Hoarding
- 48 U.R. Kohli On the Duality between Fixed and Flexible Exchange Rates.

Papers marked with an asterisk are out of stock. Copies of the others are available upon request from:

Department of Economics,
The University of Sydney,
N.S.W. 2006.

Working Papers in Economics that have
been accepted for publication elsewhere

- 2 I.G. Sharpe & R.G. Walker Journal of Accounting Research,
Fall, 1975, 293-310.
- 3 N.V. Lam Journal of the Developing Economies
vol. 17, No. 1, March 1979.
- 4 V.B. Hall & M.L. King New Zealand Economic Papers, 1976,
118-51.
- 5 A.J. Phipps Economic Record, September 1977,
297-319.
- 6 N.V. Lam Journal of Development Studies,
vol. 14, No. 1, October 1977.
- 7 I.G. Sharpe Australian Journal of Management,
April 1976, 85-106.
- 9 W.P. Hogan Economic Papers, No. 55, The Economic
Society of Australia and New Zealand,
29-57.
- 13 I.G. Sharpe & P.A. Volker Kredit und Kapital, vol. 12, No. 1,
1979
- 14 W.P. Hogan Some Calculations in Stability and
Inflation, A.R. Bergstrom et.al. (eds),
John Wiley and Sons, 1978.
- 18 F. Gill Australian Economic Papers, vol. 19,
No. 35, December 1980.
- 21 R.L. Brown Australian Journal of Management,
vol. 3, No. 1, April 1978, 17-36.
- 23 I.G. Sharpe & P.A. Volker The Australian Monetary System in the
1970s, M. Porter (ed.), Supplement to
the Economic Record, 1978.
- 24 V.B. Hall Economic Record, vol. 56, No. 152,
March 1980, 69-81.
- 27 W.P. Hogan Malayan Economic Review, vol. 24, No. 1
April 1979.
- 28 P. Saunders Australian Economic Papers, vol. 19,
No. 34, June 1980.
- 30 W.P. Hogan Australian Economic Papers, vol. 18,
No. 33, December 1980.