ABSTRACT

Sectoral Shocks in a Dependent Economy: Long-Run Adjustment and Short-Run Accommodation

This paper examines the allocation and stabilization consequences of a resource boom in a small open economy. Both the intersectoral allocation of capital and the price of non-traded goods adjust sluggishly; in contrast the nominal exchange rate adjusts instantaneously to ensure that the conditions for uncovered interest parity in the presence of rational exchange-rate expectations are always met. The ability of monetary policy to stabilise the economy is examined, and it is shown that, even when intervention is justified in principle, policy errors which arise from confusing real and monetary shocks may worsen macroeconomic performance.

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Despite, or perhaps because of, the large amount of research devoted to the study of macroeconomic stabilization policy, the 1970's failed to produce anything like a consensus on the subject. Much of the recent literature has focussed on providing explanations for deviations from the classical norm of perpetual full employment, and on analysing the robustness of various policy prescriptions under alternative rationales for the use of such policy. While proponents of the "new Clasical macroeconomics" have put forward an equilibrium interpretation of the business cycle in which no constructive role exists for "Keynesian" demand management, others have invoked wage-price stickiness as a justification for policy activism.

However, this focus on short-run demand management has distracted attention from the longer-run implications of intervention through its effects on investment and resource allocation. This paper attempts to redress this balance by explaining the interactions between exogenous shocks, short-run stabilization policy, and long-run resource allocation in a model which combines a rich production structure with an explicit treatment of money-market equilibrium and rational exchange-rate expectations. The model was introduced in Neary and Purvis (1981) where it was shown that the real adjustment of the economy arising from sluggish intersectoral reallocation of resources implies that the nominal exchange rate may overshoot its new long-run value following an exogenous real shock, even when all wages and prices are per-

fectly flexible. In the present paper we relax this last assumption and thus are able to examine the interaction between the macroeconomic dynamics resulting from sticky prices and the Marshallian dynamics arising from sluggish factor reallocation.

While our focus is on the long-run effects of stabilization policy, we do not conceive of intervention as taking place in a vacuum but rather as evolving in response to specific exogenous disturbances. The dynamic response of the economy thus reflects both the "natural" response following the shock and the "induced" response to the policy. Although policy is characterized as intending to mitigate the effects of the disturbances, the analysis suggests ways in which it might actually exacerbate such effects.

Our procedure is to analyse two different exogenous shocks which have similar short-run effects but different long-run implications for resource allocation. Policies which are appropriate for one may not be appropriate for the other. Yet, since the impact effects are similar, the two may be hard to distinguish if the shocks themselves are not directly observable. This leads us to a discussion of policy errors.

While this procedure is perfectly general, we focus on a particular pair of shocks. One is a purely monetary disturbance in the form of an equal percentage increase in all foreign prices. The second is a "resource boom" which alters the long-run allocation of resources; this focus on a "resource boom" underlies the specifics of the real model.

The allocation and stabilization consequences of resource

booms have been analysed elsewhere. Corden and Neary (1981) use a three-sector model -- resources, manufactures, and non-traded services -- to investigate the channels whereby a resource boom can lead to a reduction of output in the manufacturing sector, a phenomenon often labelled "de-industrialization" or the "Dutch disease". Two main channels are identified: a resource-movement effect, whereby the booming sector directly or indirectly bids resources away from the manufacturing sector, and a spending effect which squeezes profitability in manufacturing by raising the demand for services and so lowering the real exchange rate (the relative price of traded to non-traded goods). Buiter and Purvis (1981) argue that de-industrialization in many countries is not associated with a significant movement of labour into the booming sector and instead stress the real appreciation arising from the resource boom in conjunction with sticky domestic prices. In their model resources and manufacturing do not compete directly for factors of production since resource output is taken as exogenous; hence no labour-market pressures emerge, and de-industrialization occurs instead through the foreign exchange market.[1]

The model used in this paper retains the three-sector framework of Corden and Neary but modifies the underlying structure to reflect the Buiter and Purvis view that the direct labour-market effects arising from expansion of the resource sector are minimal. Production of the resource is assumed to require a specific factor in addition to capital, but not labour. Manufactur-

ing goods are produced using capital and labour while domestic services are produced using only labour. Labour is freely mobile between the two sectors in which it is used, manufacturing and services. In contrast, the allocation of capital between the sectors in which it is used, benzine and manufacturing, is fixed in the short run and variable only in the long run. This production structure is combined with the assumption that the economy is "dependent" in the sense that it is a price taker in the markets for both traded goods; hence the domestic demand repercussions of the exogenous shocks have direct influence only in the services sector.

The plan of the paper is as follows. Section 1 sketches the details of the real model and analyses its short and long-run responses to a resource boom. Section 2 extends the analysis to incorporate slow adjustment in the relative price of services, while section 3 introduces a macroeconomic framework and examines the dynamics that arise when both the price of services and the allocation of capital are slow to adjust while the nominal exchange rate is allowed to float. Section 4 then focusses on the key policy issues and section 5 presents some conclusions.

1. Resource Allocation and Marshallian Adjustment in a Dependent Economy

In this section we introduce the basic production and consumption relationships of the real part of our model, and illustrate the responses of output and resource allocation to structural shocks. We examine both short- and long-run responses in the Marshallian sense that some factors of production are

fixed in the short run but variable in the long run. However in this section we abstract from the macroeconomic distinction between short and long run that arises in the presence of nominal price stickiness.

The Model

The model is characterized by three sectors; the economy produces one non-traded good (services) and two traded goods (manufactures and the resource good, benzine). We assume that the economy is small in terms of world markets so that it takes the foreign currency prices of the two traded goods, and hence their relative price, as given.

The assumptions concerning the technology of production are intended to reflect the stylized facts that non-traded services are highly labour-intensive while resource-extractive sectors use very little labour. Accordingly, the output of services, X_S, is presumed to require only labour, and by appropriate choice of units the input-output coefficient is set equal to unity.[2]

$$(1.1) \quad X_S = L_S$$

Note that this means that the wage rate may be identified throughout with the domestic price of services:

$$(1.2) \quad W = P_S$$

Labour is also used in conjunction with capital to produce manufactured goods according to equation (1.3):

$$(1.3) \quad X_M = X_M(K_M, L_M)$$

Finally, benzine is produced using capital and a specific factor, V, according to equation (1.4)

$$(1.4) \quad X_B = X_B(K_B, V)$$

Labour is instantaneously mobile between the services and manufacturing sectors. In this section of the paper we assume that labour is in fixed supply and fully employed, as indicated by equation (1.5):[3]

$$(1.5) \quad L_M + L_S = L$$

While the services and manufacturing sectors thus compete directly for labour, there is no such direct link between the services and resource sectors since the latter does not use labour; in this regard our model differs from that used by Corden and Neary. There are, of course, indirect links between services and benzine through the market for capital, which is used in the production of both benzine and manufactures. However, in the short run capital is a fixed input and can only be adjusted slowly through time in response to changes in its perceived

return. Details of this adjustment mechanism are postponed until later; for the present it is sufficient to reiterate that while labour is a mobile and hence variable factor, capital is sector-specific in the short run.

The demand side of the model is straightforward. Since the country is a price-taker in world markets for manufactured goods and benzine, domestic demand for these goods plays no role in determining their prices or output. In contrast, in the market for services price and quantity are influenced by domestic demand. Domestic demand for services, C_S, depends upon prices and real income Y as shown in equation (1.6) where the signs under the arguments indicate the direction of the effect on C_S of a rise in the respective argument:

$$(1.6) \quad C_S = C_S(P_S, P_M, P_B, Y)$$
$$\qquad\qquad\quad - \quad ? \quad ? \quad +$$

If services are net substitutes for manufactures and benzine, the two uncertain signs will be positive; for concreteness we assume henceforward that this is the case.

In later sections we will examine macroeconomic phenomena using a framework in which nominal prices are determined. However, in order to introduce the full model in stages, we confine our attention in this section and the next to "real" variables. Hence only relative prices are determined and national income and expenditure are always equal, implying a zero trade balance at all times.

For the present we choose manufactured goods as numeraire, and define the real exchange rate, π, as the relative price of manufactures in terms of domestic services.

$$(1.7) \quad \pi \equiv P_M/P_S = EP_M/W$$

Movements in the real exchange rate are simply the inverse of movements in the relative price of services or, equivalently, in the real wage rate faced by the manufacturing sector.

We wish to examine how the output of the three goods and the allocation of factors respond to a resource boom in the form of an exogenous increase in either the world price of benzine or in the available supply of V, the specific factor used in the production of benzine. To do so, we first examine the determination of equilibrium and then see how that equilibrium is perturbed by a resource boom. (Technical details and derivations may be found in the Appendix.)

Labour Market Equilibrium

In Figure 1-1 the combinations of the real exchange rate and the sectoral allocation of capital consistent with labour market equilibrium are depicted by the curve LL. An increase in π, which is a fall in the manufacturing real wage, increases the demand for labour in the manufacturing sector. The rise in π is equivalent to a fall in P_S so that the demand for services, and hence for labour in the services sector, rises as well. Hence an increase in π leads unambiguously to an increase in the demand for labour. A

reduction in the capital stock in the manufacturing sector would, at a given wage, lead to a reduction in the demand for labour in the manufacturing sector. Hence the labour market equilibrium locus LL is negatively sloped as shown in Figure 1-1; points above the locus correspond to excess demand for labour and points below to excess supply. Note that LL also depicts equilibrium in the market for services.

