Title	Real and monetary aspects of the 'Dutch disease'
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Publication date	1982-10
Series	UCD Centre for Economic Research Working Paper Series; No. 5
Publisher	University College Dublin. School of Economics
Item record/more information	http://hdl.handle.net/10197/1398
Notes	A hard copy is available in UCD Library at GEN 330.08 IR/UNI

REAL AND MONETARY ASPECTS OF THE 'DUTCH DISEASE'*

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Working Paper No. 5

October 1982

* An earlier version of this paper was presented to the International Economic Association Conference on Structural Adjustment in Developed Open Economies, Yxtaholm, Sweden, 2-6 August 1982.

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ABSTRACT

This paper presents a theoretical analysis of some of the issues raised by the "Dutch Disease": the phenomenon whereby a boom in one traded goods sector squeezes profitability in other traded goods sectors. The paper begins by showing how the effects of such asymmetric growth on static and dynamic resource allocation may be examined using the concepts of resource movement and spending effects introduced in an earlier paper (Corden and Neary [1982]). The paper then proceeds to illustrate how different monetary and exchange-rate policies may facilitate or hinder the adjustment of the real economy towards its new long-run equilibrium. In particular it is shown that a fixed exchange rate cushions the impact of the boom though at the expense of more inflation than a floating rate. Moreover, under a floating exchange rate the boom may require a long-run fall in domestic prices and wages. If these are sticky, the economy will undergo transitional unemployment and the exchange rate will overshoot its new long-run equilibrium value, thus exacerbating the Dutch Disease. An appendix to the paper shows that the decomposition of the real effects of a boom outlined in the paper may be generalised to production models with any number of goods and factors.

REAL AND MONETARY ASPECTS OF THE "DUTCH DISEASE" *

by

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1. Introduction

When the average rate of growth of an economy is high, considerable changes in the relative sizes of different sectors can often be accommodated without great cost. However, in an environment of sluggish overall growth, such as has characterized most of the world in the past eight years, structural adjustment may be extremely painful, even though it results from a boom elsewhere in the economy. The problems are likely to be particularly acute if the boom takes the form of a rapid and unanticipated expansion of a small number of sectors, as typically follows the exploitation of natural resource discoveries.

These problems have attracted increasing attention from policy-makers and theorists in recent years and are frequently referred to as the "Dutch Disease"-- a reference to the difficulties faced by the Dutch economy in the wake of the development of the Slochteren natural gas reserves during the 1960's. The objective of the present paper is

*This paper was written while I was Ford Visiting Research Professor at the University of California, Berkeley, and an earlier version was presented at the Third Latin American Meeting of the Econometric Society, Mexico City, July 1982. I am very grateful to W.M. Corden, J.A.Frankel, R.W. Jones and D.D. Purvis for invaluable discussions, to J.Bhagwati, R.Dornbusch, D.Hague and E.Helpman for helpful comments, and to the Committee for Social Science Research in Ireland for supporting this research.

to throw light on these issues and on the policy dilemmas they pose by considering their implications in some simple general-equilibrium models of economies engaged in international trade. While each individual model deals with only a small part of the problem, taken together they cover many of the aspects which have concerned policy-makers, as well as providing a framework within which many other theoretical discussions of the Dutch Disease may be compared.

Since the problems we consider emanate from a real shock, we begin in Section II by examining the effects of a sectoral boom in a static real model of an open economy. This section, which is based on the analysis in Corden and Neary [1982], serves to introduce the framework used throughout the paper and also presents a key decomposition of the real effects of a boom. Although the model in this section is relatively simple, it is shown in the Appendix that this decomposition continues to be valid in an extremely general production model with any number of commodities and factors.

While a static model is perfectly adequate as a guide to the different channels through which a boom influences the rest of the economy, it throws no light on the timing of the real adjustments which are required. Drawing on work by Neary and Purvis [1981] and [1982], Section III attempts to fill this gap by examining the effects of a boom on resource reallocation and growth. Section IV then turns from the real consequences of a boom to consider its implications for nominal magnitudes in a fully-specified monetary model. This throws some light on the options available to domestic fiscal, monetary and exchange-rate policy, and also provides a necessary background to

the discussion in Section V of the employment effects of a boom when prices and wages do not adjust instantly to eliminate disequilibrium *in domestic goods and factor markets.* *Finally, Section VI draws* together the conclusions from the various models and notes some implications for the diagnosis and treatment of the Dutch Disease.

II. The Dutch Disease in a Static Framework

This section outlines what is probably the simplest general-equilibrium model within which the real aspects of the Dutch Disease can be considered.[1] Clearly, such a model must distinguish between at least two sectors, one which experiences a boom and the other which is buffetted by the ensuing repercussions. To fix ideas, we shall refer to the outputs of these two sectors as "benzene" and "manufactures" respectively, but many alternative interpretations of the models' formal structures are possible. In Nigeria, for example, one of the sectors which has been most squeezed as a result of the oil boom is export-oriented agriculture; whereas in Ireland and other semi-developed economies pressures on traditional manufacturing have come not from natural-resource extraction but from the rapid expansion of technologically advanced sub-sectors within manufacturing itself.

Since our focus is on the effects of a boom in a trade-dependent economy, we make the simplifying assumption that both the benzene and manufacturing sectors are completely exposed to foreign competition, facing

[1] The model in this section is taken from Corden and Neary [1982] which in turn is closely based on Snape's [1977] general-equilibrium extension of Gregory's [1976] analysis of the effects of the Australian mineral boom.

fixed world prices for their outputs. However, as we shall see, a key issue in all but the smallest of small open economies is the effect of the boom on the real exchange rate, i.e., the relative price of traded to non-traded goods. In order to examine this issue we must add a third sector producing a non-traded good whose price is determined endogenously. For concreteness, we shall refer to this as the "services" sector, but once again the label we have chosen may be inappropriate in some applications. Many medium-sized economies, for example, face less than infinitely elastic demand curves for their manufacturing exports. In such economies the price of exports relative to imports (i.e., the terms of trade) is influenced by domestic conditions, and so their manufacturing sectors are more akin to what we call the "services" sector in this paper. This issue should be kept in mind in comparing our results with those of other models of the Dutch Disease, which assume that the home economy has some monopoly power in its export market. (See, for example, Buiter and Purvis [1982].)[2] From an analytical point of view we prefer to assume given world prices for all traded goods: otherwise the economy could raise its real income by imposing an export tax, and so the effects of the boom itself may be confused with second-best "paradoxes" which arise from a failure to implement an optimal policy of trade restriction.

[2] In their simulation results (though not in their analytical model) Bruno and Sachs [1982] allow for both a non-traded good and a traded good facing a less than infinitely elastic foreign demand curve.

Having settled on a three-sector structure, the next issue to be considered is how factor markets are assumed to operate in our model economy. Here too our choice of assumptions is largely dictated by the nature of the problem. One of the questions of interest in examining the Dutch Disease is the effect of the resource boom on profitability in manufacturing. However, the concept of a sector's profitability is not one which can easily be accommodated in a competitive model if it is assumed that all factors are intersectorally mobile.[3] Hence we assume that, at least in the short run, manufacturing uses a specific factor whose return can be interpreted as an index of the sector's profitability. This suggests that a natural framework within which to examine the Dutch Disease is the specific-factors model of Jones [1971], and this is the approach adopted in the present section. Thus we assume that each sector uses a specific factor and also draws on a common pool of intersectorally mobile labour.

Under these assumptions, the effects of the boom can be illustrated in Fig. 1. The horizontal axis measures the economy's labour force (which for simplicity we assume is fixed), and each of the curves depicts the demand for labour from one or more sectors as a decreasing function of the wage rate.[4] Assuming the wage has adjusted to ensure

[3] This point is made in Jones and Neary [1982], Section 2.4.