Capital Market Equilibrium

While at any moment of time the capital stock in both the manufacturing and resources sectors is predetermined, in the long run the capital stocks in both sectors adjust so as to equalize their rates of return. In this paper we consider the case where the total stock of capital in the economy is fixed so that the capital stock adjustment process involves reallocating capital from one sector to the other. This of course follows the tradition of the Heckscher-Ohlin model of international trade in which such reallocation occurs instantaneously and costlessly. In postulating slow, costly adjustment in our model we follow earlier work by Mayer (1974), Mussa (1974, 1978) and Neary (1978).[4]

Consider the implications of a permanent increase in the real exchange rate for the long-run allocation of capital. An increase in π raises profitability in manufacturing and so raises the long-run return to capital in that sector. If capital market equilibrium is to be restored the return to capital in the benzine sector must also rise, which requires that capital allocated to that sector must decrease. Hence the capital market equilibrium locus, KK, is positively sloped as depicted

in Figure 1-1, with points above the line corresponding to excess demand for capital in manufacturing, and conversely for points below.

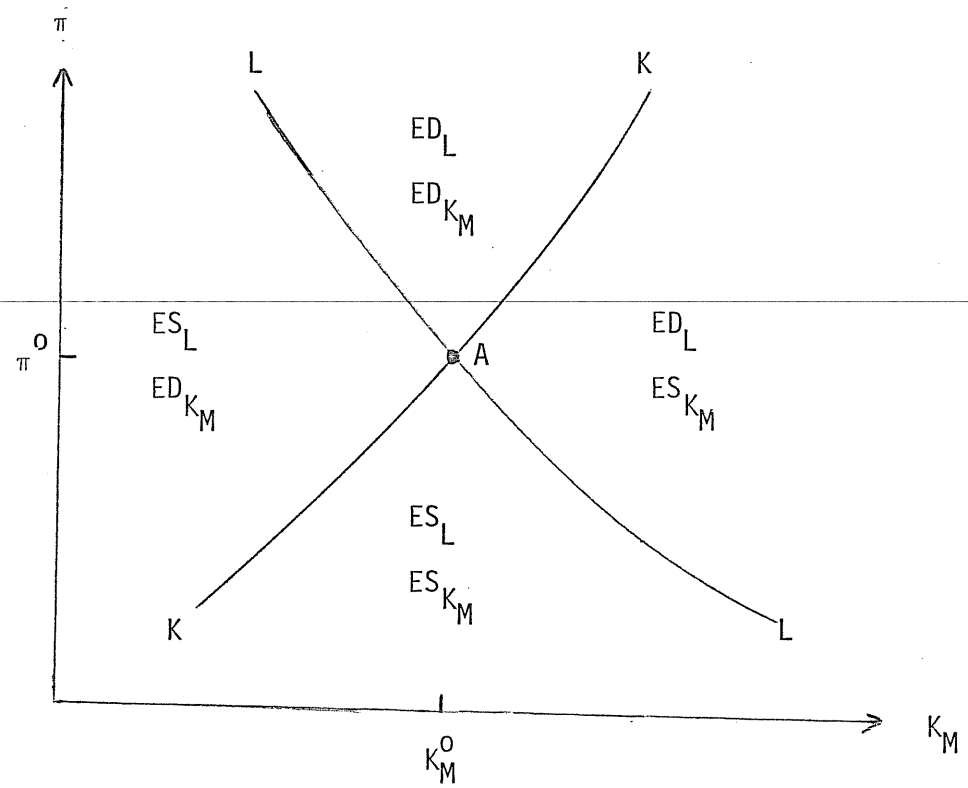
Long-Run Comparative Statics

Consider now the effects of a "resource boom" due to either a "discovery" of new stocks of the specific factor V or an increase in the price of benzine, P_B.[5] Since real income rises, there is an increased demand for services which amounts to an increased demand for labour in the services sector. To equilibrate the labour market, the demand for labour in manufacturing must fall; at a given real exchange rate and hence at given factor proportions, this is accomplished through a reduction in capital in the manufacturing sector. The LL curve therefore shifts left, reflecting the spending effect of the boom. In addition, the boom raises the rate of return to capital in the benzine sector calling for a long-run reallocation of capital away from manufacturing towards benzine. Hence the KK curve also shifts left, reflecting the resource-movement effect of the boom.

This is illustrated in Figure 1-2 where the dashed lines LL and KK replicate the initial equilibrium loci from Figure 1-1 and the solid lines L'L' and K'K' are the new loci following the boom. The stock of capital in manufacturing unambiguously falls. The real exchange rate may rise or fall depending on whether the KK or LL curve shifts more; in the figure we illustrate the intuitively more plausible case where the spending effect dominates and so the new long-run equilibrium at C is characterized by a real appreciation.

Figure 1-1

Factor Market Equilibrium



Marshallian Dynamics

While the long-run equilibrium following a resource boom involves a reduced capital stock in manufacturing, in the short run the capital stock is fixed at its initial value, K_M^o. Hence on impact there is no resource-movement effect and the economy moves from A to B in Figure 1-2. There is an unambiguous real appreciation, while the return on capital rises in the resource sector and falls in the manufacturing sector.[6] It is clear that this gives rise to an incentive for capital reallocation, and we postulate the simple mechanism whereby the capital stock in manufacturing adjusts through time in response to differences in the rentals earned by capital in the two sectors, as given by equation (1.8):[7]

$$(1.8) \qquad \dot{K}_M = \Phi(r_M/r_B) \qquad \Phi(1) = 0, \quad \Phi' > 0$$

This describes completely the capital adjustment process since the total capital stock is assumed to be fixed:

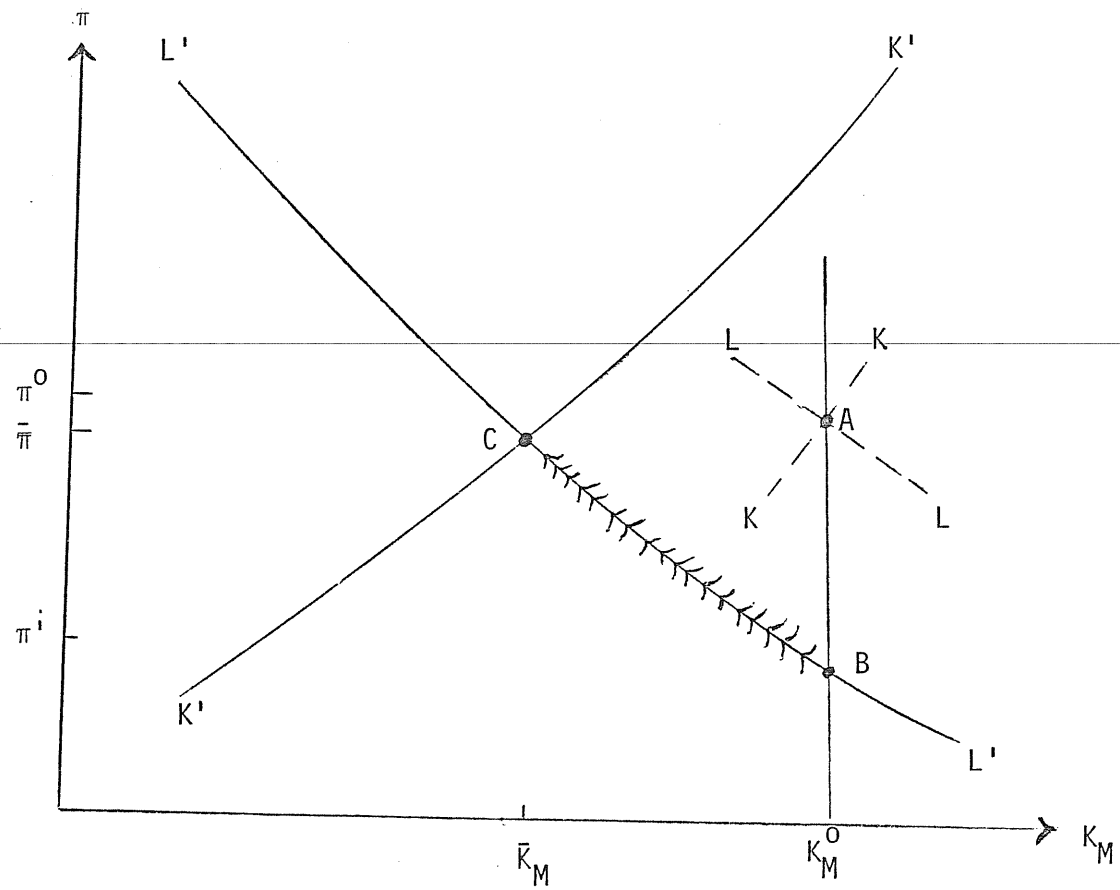
$$(1.9) \qquad K_M + K_B = K,$$

A change in the capital stock in the resource sector is matched by an equal and opposite change in the capital stock in manufacturing.

Since the labour market clears continuously, the dynamic adjustment after the jump appreciation to B takes place along the LL curve. The economy therefore follows a monotonic path along

Figure 1-2

Comparative Statics and Marshallian Dynamics



which K_M steadily declines accompanied by continuous real depreciation, as indicated by the arrows in Figure 1-2. Note that there is "overshooting" of the real exchange rate in that it falls immediately to $\underline{\pi}'$ and then rises continuously thereafter until it reaches its new equilibrium value $\underline{\pi}$. This overshooting is of the real exchange rate in response to a real disturbance; it occurs due to a real rigidity -- the short-run fixity of the capital stock. Initially, with the capital stock fixed, the brunt of the adjustment is borne by the relative price; in the longer run the adjustment in the capital stock mitigates the required adjustment in price. This, of course, is exactly the Marshallian analysis of short- and long-run adjustment to a change in demand.

In the figure, both $\underline{\pi}'$ and $\underline{\pi}$ are below the initial exchange rate $\underline{\pi}^0$ so that the initial change in is in the right direction but exceeds in magnitude the long-run change. If, however, the resource-movement effect is large relative to the spending effect, so that there is a real depreciation in the long run, then rather than overshooting, in the short-run the real exchange rate moves in the "wrong" direction.

2. Marshallian Adjustment with Relative Price Rigidities

In the previous section, following Neary and Purvis (1981), we considered the short- and long-run adjustment to a sectoral shock under the assumption that domestic prices are instantaneously flexible. In the present section we allow for the possibility that the relative

price of services adjusts sluggishly in response to imbalances between supply and demand. Recall that an increase in the real exchange rate, π, is equivalent to a fall in the relative price of services, hence we write:

$$(2.1) \qquad \dot{\pi} = \Psi(X_S/C_S) \qquad \Psi(1) = 0, \Psi' > 0$$

Since labour is the only factor used in the services sector, equation (2.1) may be interpreted as both a labour-market and a services-market adjustment mechanism.[8] Thus the presence of non-market clearing in the services market is equivalent to a departure from full employment with the wage rate adjusting slowly to eliminate under- or over-full employment. The parameter L in equation (1.5) in the last section should therefore now be interpreted as the "natural" rate of full employment rather than as a binding constraint which cannot be exceeded in the short run. In order to simplify the analysis we ignore the fact that departures from this "natural" level may cause either firms or households to face quantity constraints, forcing them to recalculate their decisions on other markets in the manner familiar from Clower's "dual-decision hypothesis". Hence our analysis is strictly applicable only in the neighbourhood of full employment, although for the issues on which we wish to focus this omission is not a crucial one.[9]

While in the present section we allow for sluggish relative price adjustment, the model is still a real one in which nominal magnitudes are not determined. The dynamic evolution of

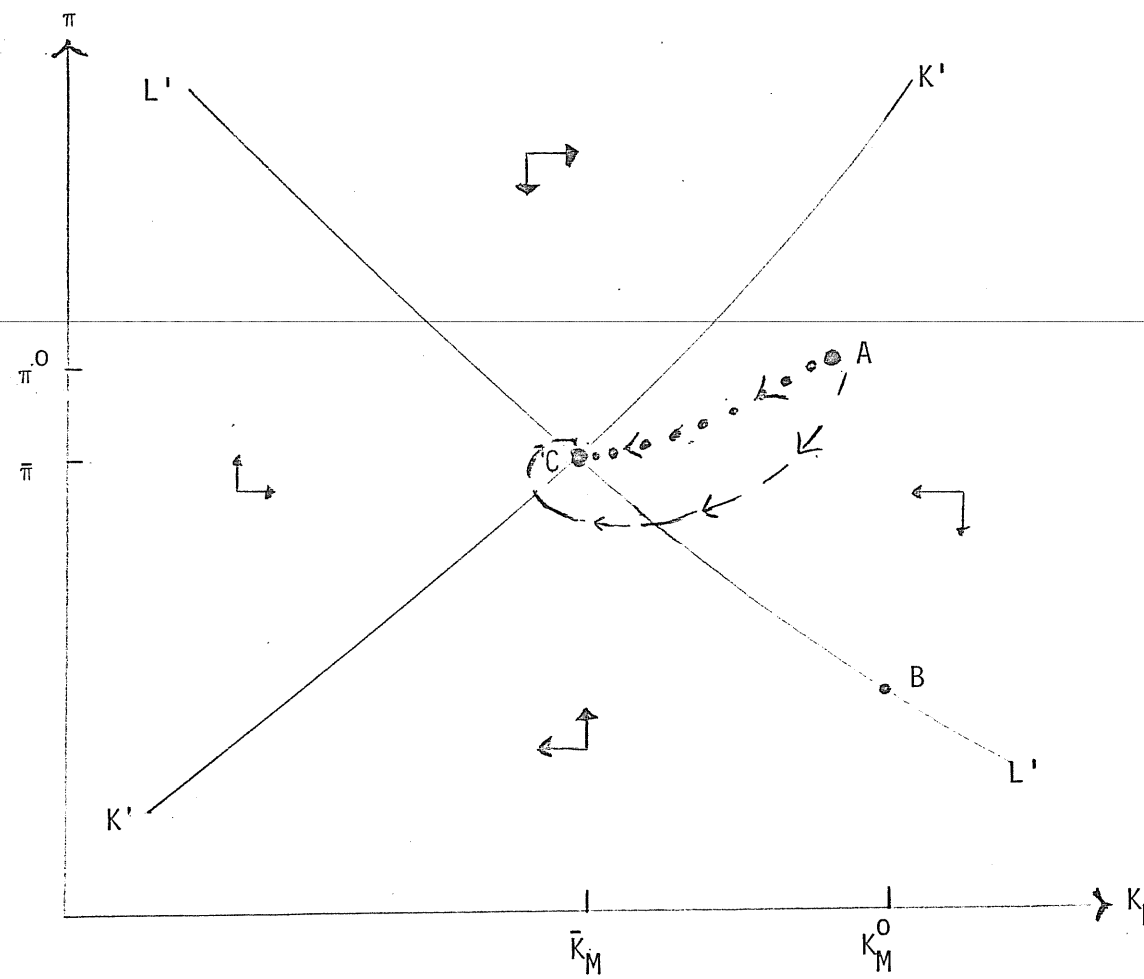
the system illustrated in Figure 2-1, whose essential features are identical to those of Figure 1-2. However, the economy is no longer constrained to lie on the labour-market equilibrium locus L'L'. Recall that points above this locus correspond to excess demand for services and labour and hence to upward pressure on their price, and conversely for points below the locus; the resulting tendencies for the real exchange rate to adjust are indicated by the vertical arrows in the diagram. As shown in the Appendix (see equation A.19), the system is globally stable; whether or not it generates cyclical adjustment paths depends on both the parameters of the long-run model and on the relative adjustment speeds embodied in the adjustment equations (1.8) and (2.1).

The response of the economy to a boom is now easily determined from Figure 2-1. Starting in initial long-run equilibrium at point A, the boom gives rise to excess demand for services and an incentive to reallocate capital out of the manufacturing sector. However, unlike the flex-price case analysed in the previous section, the economy does not shift immediately to point B. Rather, the economy starts off on a continuous path to the south-west of A. Sluggish price adjustment therefore mitigates the extent to which the real exchange rate overshoots its long-run value.

When both the labour and capital markets adjust gradually, the economy may move directly from A to C as in the dotted path in Figure 2-1, or cyclically as in the dashed path. The slower is the speed of price adjustment relative to the speed of capital

Figure 2-1

Simultaneous Adjustment of the Capital Stock and the Real Exchange Rate



reallocation, the more likely is the direct path. Hence in contrast to the Dornbusch (1976) analysis of nominal overshooting in response to monetary disturbances, sticky relative prices provide a "stabilizing" influence on the (real) exchange rate.[10]

3. Macroeconomic Adjustment and Real Shocks

In the previous section we postulated a sluggish adjustment mechanism for the real exchange rate, π. However no account was taken of the fact that changes in this variable reflect changes in both the nominal price of services, P_S, and the nominal exchange rate, E, and that the determinants of these two components are likely to be very different. Thus, instead of (1.7) we may write:

$$(3.1) \quad \pi \equiv EP_M^f/P_S$$

where P_M^f is the price of manufactures in foreign currency, assumed to be exogenously determined. Following Dornbusch (1976), we assume that the nominal price of domestic goods moves slowly to eliminate imbalances between supply and demand. Hence (2.1) is replaced by:

$$(3.2) \qquad \dot{P}_S = \Psi(C_S/X_S) \qquad ; \Psi(1) = 0, \Psi' > 0$$

By contrast, the nominal exchange rate is assumed to be determined by the requirement of stock equilibrium in the market for foreign exchange, in an environment where exchange-rate expectations are formed rationally and domestic and foreign interest-bearing assets are perfect

substitutes. The latter assumption implies that domestic and foreign nominal interest rates are linked by the uncovered interest parity condition given by equation (3.3).

$$(3.3) \quad i = i^f + \hat{E}$$

$\hat{E}$ is the expected proportionate rate of change of the nominal exchange rate which, given the assumption of rational expectations, equals the actual rate of change. Equation (3.3) thus shows that the domestic interest rate can exceed the foreign rate only if there is an expected depreciation of the domestic currency.