[4] The demand for labour by the services sector is measured rightwards in the diagram from 0_S whereas that by the other two sectors is measured leftwards from 0_T.

full employment, the initial equilibrium is at point A, where the curves L_S and L_T intersect. The latter curve depicts the demand for labour by the two traded goods sectors combined, and so is a lateral summation of the individual curves for manufacturing (denoted by L_M) and benzene (not drawn). The curve L_S depicts the demand for labour by the services sector; unlike L_T, the location of this curve is endogenous, since it depends on the price of services in the initial equilibrium.

Although in general the price of services must adjust following the boom, it is illuminating to begin by considering what happens if it does not. The only effect on the diagram is then a leftward shift of the L_T schedule to L_T', as the boom raises profitability in the benzene sector and so raises its demand for labour at the initial wage rate. Clearly this drives up the wage from w_0 to w_1 and induces both the services and manufacturing sectors to release labour to the benzene sector. Following Corden and Neary [1982], we shall refer to the resulting decline in manufacturing output as direct de-industrialisation brought about by the resource movement effect of the boom. Notice that we have not had to specify the source of the boom: provided that it is unanticipated and permanent, the same qualitative results follow from the discovery of new resources specific to the benzene sector; or a neutral technological improvement there; or (with minor qualifications, noted in footnotes where necessary) a rise in the world price of benzene.[5]

[5] One not-so-minor qualification is that we ignore the consequences of benzene being used as an intermediate input, which have been extensively examined elsewhere.

Now we must ask what happens to the relative price of the non-traded good, services, which is the inverse of the real exchange rate.[6] Once we know this, we can deduce the full change in the wage rate (and so in the levels of output and employment in each sector) from a standard property of the specific-factors model:[7]

$$(1) \qquad \hat{w} = \xi_B \hat{b} + \xi_S \hat{p}_S$$

Here the term $\hat{b}$ measures the extent of the boom in the benzene sector, and the parameters ξ_B and ξ_S, which must lie between zero and one, measure the contribution of the sectors in question to the aggregate elasticity of demand for labour.[8] (Thus ξ_S, for example, is smaller the steeper is the curve L_S in Fig. 1 relative to L_T.) The first term in equation (1) corresponds to the direct de-industrialisation already mentioned, while the second shows that the wage rate is increased by any real appreciation (i.e., a rise in p_S) which takes place as a result of the boom.

To establish that a real appreciation does occur, note that the boom affects the market for services in two separate ways. Firstly, the resource movement effect tends to reduce the output of services. The magnitude of this reduction depends on the parameter ξ_S in (1) and on

[6] Thus a rise in the relative price of services, p_S, represents a real appreciation.

[7] See Jones [1971]. A circumflex denotes a proportional rate of change (e.g., $\hat{w} = d\ln w$).

[8] As equation (1) is written, it holds exactly if the boom takes the form of Hicks-neutral technological progress or a rise in the world price of benzene. Minor modifications are required to accommodate other sources of a boom.

the services sector's output-elasticity of supply with respect to the real wage, ϕ_S . Secondly, the boom raises the economy's real income and so increases the demand for services; the magnitude of this spending effect depends on the share of the benzene sector in national income, θ_B , and on the income-elasticity of demand for services, η .[9] Since both of these effects lead to excess demand for services, they necessarily raise their relative price, p_S (assuming that the market for services is stable):[10]

$$(2) \qquad \hat{p}_S = \frac{1}{A}(\xi_S \phi_S + \theta_B)\hat{b}$$

Hence, in Fig. 1, the services sector's labour demand schedule shifts upwards to L_S' and a new equilibrium is established at point C. By comparison with the pre-boom equilibrium at A, it is clear that the manufacturing sector is unambiguously squeezed: its output and employment fall, its profitability (as measured by the return to the specific factor there) is reduced and the balance of trade in manufacturing worsens. (A sufficient though not necessary condition for the last-mentioned outcome is that manufactures are a normal good in home consumption).

[9] If the boom is due to an increase in the stock of the factor specific to the benzene sector, its effect on real income depends not on θ_B but on the share of that factor in national income. A more significant modification to (2) is needed if the boom arises from an increase in the world price of benzene: in this case national income rises if benzene is a net export, and the degree of substitutability or complementarity in demand between benzene and services also plays a role. See Neary and Purvis [1982] for further details.