The demand for real balances depends on real income and the domestic nominal interest rate:

$$(3.4) \quad M/P = \ell_D(Y,i)$$

The price level P is a linearly homogeneous function of all final-goods prices and hence increases with the nominal exchange rate. An increase in the nominal exchange rate thus gives rise to a fall in real balances; this must be accompanied by a rise in i or a fall in Y in order for monetary equilibrium to be maintained. The values of i and E which are consistent with monetary equilibrium for given values of M, P_S and Y are thus depicted by the positively sloped locus MM in Figure 3-1. In the long run the ratio of E to P_S is determined by the conditions for real equilibrium outlined in Section 1, and so, for a given M and with real income fixed at its full-employment level, the

value of P_S adjusts to ensure that equilibrium of the real and nominal sectors is simultaneously attained. Such a long-run equilibrium is illustrated by point Z in Figure 3-1: the domestic interest rate equals the foreign interest rate so the expected and actual change in the exchange rate are zero, and the actual exchange rate is equal to the long-run rate $\bar{E}$.

Notice finally that, unlike the real models of Sections 1 and 2, the current account need not be in balance except in long-run equilibrium. Hence the level of domestically-held wealth changes throughout the adjustment period and national expenditure and income are not equal. However, rather than complicating the model further in order to consider these issues, we follow earlier work in omitting them from consideration.

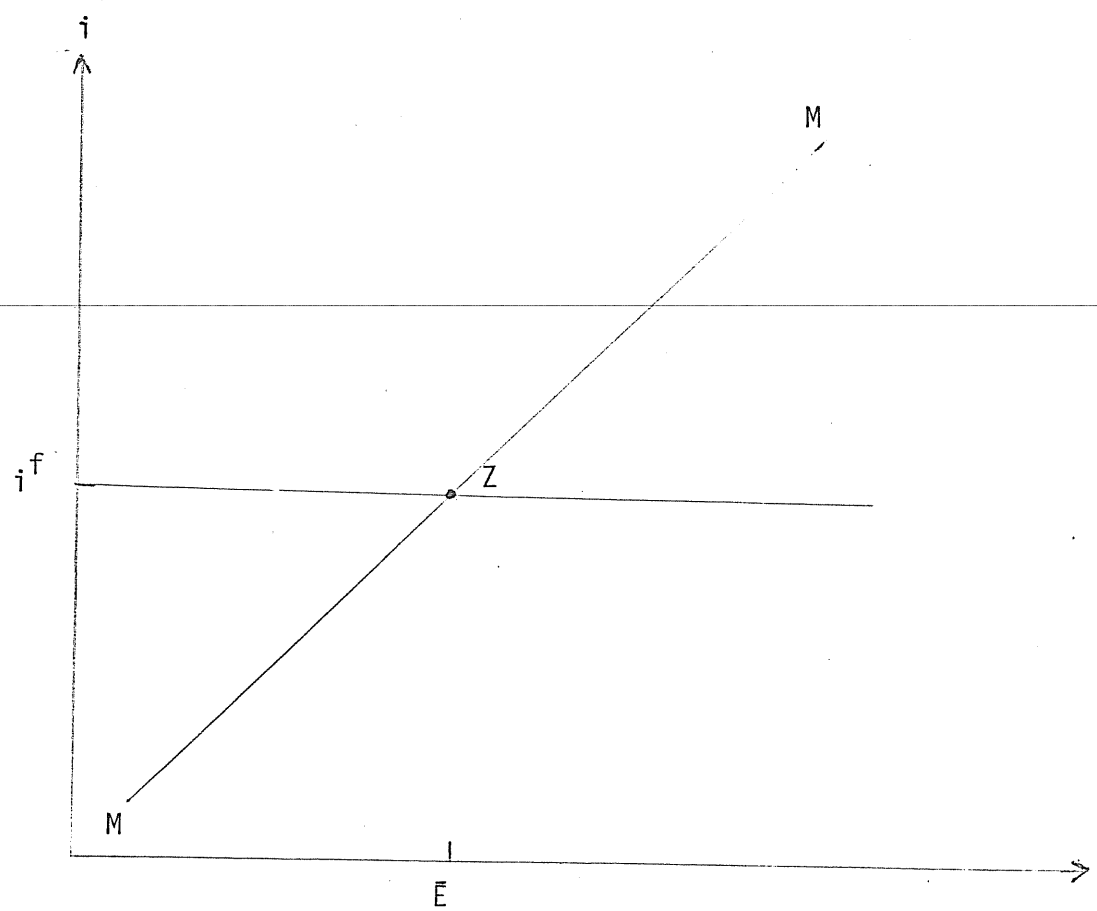
We now turn to examine the dynamic responses of the full model following a monetary shock and a resource boom.

A Monetary Shock

Consider first an unanticipated once-and-for-all reduction in the domestic money supply.[11] In the long run this shock is neutral; the nominal exchange rate and the domestic price of services fall in proportion to the reduction in the money supply. In Figure 3-2 the long-run equilibrium occurs at Z, with the nominal exchange rate equal to E_1, where $(E_1-E_0)/E_0$ equals the percentage fall in the money supply. On impact there is excess demand for money at the initial equilibrium Z_0 so MM shifts leftwards. Moreover MM must shift leftwards by more than the extent of the reduction in the money supply, since with a

Figure 3-1

Long-Run Equilibrium Determination of the Interest Rate and the Nominal Exchange Rate



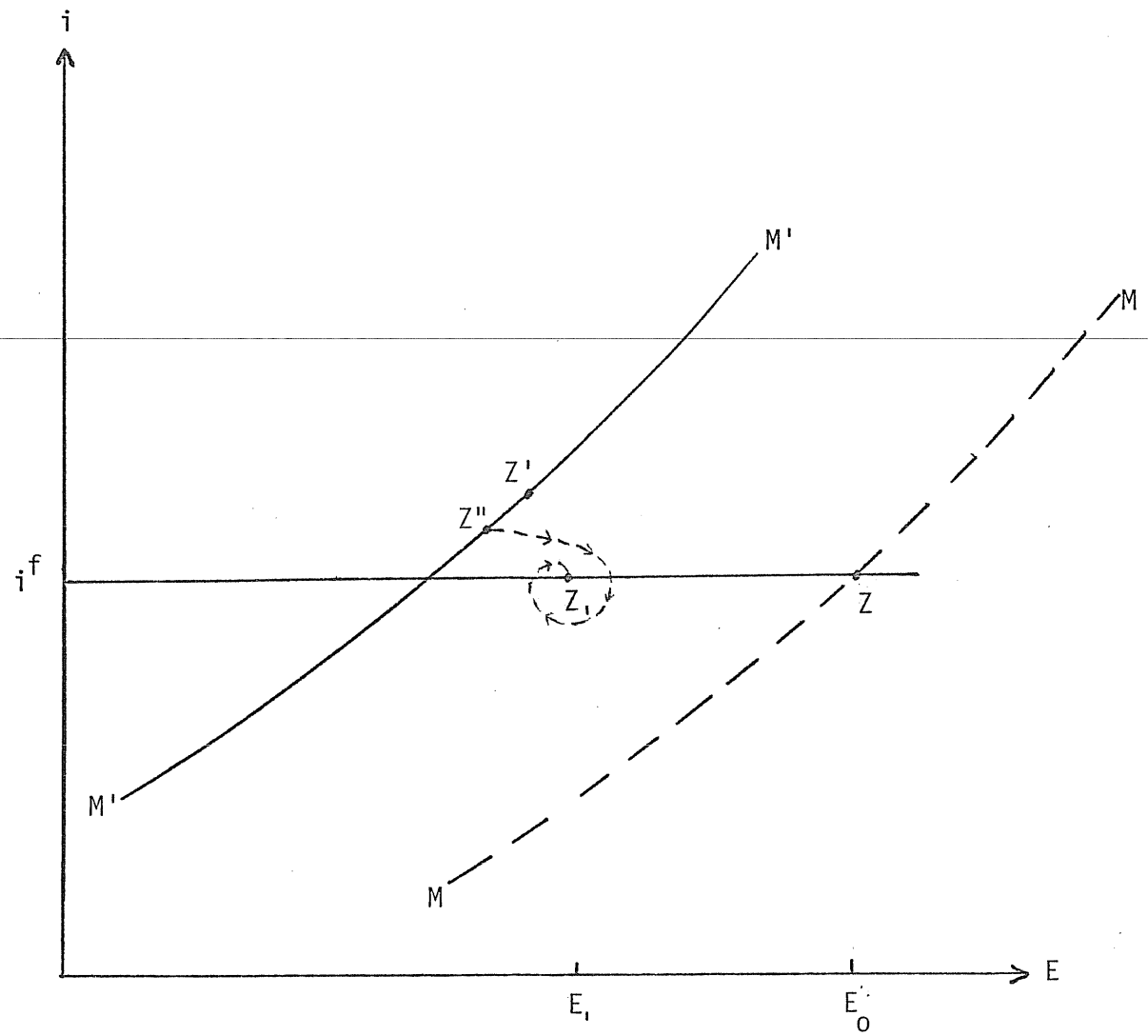
sticky nominal price of services, the nominal exchange rate must fall more than proportionately in order to restore money-market equilibrium for given values of Y and i. With P_S given at its initial value, the money-market equilibrium locus M'M' must cut it to the left of Z, as shown in Figure 3-2.