[10] The parameter A is the general-equilibrium elasticity of excess supply of services, equal to $\varepsilon_S + \phi_S(1-\xi_S)$. The term ε_S is the compensated price-elasticity of demand for services (in absolute value) and the damping factor $(1-\xi_S)$ reflects the induced rise in wages which partially offsets the supply effect represented by ϕ_S .

This simple model provides an intuitively plausible and unambiguous characterization of the Dutch Disease. Moreover, the taxonomy of effects which it yields may be fruitfully applied to assist our understanding of other models. Indeed, as shown in the Appendix, the distinction between the resource movement effect and the spending effect has an exact counterpart in any static competitive production model irrespective of the numbers of goods and factors assumed. The same is also true of the different channels we have identified through which these effects operate: the resource movement effect giving rise to direct de-industrialization and both effects having an indirect influence by way of changes in the prices of non-traded goods. Of course, the clear-cut signs which we have found for these effects do not necessarily survive in more complicated models. In particular, if all factors used in manufacturing are assumed to be intersectorally mobile, it is possible for resources to flow into that sector so that on balance its output actually expands.[11] However, many of the results of this type which have been obtained require relatively implausible parameter values,[12] and so there remains a strong presumption that the Dutch Disease outcome - of a decline in manufacturing output - will ensue.' (Indeed, in

[11] This is quite consistent with our finding that, if labour is the only mobile factor, the return to the specific factor must fall, because in the medium run the reallocation of (temporarily) specific factors is induced not by absolute but by relative returns. Thus it is conceivable that the return to the specific factor in either of the other sectors falls by more than does the return to the specific factor in manufacturing, so inducing reallocation into that sector.

[12] Examples of this phenomenon in a variety of models may be found in Corden and Neary [1982], Jones, Neary and Ruane [1981] and Long [1981].

the short run at least, this outcome is virtually certain).

Before leaving this static framework, we may note that a number of the models of the Dutch Disease which have been developed in recent years do not allow any participation by the booming sector in domestic factor markets. This is true, for example, of the models examined by Bruno and Sachs [1982], Buiter and Purvis [1982] and van Wijnbergen [1981]. In such models, the boom thus has no resource movement effect whatsoever, only a spending effect, so that its consequences are identical to those of a direct transfer of final goods from abroad. Of course, all these papers are primarily concerned with other issues, so that from an analytic point of view the simplifications they make with respect to the structure of factor markets should be seen as a virtue rather than a vice. However, as far as understanding real phonemena is concerned, we must accept that most booming sectors make use of some factors which (at least in the short run) are available only in the home country and are in limited supply, so that their diversion towards the booming sector imposes additional costs on manufacturing.[13] For a complete understanding of the Dutch Disease, therefore, the resource movement effect cannot be ignored.

III. De-industrialization and Dynamic Adjustment

In the model of Section II, one of the channels of "de-industrialization," or the decline of the manufacturing sector, was a real appreciation. However, although these two phenomena are often seen as closely linked, they are not necessarily associated. In this section we present a

[13] This is especially the case if factors are relatively immobile between regions in the short run and the booming sector is geographically concentrated.

different model in which de-industrialization is inevitable, as before, but in which the real exchange rate may rise in the long run (i.e., there may be a real depreciation). This model also introduces an *explicit temporal sequence of effects in place of the static* decomposition of Section II. Thus, for the first time, we are able to consider dynamic issues such as the influence of expectations on the time path taken by the economy.

The model of this section is based on Neary and Purvis [1981] which in turn draws on work by Kouri [1979]. Its sectoral structure is identical to that of the model of Section II; the differences arise instead in the specification of factor markets. In particular, the benzene sector is assumed to use no mobile factors in the short run, thus precluding any resource movement effect over that time horizon. However, both the benzene and manufacturing sectors use stocks of capital, which can be gradually augmented or depleted with the passage of time. Manufacturing can also draw on a pool of labour, which is instantaneously mobile between that sector and services. The specification of the model is completed by assuming that both benzene and services use a permanently specific factor.[14]