While the equilibrium values of E and i immediately following the monetary contraction must therefore lie along M'M', the determination of their precise location requires a more detailed analysis. If the price of services is the only variable which adjusts sluggishly then, as shown by Dornbusch (1976), the new short-run equilibrium must lie at a point such as Z', implying a rise in the domestic interest rate and an overshooting by the nominal exchange rate of its new long-run value. From the condition for uncovered interest parity, equation (3.3), a higher interest rate is possible only if there is expected depreciation. Speculators therefore set the current spot exchange rate below its long-run value so that the actual adjustment of the exchange rate is consistent with these expectations, and the exchange rate rises monotonically during the adjustment period until it reaches its new long-run equilibrium value. Note that this is a case of overshooting of the nominal exchange rate in response to a monetary shock and caused by a nominal rigidity, in sharp contrast to the real overshooting discussed in Section 1.

However when both the price of services and the allocation of capital adjust slowly, the analysis of the model is considerably more complicated. There is still a presumption that the nominal exchange rate overshoots its long-run value but the adjustment path which it

Figure 3-2

Short-Run Equilibrium and Exchange-Rate Dynamics
Following Monetary Deflation



follows need not be monotonic, as shown in the Appendix. One possible path is illustrated by the dashed line from Z" in Figure 3-2. If the adjustment path is cyclical then it must converge in a clockwise fashion as shown, since from equation (3.3) phases of depreciation must be associated with values of the domestic interest rate which lie above the return available on foreign securities.

Corresponding to the adjustment of nominal variables illustrated in Figure 3-2, real variables are also adjusting, since with a sticky domestic price of services the initial monetary deflation has real effects. At Z" the relative price of services has risen, giving rise to excess supply in that sector. According to equation (3.2) the price of services starts to fall; this in turn tends to raise real balances and to reduce the domestic interest rate. Corresponding to the higher relative price of services is a rise in the real wage. Hence there is an incentive to reallocate capital from the labour-using manufacturing sector to the resource sector, and during the initial stage of the adjustment process X_M falls below its steady-state level.

A Resource Boom

The long-run real effects of a resource boom were analysed in Section 1 where we saw that the spending effect of the boom tends to reduce the real exchange rate whereas the resource-movement effect tends to raise it. There is an additional effect working on the nominal exchange rate through the money-market equilibrium condition (3.4); this we call the liquidity effect. By raising real income, the boom requires a fall in the domestic price level in the long run

which, with a constant real exchange rate, implies a nominal appreca-tion. Hence we take this to be the "expected" outcome, although as the full expression for the change in E (equation (A.25) in the Ap-pendix) shows, whether or not this actually ensues depends on the parameters of the model.

Confining attention to the case of nominal and real apprecia-tion in the long run, the induced changes in nominal variables may again be illustrated with the aid of Figure 3-2. When the price of services adjusts instantaneously, Neary and Purvis (1981) show that the nominal exchange rate may overshoot its long-run value leading to a new short-run equilibrium at a point such as Z', followed by a steady depreciation as capital is reallocated out of the manufacturing sector. When both the price of services and the capital stock adjust sluggishly, there is, again initial overshooting followed by either cyclical or monotonic movement towards the new long-run equilibrium.

4. Interactions between Sectoral Adjustment and Macroeconomic Policy

So far our objective has been to develop the complete model in the absense of intervention. In the present section we turn to the primary concern of this paper, namely the manner in which policy rules which may appear appropriate in the short run affect the longer-run adjustment of the economy.

Inappropriate Responses to Nominal Exchange Rate Movements

We begin by considering a foreign price disturbance which if

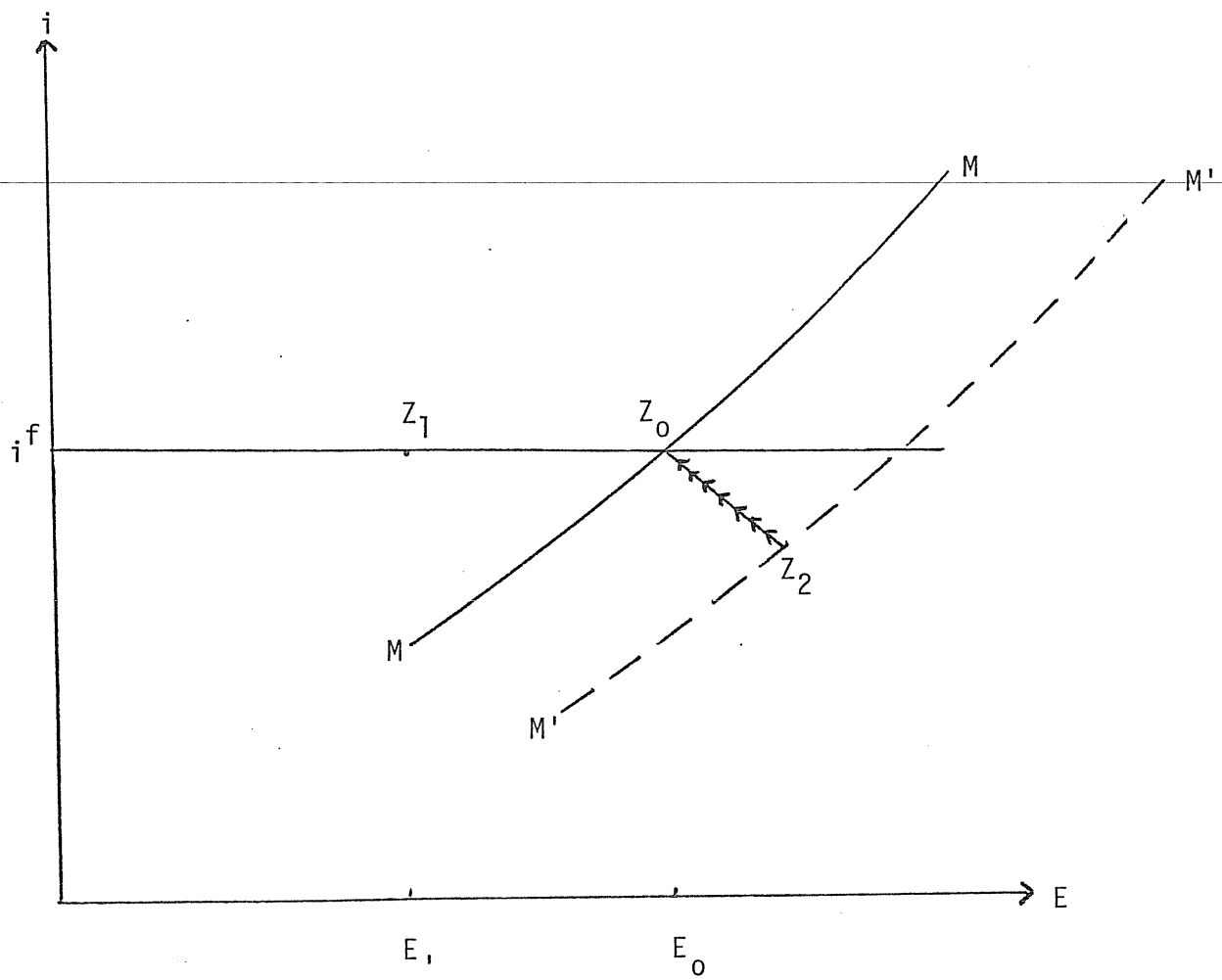
properly perceived requires no response from the authorities. Starting in initial long-run equilibrium at Z_0 in Figure 4-1, suppose that the world prices of both traded goods increase by an equi-proportional amount. If there were no policy response, the new long-run equilibrium at Z_1, with a proportionate fall in the exchange rate to E_1, would be attained instantaneously. There would be no real changes even in the short run, and the domestic currency prices of all three goods would remain unchanged. Since no change in P_S is required, no dynamics are elicited.[12]

However the nominal appreciation entailed in moving from Z_0 to Z_1 may be resisted, perhaps on the false grounds that it will also imply a real appreciation leading to a loss in competitiveness of the domestic traded-goods sector. Such a view is incorrect, of course, since the nominal appreciation is in response to a foreign price rise, and so is merely the process by which domestic competitiveness is kept in line. However, if the source of the fall in the nominal exchange rate is not clearly identified, the situation might be confused with one where a nominal appreciation does harm the competitive position of the domestic export sector. Let us examine the implications of using monetary policy to "offset" the nominal appreciation.

Suppose first that the domestic money supply were raised in proportion to the foreign price rise. This would mean that the long-run equilibrium would remain at Z_0 in Figure 4-1 and the long-run exchange rate would remain at E_0. But in the short run with P_S given, there would be an excess supply of money at Z_0. The MM curve shifts right to M'M' and the short-run equilibrium moves to a point such as

Figure 4-1

Inappropriate Response to a Foreign Price Shock

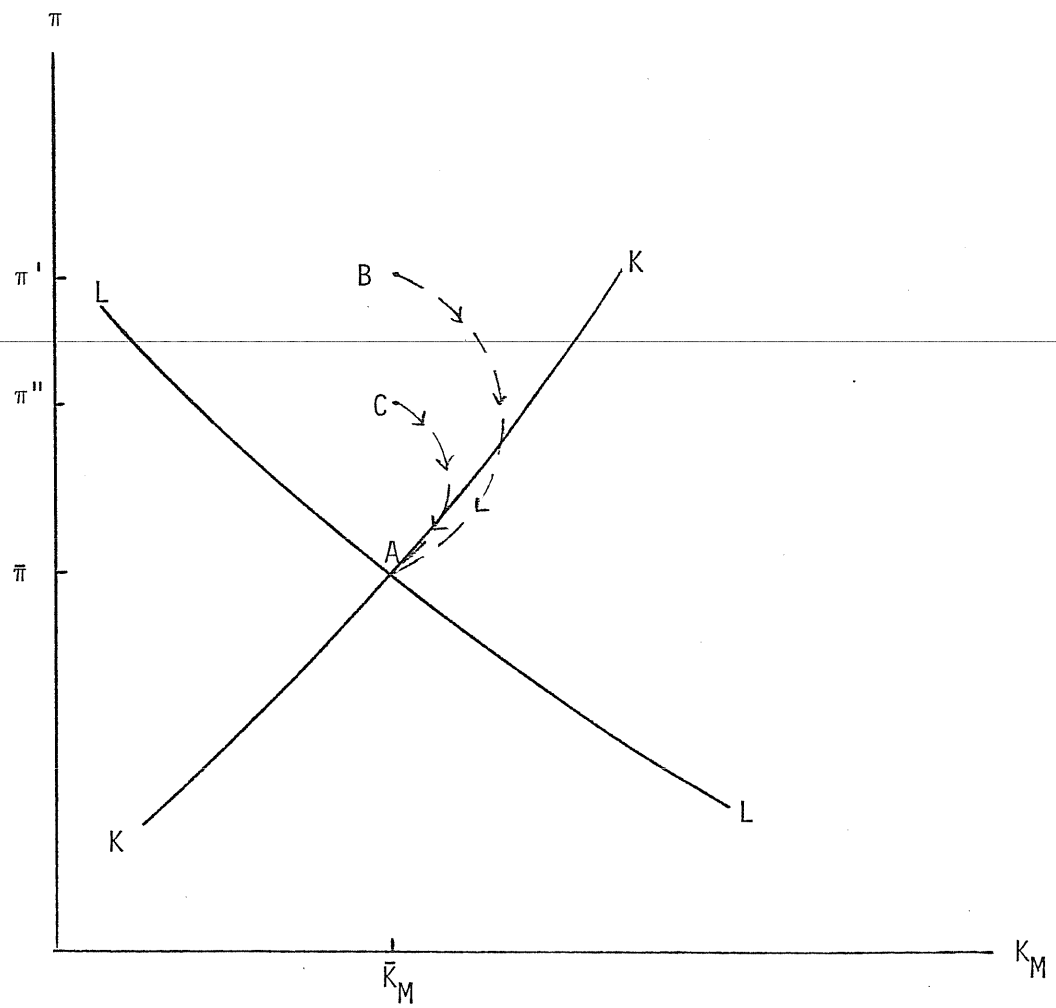


Z_2. Dynamic adjustment involves instantaneous increases in E and π followed by either continuous appreciation combined with increases in the price of domestic services (as depicted in Figure 4-1) or by cyclical adjustment of all nominal variables. The policy mistake results in "importing" the foreign price increase since all domestic prices are higher at Z_0 that at Z_1 (where they were in fact unchanged), and in a misallocation of resources during the adjustment period since both nominal and real exchange rates differ from their long-run equilibrium values. The real adjustment is illustrated in Figure 4-2; the initial and final equilibria are both at A and the short-run equilibrium immediately following the monetary intervention is at B. It is clear that there is at least one turning point in the adjustment of K_M, and in fact cyclical adjustment of both π and K_M is also possible.

An alternative form of monetary intervention would be to simply fix the nominal exchange rate at E_0 in Figure 4-1. This would involve an instantaneous increase in the money supply proportionate to the impact on the price index of the rise in the traded-goods price (i.e., a less-than-proportionate change in M). There would then be excess demand for services leading to a continuous rise in P_S matched by a rise in the money supply sufficient to keep real balances constant. In terms of the nominal variables in Figure 4-1 there are no dynamics as the economy remains at Z_0 throughout. However real adjustment still involves an instantaneous increase in the real exchange rate followed by either continuous real appreciation or a clockwise cyclical path. The former case is illustrated in Figure 4-2 where

Figure 4-2

Real Adjustment to Inappropriate Monetary Intervention



the short-run equilibrium is at point C which involves a smaller real depreciation than when the money supply increases in proportion to the foreign price shock.

Inappropriate Policies and A Resource Boom

In the case of a foreign price disturbance just considered, the appropriate response on the part of the monetary authorities was to forego intervention and let the foreign-exchange market adjust completely to the shock. By contrast, in the case of a resource boom the sluggish adjustment of domestic prices provides a rationale for intervention: some of the transitional loss of output and employment could be avoided by a monetary expansion which would mitigate the initial rises in the real and nominal exchange rates.[13] This assumes however that the authorities correctly identify the source of the initial appreciation. If they fail to do so then by inaction they in effect tolerate the transitional unemployment attributable to the de-industrialisation effect of the boom. Worse still, if monetary policy is targeted towards exchange-rate stability rather than towards internal balance it may exacerbate the medium-run costs of the boom and delay the attainment of the new long-run equilibrium.[14]

These issues are illustrated in Figure 4-3 which repeats the essential features of Figure 2-1. Starting in initial equilibrium at A the boom leads to a new long-run equilibrium at C. With the sectoral allocation of capital and the nominal price of services fixed in the short run, speculative behaviour in the absence of intervention induces a severe nominal appreciation which shifts the economy to

point F, causing the real exchange rate to overshoot both its new long-run equilibrium level and the short-run equilibrium level which would obtain at B if commodity prices were flexible. The boom thus gives rise to a decline in competitiveness of the manufacturing sector accompanied by a rise in unemployment. Once again a cyclical adjustment path is possible, although for simplicity we concentrate on the case of monotonic adjustment.

One option open to the authorities in this case is to expand the money supply so as to partly offset the initial appreciation. Such a strategy could for example be targeted on the restoration of full employment in the short run, implying a move from A to B. At B foreign-exchange speculators would choose a path for the nominal exchange rate which would lead to a convergent movement towards the new long-run equilibrium C. Without further intervention some unemployment during the transition period is still inevitable, but its extent is less than along the no-intervention path starting at F.

However the high employment path through B will be attained only if the authorities correctly identify the source of the initial appreciation and recognize the desirability of responding to it with a policy which partly offsets the initial appreciation. Suppose instead that the authorities acquiesce in the initial appreciation and then subsequently attempt to counter the steady rise of the nominal and real exchange rates. One possible outcome is illustrated by the jagged path from F to C in Figure 4-3 which assumes that the authorities, in the mistaken belief that the economy should be shielded from the steady nominal and real depreciation, twice intervene by