Assuming that the economy is initially in long-run equilibrium, the effects of a boom in this model are illustrated in Fig. 2. The horizontal axis denotes the stock of capital located in the manufacturing sector. So, in the short run the economy is constrained by the

[14] In the model of Neary and Purvis [1981], it was assumed that the services sector uses labour only. However, the model is easily extended to allow for a specific factor in services, and this specification is adopted in what follows.

initial allocation of capital to that sector, K_M^0 . Along the vertical axis is measured the real exchange rate π , which is simply the inverse of p_S , the relative price of non-traded goods. (Recall that a rise in π or a fall in p_S represents a real depreciation.) The curve SS indicates those combinations of π and K_M which are consistent with equilibrium in the market for services before the boom takes place. This curve is downward-sloping, since a rise in K_M , with no change in π , induces the withdrawal of labour from services and so generates excess demand; to eliminate this a fall in π is required, and this both stimulates the supply of and discourages the demand for services.

As already noted, in the short run the boom has only a spending effect in this model. This is reflected in the downward shift of the services market equilibrium locus from SS to S'S': following the increased demand for services, either a rise in their relative price (i.e., a fall in π) or a contraction of the manufacturing sector (so releasing labour to services) is required if equilibrium is to be restored. With K_M fixed in the short run, this implies that on impact the equilibrium moves from A to B : there is a real appreciation, which induces a rise in the wage relative to the price of manufactures and so manufacturing output and employment contract.

However, this real appreciation disturbs the initial capital-market equilibrium, by reducing the return to capital in the manufacturing sector. Since the return to capital in benzene has risen in any case as a direct consequence of the boom, there is now a clear incentive to run down the stock of capital in manufacturing. Whether this is done by reallocating existing capital goods or by allowing

them to depreciate without replacing them, the consequences for the medium-run evolution of the economy are the same: the real exchange rate gradually rises as the equilibrium point moves in a north-westerly direction along S'S' as indicated by the arrows in the diagram. The implcations of this movement for the level of manufacturing output are easily seen. Along S'S' the demand for services steadily rises, both because their relative price falls and because capital is being allocated more efficiently between sectors, which raises real income. Hence the equilibrium output of services must rise, which squeezes labour out of the manufacturing sector. Since manufacturing is simultaneously losing capital, the sector's output must fall steadily as the economy moves away from point B.

Exactly where this adjustment path ends is considered in Neary and Purvis [1981] and the details need not delay us here. As shown there, if capital is available from abroad at a fixed world rental, the long-run equilibrium real exchange rate is unaffected by the boom and so the economy converges to point C. Alternatively, if capital is a non-traded factor available in fixed supply, the final equilibrium may be at points such as C' or C''. In the former case the exchange rate "overshoots" its new long-run value whereas in the latter case it initially moves in the "wrong" direction.[15] Whichever of these assumptions about capital markets

[15] Allowing a specific factor in services dampens the resource-movement effect of the boom and so makes it more likely that the final equilibrium will be at a point such as C' rather than one such as C''. The condition for π to rise in the long run when capital is non-traded (which is also the condition for the total stock of capital in the economy to rise if it is internationally mobile) is as follows: $\lambda_L \theta_{LS} \xi_S > \lambda_K n \theta_B$, where λ_L measures the labour-intensity of manufacturing relative to services, λ_K measures its capital-intensity relative to benzene, θ_{LS} is the share of wages in the value of services output and the other parameters are defined in Section II. This condition is more likely to be met if labour is the only factor used in services (as in Neary and Purvis [1981]), since in that case the term $\theta_{LS}\xi_S$ attains its upper bound of unity.

is made, the implications for the Dutch Disease symptoms are the same: both the initial real appreciation and the subsequent real depreciation are associated with steady declines in manufacturing output and employment.

One advantage of an explicitly dynamic model such as this is that it allows us to consider the role of expectations. From this perspective, it is clear that what is crucial is not the date at which the booming sector's output increases, but the date at which the consequences of this are foreseen by different agents in the economy. If consumers anticipate an increase in real national income, their capitalized permanent income is increased so that their current demand for services rises (unless they are constrained in credit markets).[16] Similarly, given positive adjustment costs, factor owners will begin to reallocate capital out of manufacturing and into benzene in anticipation of the boom.[17] Thus, both the spending and the resource movement effect of the boom may come into play, squeezing the output of manufacturing before any increase in benzene output takes place.

[16] In their simulation model, Bruno and Sachs [1982] assume that a fixed proportion of households are infinitely-lived life-cycle utility maximizers, with the remainder completely constrained by their current incomes.

[17] The same is true if capital is mobile between manufacturing and services, as in the models of van Wijnbergen [1981] and Bruno and Sachs [1982].

IV. Monetary and Exchange-Rate Policies and De-industrialization

So far, we have considered only the aspects of the Dutch Disease which concern the allocation of real resources, whereas many of the important policy issues it raises involve monetary considerations. In this section we turn to consider these issues, assuming for simplicity that the real side of the economy is characterized by the static model of Section II. We continue to assume that both the wage and the price of services are flexible, postponing the consequences of nominal wage and price rigidities until Section V.

We have already assumed that the economy under consideration is small relative to world markets for traded goods, so it is natural to assume that it is also small in asset markets. If we further abstract from market "distortions" such as controls on international capital movements, political risk and transactions costs, then domestic and foreign bonds may be viewed as perfect substitutes.[18] In addition, we assume that there is a third asset, domestic money, which is not held by foreign residents. Just as, in trying to understand the real models of earlier sections, it was helpful to focus on the market for the non-traded good, so we begin this section by considering the market for the non-traded asset. To do this, we make use of Fig. 3, where the vertical axis measures the nominal price of services, P_S, and the horizontal axis measures the nominal exchange rate, e (i.e., the home-currency price

[18] Our model is thus of the monetary rather than the portfolio-balance variety, although as we shall see in Section V this does not preclude consideration of Keynesian issues. See Frankel [1982] for a comparison of alternative approaches to modelling floating exchange rates.

of a unit of foreign exchange).[19] Provided the relative price of benzene and manufactures remains fixed, e may be interpreted as the domestic price level for traded goods. Note that each ray through the origin in Fig. 3 corresponds to a given relative price of non-traded to traded goods and thus to a given real exchange rate.

We assume that the desired level of real money balances is determined by a conventional money demand function:

$$(3) \qquad m - P = \alpha y - \delta i$$

where i is the domestic interest rate and m , P and y are the logarithms of nominal money demand, the price level and the level of real income, respectively. Equation (3) is related to the nominal exchange rate in two distinct ways. Firstly, the domestic price level P is a weighted average of the prices of traded and non-traded goods:

$$(4) \qquad P = \beta_S P_S + (1-\beta_S)\, e \quad .$$

Secondly, expected changes in the exchange rate influence the link between the domestic interest rate i and the world interest rate i* (which the home country is too small to affect). It is convenient to begin by ignoring expected exchange-rate changes, so we assume for the present that the domestic and foreign interest rates are identical. (As we shall see, this does not significantly affect the conclusions.) The money-market equilibrium condition, obtained by substituting the domestic money supply into (3), can then be depicted by the downward-sloping locus MM in Fig. 3. If the exchange rate is flexible and the domestic money market is always in equilibrium, the economy must

[19] Both variables are measured in logarithms. This diagram has been used by Mundell [1971], Black [1976] and Dornbusch [1976].

always lie along this locus: a rise in P_S must be accompanied by a fall in e if the domestic money supply is to be willingly held when income is at its full-employment level and the domestic interest rate equals i* . Alternatively, under a fixed exchange rate, the economy may be (for example) at a point above MM , reflecting a shortfall of actual holdings of real money balances below desired holdings. This disequilibrium must be offset by a build-up of foreign-exchange reserves to augment the domestic money supply. Hence, all points above MM correspond to situations of balance-of-trade surplus and points below MM correspond to a deficit.