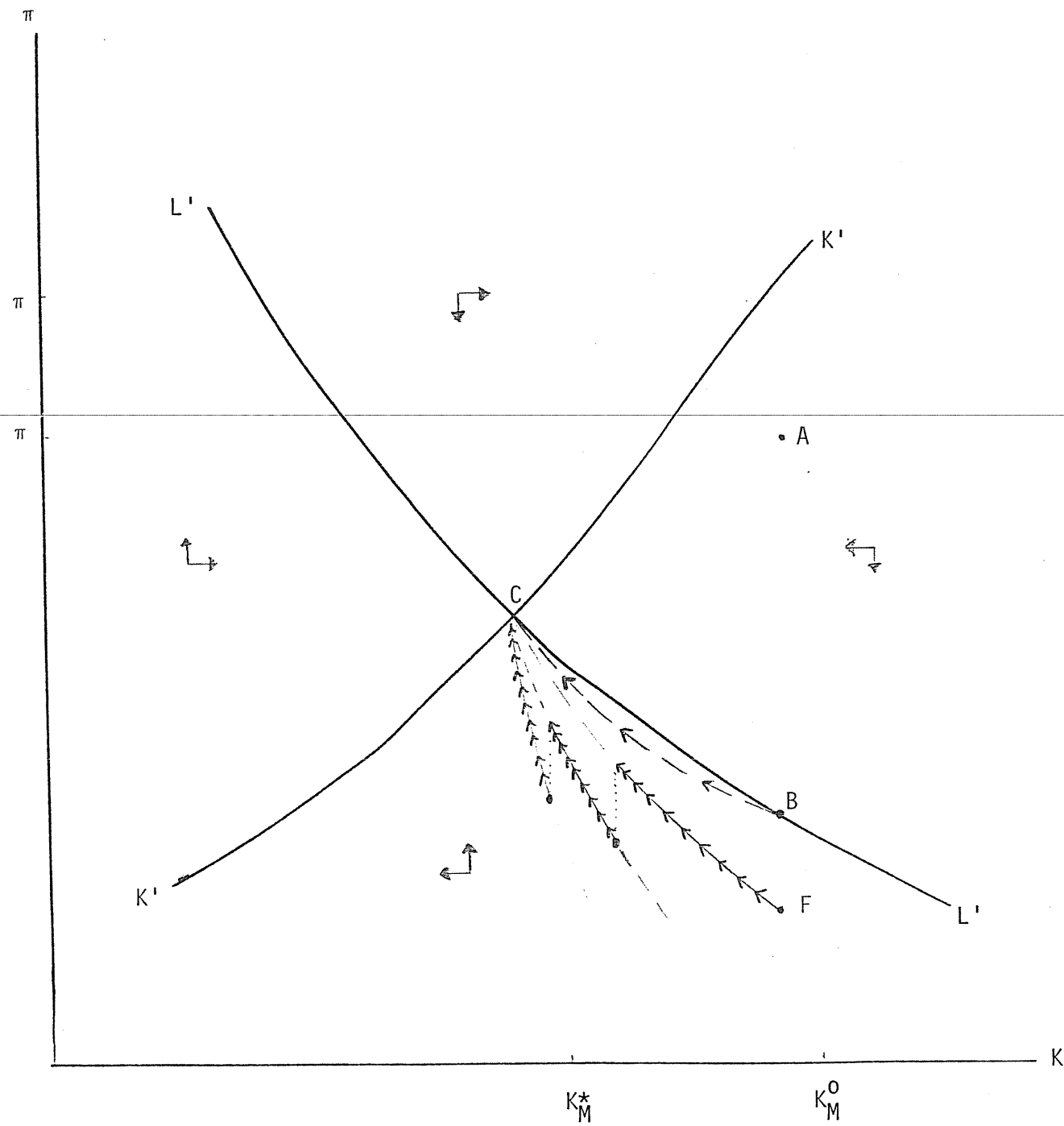


FIGURE 4.3

APPROPRIATE AND INAPPROPRIATE RESPONSE TO
A RESOURCE BOOM

reducing the money supply in an unanticipated manner. It is clear that the effect of this intervention is to delay the attainment of the long-run equilibrium and to lead to more transitional unemployment and loss of output than either the no-intervention path (implying a steady monotonic adjustment from F to C) or the high-employment path (from B to C).

5. Conclusion

In this paper we have presented a model in which domestic prices do not respond instantaneously to imbalances between supply and demand. Without examining the micro foundations of this price-stickiness, we have assumed that it provides, in principle, a justification for government intervention. However because domestic factor markets do not adjust immediately to exogenous shocks, disturbances with similar short-run impacts may have very different long-run effects. Hence, as we have shown, an interventionist government which is unable to identify the source of a disturbance may respond in a manner which exacerbates the economy's performance and slows the return to long-run equilibrium.

In our view it is the risk of policy confusions of this sort rather than the undesirability of activist policy in itself which constitutes the major objection to a strategy of "fine-tuning" the macro-economy. This is not to deny that the authorities can and should take action to offset the effects of significant and clearly

identifiable shocks. But they should be conscious of the need for different responses to shocks which have the same short-run effects. In particular, when international capital movements are volatile and exchange-rate expectations are formed in a rational manner, the authorities should not attempt to offset movements in the exchange rate which are an essential concomitant of the adjustment towards a new long-run real equilibrium. Finally, although we have concentrated in this paper on monetary intervention which can only affect the adjustment path, it is clear that the same principles also apply to fiscal intervention which can influence the economy's long-run real equilibrium.[16]

Footnotes

* We are grateful to our discussant, John Flemming, to other conference participants, and to Neil Bruce, Willem Buiter and Slobodan Djajic for helpful comments. Peter Neary's research was supported, in part, by the Committee for Social Science Research in Ireland.

1. A third approach is to emphasize the intermediate goods aspect of resources, as is done, for example, by Bruno and Sachs (1979) and Djajic (1980). However, this cannot be central to the case treated here where a boom results from a domestic discovery of a traded resource.

2. See Kouri (1979) for an earlier use of this assumption.

3. In Section 2 we replace this assumption with one specifying a "natural level" of employment about which actual employment can fluctuate in response to real wage movements.

4. In Neary and Purvis (1981) we also examine the case where physical capital is mobile internationally so that the total stock of capital in the country is endogenous.

5. An increase in the foreign relative price of benzine can be identified with a boom only if the country is a net exporter of benzine, so that an increase in its price amounts to an improvement in the terms of trade. Such a price increase also has a cross-price effect on the demand for services, which is positive if and only if benzine and services are net substitutes in demand.

For ease of exposition we assume throughout the paper that both these effects are positive, although our results are easily modifie to allow for alternative assumptions. See equations (A.1) and (A.3) the Appendix for further details.

6. The latter occurs since on impact labour moves from manufacturing to services so the capital-labour ratio in manufacturing rises.

7. Mussa (1978) postulates a more satisfactory but more complicated process whereby the rate of capital movement depends on the present value of expected future rents less the costs incurred in re-allocating capital.

8. The implications of sluggish price adjustment have been studied in open-economy models by Dornbusch (1976) in the context of goods-market adjustment and by Noman and Jones (1980) in the contex of labour-market adjustment.

9. The consequences of "disequilibrium" spillovers in open economies have been explored by Dixit (1978), Liviatan (1979) and Neary (1980

10. We have restricted our discussion to the "plausible" case of long-run appreciation. If instead, the long-run effect is a rise in $\underline{\pi}$, then inevitably there must be at least one turning point in $\underline{\pi}$ during the adjustment.

11. Throughout the paper, monetary shocks are modelled as changes in th level of foreign prices or the domestic money supply, but the model may easily be extended to consider the effects of changes in rate of foreign inflation or domestic monetary growth, along the lines of Buiter and Purvis (1981) and Buiter and Miller (1981).

12. The new long-run equilibrium is attained instantaneously because

in our model the only role for the exchange rate is to convert foreign prices into domestic currency units and hence only the produ of E and the respective foreign prices matters. If the exchange rat played an additional role, for example in converting foreign denomin ated assets into domestic currency units which then influenced real spending the results could be substantially different. See, for example, Purvis (1979) or Calvo and Rodriguez (1979).

13. In adopting this traditional Keynesian view of the desirability of intervention we are ignoring the possibility that the price adjustment equation (3.2) may embody a rational response to a changing economic environment, in which case it would not be independent of the policy rule adopted by the authorities.

14. Throughout this section we assume that monetary policy takes the form of a relatively small number of once-and-for-all changes in the money supply, rather than the "fine-tuning" implied by the perfect accomodation assumption of Section 2.

15. Still more complicated adjustment paths (without any jumps in the exchange rate) would ensue if speculators foresee such interventions The effects of anticipated future disturbances on the adjustment paths of models with rational expectations have been studied by Wilson (1979) and Buiter and Purvis (1981).

16. As noted by Dixit (1978) and Neary (1980) this is only the case if the intervention takes the form of government purchases of non-traded goods since, with exogenously given world prices of traded goods, intervention in traded goods markets effectively bypasses the domestic economy.

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APPENDIX

This appendix presents the principal equations of the model and sketches the derivation of the results. Further details on the flexible-price case may be found in Neary and Purvis (1981). Except where otherwise indicated, all variables are measured as natural logarithms, denoted by lower-case symbols (e.g., $e = \ell n\, E$), and expressed in terms of deviations from their values in the initial equilibrium. (This is equivalent to choosing units of measurement such that the initial equilibrium levels of all variables are equal to unity). Except where noted, all coefficients are defined to be positive.

A.1 The Real Model

The demand for services, which is also that sector's demand for labour (since labour is the only factor used there), depends on prices and real income:

$$(A.1) \qquad c_S = -\varepsilon_S p_S + \varepsilon_B p_B + \varepsilon_M p_M + \eta y$$

The compensated elasticities of demand ε_i obey the homogeneity restriction ($\varepsilon_B + \varepsilon_M = \varepsilon_S$), and the domestic prices of traded goods are related to their world prices by the nominal exchange rate e:

$$(A.2) \qquad p_i = p_i^f + e \qquad\qquad i = B,M$$

In the present paper we consider only two sources of change in real income: first, an increase in V, the endowment of the specific factor used in the benzine sector (whose impact depends on the share of that factor in national income θ_V); second, an increase in the world relative price of benzine which raises real income on the assumption that benzine is a net export (so that its share in national product, θ_B, exceeds its share in national ex-

penditure, β_B):

$$(A.3) \qquad y = \theta_V v + (\theta_B - \beta_B)\pi_B$$

We have introduced the symbol π_B to denote the terms of trade, and for later use we define π as the real exchange rate:

$$(A.4) \qquad \pi_B \equiv p_B^f - p_M^f = p_B - p_M$$

$$(A.5) \qquad \pi \equiv p_M - p_S = e + p_M^f - w$$

The demand for labour in manufacturing depends on the quantity of capital located there and on the real wage facing manufacturing firms:

$$(A.6) \qquad \ell_M = k_M - \gamma_M(w - p_M)$$

where γ_M is the wage elasticity of the demand for labour in manufacturing. This in turn is related to the level of employment in the services sector by the full-employment constraint for labour:

$$(A.7) \qquad \lambda_{LM}\ell_M + \lambda_{LS}\ell_S = 0$$

where λ_{ij} is the proportion of factor i used in sector j. From equation (1.1) in the text the level of employment in the services sector may be identified with that sector's output. Hence equating demand and supply of services and substituting from earlier equations (recalling that $w = p_S$), we obtain an expression for the labour-market equilibrium locus, LL in Figure 1.1, in terms of k_M, π and exogenous shocks:

$$(A.8) \qquad \lambda_L k_M + \varepsilon\pi + \alpha_1 = 0$$

where:

$$(A.9) \qquad \varepsilon \equiv \lambda_L\gamma_M + \varepsilon_S > 0; \qquad \lambda_L \equiv \lambda_{LM}/\lambda_{LS}$$

and

(A.10) $\alpha_1 \equiv \eta\theta_V v + \{\varepsilon_B + \eta(\theta_B - \beta_B)\}\ \pi_B$

In the definition of the exogenous disturbance given by equation (A.10) the coefficient of π_B is the compensated cross-elasticity of demand for services with respect to the price of services, adjusted for the terms-of-trade effect on real income.