The depiction of the initial equilibrium is completed by adding the conditions for equilibrium in the non-traded good market. Obviously, a rise in P_S induces an excess supply of services while an increase in e gives rise to excess demand. Morever, with a fixed nominal money supply, an equi-proportionate increase in P_S and e leads to excess supply of services by reducing the value of real balances and so depressing spending. The services market equilibrium locus, SS , is thus upward-sloping and less steeply sloped than a ray from the origin, as shown. The pre-boom equilibrium is therefore at point A , where the loci MM and SS intersect.

We are now in a position to consider the consequences of a boom. As far as the SS locus is concerned, we know already that both the spending and the resource movement effects lead to excess demand for services at initial prices. Hence this locus shifts upwards to S'S'. The rise in real income also raises money demand and, if the domestic money supply is not changed, the price level must fall to restore money-

market equilibrium. This third effect of the boom, which we may call the liquidity effect, therefore shifts the MM curve inwards to M'M'. Provided the nominal exchange rate is allowed to float freely, the new equilibrium must be at point C, where M'M' and S'S' intersect. The fall in the real exchange rate, represented by the greater slope of OC relative to OA , corresponds exactly to that given in equation (2). This real appreciation is accompanied by a nominal appreciation, so that the domestic prices of traded goods unambiguously fall, but the price of services may either rise or fall.

What happens if the nominal exchange rate is not free to change but instead remains equal to its initial value e_0 ? On impact, with a constant nominal money supply, the shifts in the two equilibrium loci are as just described, and so if the price of services is free to adjust the economy moves in the short run to point J. The change in the relative price of services, and hence the degree to which the real side of the economy adjusts, is less than that required for long-run equilibrium, since the spending effect is dampened by the leakage into hoarding which is reflected in a balance-of-trade surplus. Since desired money balances are now greater than actual, the equilibrium at J cannot be permanently sustained. Instead, the trade surplus leads to a build-up of foreign-exchange reserves, and so, provided the authorities do not attempt to sterilise this inflow, the domestic money supply gradually increases. This causes both S'S' and M'M' to drift upwards and so the equilibrium point moves upwards from point J as indicated by the arrows. This process can only end when the post-boom equilibrium real exchange rate is attained at point C': at this point, the two loci once again intersect, the surplus is eliminated and

the economy reaches its new long-run equilibrium.[20] The implications are clear: a fixed exchange rate delays the real effects of the boom and gives rise to inflationary rather than deflationary pressures. The required increase in the relative price of non-traded goods is brought about by a rise in their nominal price rather than by a fall in the nominal prices of traded goods. Experience in many countries has shown that the domestic inflation induced by a boom under fixed exchange rates may pose political problems which are just as severe as those arising from the required change in the structure of the economy.

Of course, the assumption adopted so far - that the domestic monetary authorities adopt a neutral stance - has been made for analytic convenience only, and the consequences of alternative assumptions can easily be examined in the diagram. For example, if the authorities are committed to a fixed nominal exchange rate but are concerned about the inflationary consequences of the boom, their only option is to reduce the money supply and sterilize the subsequent inflow of reserves. This amounts to what Corden [1981] has called "exchange-rate protection": the central bank acts to suppress the real appreciation, so protecting the traded goods sectors and mitigating the extent of de-industrialization. The cost of such a policy does not arise from a divergence between home and foreign relative prices (as with orthodox tariff protection). Rather, to the extent that the policy is successful, it arises from a permanent

[20] Since the real side of the economy is homogeneous of degree zero in all nominal variables, the new equilibrium real exchange rate, represented by the slope of OG , is independent of the exchange-rate regime adopted.

reduction in aggregate consumption below the level of national income, which is reflected in a continuing balance-of-trade surplus.

V. Sticky Prices and the Adjustment Problem

So far we have assumed that prices and wages adjust instantaneously, so as to ensure the continual clearing of domestic goods and factor markets. It might be thought that this is not a serious limitation on the analysis, since a boom might be expected to place upward pressure on prices and wages which are usually assumed to be flexible upwards in developed market economies. However, we have just seen in Section IV that unless the money supply is increased the boom is deflationary under a floating exchange rate, and we shall see below that it may also require a fall in wages, in both real and nominal terms. In such circumstances, price and wage rigidities give rise to non-price rationing in goods and factors markets. This adds a new dimension to the Dutch Disease problem, which we must now examine.