The capital-market equilibrium locus is found in a similar manne by relating the demands for capital from the benzine and manufacturing sectors by the full-employment constraint for capital:

(A.11) $\lambda_{KB}k_B + \lambda_{KM}k_M = 0$

The demand for capital in the benzine sector depends on the stock of the resource available there and on the real rental facing the sector (where γ_B denotes the rental elasticity of capital demand):

(A.12) $k_B = v - \gamma_B(r_B - p_B)$

In long-run equilibrium the rental in the benzine sector must equal that in manufacturing; the latter is related to the wage by the requirement that the price of manufactures must just cover unit costs:

(A.13) $p_M = \theta_{LM}w + \theta_{KM}r_M$

where θ_{ij} is the share of factor i in the value of output in sector j. Setting $r_M = r_B$ and combining these equations with (A.2) yields the capital market equilibrium locus:

(A.14) $\gamma_B^{-1}\lambda_K k_M - \theta_L\pi + \alpha_2 = 0; \qquad \lambda_K \equiv \lambda_{KM}/\lambda_{KB}, \quad \theta_L \equiv \theta_{LM}/\theta_{KM}$

where:

(A.15) $\alpha_2 \equiv \gamma_B^{-1} v + \pi_B$

This is depicted by the positively sloped KK curve in Figure 1.1.

A.2 Long-Run Comparative Statics and Disequilibrium Dynamics

The long-run equilibrium values of k_M and π may be found by solving (A.8) and (A.14):

(A.16) $\Delta \cdot \bar{k}_M = - (\theta_L \alpha_1 + \varepsilon \alpha_2)$

(A.17) $\Delta \cdot \bar{\pi} = - \gamma_B^{-1} \lambda_K \alpha_1 + \lambda_L \alpha_2$

where:

(A.18) $\Delta \equiv \lambda_L \theta_L + \gamma_B^{-1} \lambda_K \varepsilon > 0.$

For given values of the exogenous variables, the attainment of long-run equilibrium is brought about by the dynamic adjustment equations (1.8) and (2.1) in the text. These may be written as a matrix differential equation, where ϕ and ψ denote the speeds of adjustment of the capital and labour markets respectively:

(A.19) $$\begin{bmatrix} \dot{k}_M \\ \dot{\pi} \end{bmatrix} = \begin{bmatrix} - \phi\lambda_K/\gamma_B & \phi\theta_L \\ - \psi\lambda_L & -\psi\varepsilon \end{bmatrix} \begin{bmatrix} k_M - \bar{k}_M \\ \pi - \bar{\pi} \end{bmatrix}$$

The determinant of the coefficient matrix in (A.19) is given by $\phi\psi\gamma_B^{-1} \Delta > 0$ and the trace equals $- \{\psi\varepsilon + \phi\lambda_K \gamma_B^{-1}\} < 0$. Since the trace and determinant conditions are satisfied, the system is globally stable.

(A.25) $$\bar{e} = \beta_S \Delta^{-1}(-\gamma_B^{-1} \lambda_K \alpha_1 + \lambda_L \alpha_2) - \alpha_3.$$

The three channels by which the nominal exchange rate is affected by exogenous shocks, α_1, α_2 and α_3, correspond respectively to the spending, resource-movement and liquidity effects discussed in the text.

A.4 Exchange-Rate Expectations and Saddle-Point Stability

Taking a logarithmic approximation to the uncovered interest parity condition (3.1) yields:

(A.26) $$i = i^f + \dot{e}$$

When combined with (A.20) this yields a third differential equation. The two dynamic system may be written as follows:

(A.27) $$\begin{bmatrix} \dot{k}_M \\ \dot{p}_S \\ \dot{e} \end{bmatrix} = \begin{bmatrix} -\phi\gamma_B^{-1}\lambda_K & -\phi\theta_L & \phi\theta_L \\ \psi\lambda_L & -\psi\varepsilon & \psi\varepsilon \\ 0 & \delta\beta_S & \delta(1-\beta_S) \end{bmatrix} \begin{bmatrix} k_M - \bar{k}_M \\ p_S - \bar{p}_S \\ e - \bar{e} \end{bmatrix}$$

Denoting the coefficient matrix in (A.27) by A, we wish to solve for its characteristic roots, which are the solutions to the characteristic equati

(A.28) $$f(\mu) = |-A + \mu I| = \mu^3 - a_2\mu^2 + a_1\mu - a_0 = 0$$

where the coefficients are defined as follows:

(A.29) $$a_0 = |A| = \phi\ \psi\ \delta\ \Delta > 0$$

(A.30) $$a_1 = \phi\ \psi\ \Delta - \delta[\phi\gamma_B^{-1}\lambda_K\ (1-\beta_S) + \psi\varepsilon]$$

(A.31) $\quad a_2 = \text{tr } A = \delta(1-\beta_S) - \phi\, \gamma_B^{-1}\, \lambda_K - \psi\varepsilon$

Since the determinant is positive the system (A.27) must have either one or three positive roots. Since the trace of A (and so the sum of the roots) may be either positive or negative, we cannot rule out the unstable configuration of all three roots positive. We focus, however, on the more interesting case where only one root is positive. This gives rise to a typical saddle-point structure: the single positive root contributes a direction of instability, but exchange-rate speculators are assumed to choose an initial value of e (and hence of π) which ensures that the model converges towards a long-run equilibrium.

In order to solve (A.27) we use a technique suggested by Dixit (1980). He shows that if the solution paths for the three variables are to lie on the stable manifold they must satisfy the following equation:

(A.32) $\quad e(t) - \bar{e} = u_1\{k_M(t) - \bar{k}_M\} + u_2\{p_S(t) - \bar{p}_S\}$

where u_1 and u_2 are elements of the (normalized) left characteristic vector of A corresponding to the unstable positive characteristic root. They therefore satisfy the equation:

(A.33) $\quad [u_1 \;\; u_2 \;\; -1][-A + \bar{\mu}I] = [0 \;\; 0 \;\; 0].$

where $\bar{\mu}$ is the positive root of (A.28). Equation (A.33) may be solved for u_1 and u_2 in terms of $\bar{\mu}$:

$$u_1 = \frac{\psi\lambda_L u_2}{\psi\lambda_B^{-1}\lambda_K + \bar{\mu}} \tag{A.34}$$

$$u_2 = \frac{\bar{\mu} - \delta}{\bar{\mu}} \tag{A.35}$$

By evaluating (A.28) for $\mu = \delta$ it can be established that $f(\delta)$ is positive which implies that $\delta > \bar{\mu}$. Hence (A.34) and (A.35) show that both u_1 and u_2 are negative.

These results may be used to establish conditions under which an exogenous shock causes the nominal exchange rate to overshoot its long-run value. If $t = 0$ is the period immediately following the shock, then, since the values of k_M and p_S are fixed at their initial levels, (A.32) implies that:

$$e(0) - \bar{e} = u_1(k_M^0 - \bar{k}_M) + u_2(p_S^0 - \bar{p}_S). \tag{A.36}$$

The long-run value of k_M is lowered by a resource boom and that of p_S also falls unless the spending effect is dominant. Hence, as was asserted in the text, there is a presumption that $e(0) - \bar{e}$ is negative, implying (in the case where $\bar{e} < 0$) that the nominal exchange rate overshoots. However it does not offer to be possible to establish that this is necessarily the case.

Using (A.32), the system (A.27) may be reduced to a system of two differential equations in k_M and p_S:

$$\begin{bmatrix} \dot{k}_M \\ \dot{p}_S \end{bmatrix} = \begin{bmatrix} -\phi(\gamma_B^{-1}\lambda_K - \theta_L u_1) & -\phi\theta_L(1-u_2) \\ \psi(\lambda_L + \varepsilon u_1) & -\psi\varepsilon(1-u_2) \end{bmatrix} \begin{bmatrix} k_M - \bar{k}_M \\ p_S - \bar{p}_S \end{bmatrix} \tag{A.37}$$

The trace and determinant conditions are both satisfied (the determinant of the coefficient matrix equals $\phi\psi\delta\varepsilon\Delta/\bar{\mu}$). Hence convergence towards long-run equilibrium is globally stable, with the value of e changing continually to keep the system on the stable manifold. Just as with the system (A.19), a cyclical path is possible though not inevitable.