Consider first the case where the nominal price of services is sticky in the short run. The nature of the pressures to which this gives rise depends on the required long-run change in P_S. Assuming a constant nominal money supply this may be shown to equal:[21]

$$\hat{P}_S = [(1-\beta_S)\, H - \alpha\theta_B]\ \hat{b} \quad . \tag{5}$$

[21] Equation (5) is derived from (2) and (3), noting that proportional changes in the absolute and relative prices of services are related as follows: $\hat{P}_S = \hat{\mathbf{P}}_S + \hat{e}$.

The parameter H is the coefficient which relates the magnitude of the boom to the change in the relative price of services in equation (2). It thus reflects the spending and resource movement effects of the boom, both of which tend to raise P_S. Working in the opposite direction is the liquidity effect, and equation (5) shows that this is more likely to dominate the greater the income-elasticity of demand for money (α) and the larger the share of non-traded goods in national income and expenditure (β_S); in other words, the less open is the economy.[22]

Fig. 4 illustrates the effects of the boom under floating exchange rates when the liquidity effect dominates so that the long-run equilibrium moves from A to C, requiring a fall in P_S. In the short run the price of services cannot fall below its initial value, and, since foreign and domestic bonds are perfect substitutes, the domestic interest rate is tied to the world rate. Hence the exchange rate must bear all the brunt of ensuring that the money market clears at the new higher level of real income. In the short run the equilibrium therefore jumps from A to B, which lies on the post-boom money-market equilibrium locus $M'M'$. At this point, there is an excess supply of services which, over time, drives down their price. The economy therefore moves gradually towards the new

[22] In a very similar model, Eastwood and Venables [1982] claim that the price of the domestic good (P_S in our notation) cannot fall in the long run. Hence, they conclude that an oil discovery cannot give rise to deflationary pressures (unless there is a lag between the announcement of the discovery and the response of domestic spending). However, these results follow only because they assume, without justification, that the demand for money is unaffected by the discovery, so that there is no liquidity effect.

long-run equilibrium as shown by the arrows.[23] The consequences for the real economy of moving along this path are clear: because the exchange rate overshoots its final equilibrium value e^*, manufacturing profitability falls even more in the short run than in the long run. Floating exchange rates thus exacerbate the Dutch Disease when domestic prices are sticky.

It should be emphasized that this outcome does not depend on any assumed irrationality of behaviour or expectations. For example, although we have assumed so far that the domestic interest rate is always equal to the foreign rate, the analysis is not significantly affected if instead bond-holders rationally anticipate the nominal depreciation which takes place as the economy moves from B to C. Because this raises the relativ attractiveness of holding foreign bonds, the domestic interest rate must rise to restore portfolio equilibrium. Hence, a smaller initial fall in the exchange rate is required to ensure that the money market clears. Rational exchange-rate expectations thus reduce the degree of over-shooting relative to that which occurs with static expectations, but the qualitative

[23] Except that the initial shock is a real one, the economy's response as illustrated in Fig. 4 is identical to that considered by Niehans [1975] and Dornbusch [1976] following a monetary shock. Purvis [1982] gives an alternative diagrammatic illustration of the overshooting result following a monetary shock and Neary and Purvis [1981] show how it can come about following a real shock even when all prices are flexible.

properties of the adjustment path are unchanged.[24]

So far, we have examined the implications of price stickiness, but wage stickiness has very similar effects. Moreover, the boom is more likely to require a fall in wages, whether real or nominal, than a fall in the nominal price of services. Consider first the real wage. Although Section II showed that the mechanism inducing de-industrialisation is a rise in the real wage facing the manufacturing sector, this does not mean that the real reward of wage-earners necessarily rises, since they consume services, whose prise has risen. Assuming that wage-earners' tastes are the same at the margin as those of the economy as a whole, the change in their real reward is given by the following:

$$(6) \qquad \hat{w} - \beta_S \hat{p}_S = [\xi_B + (\xi_S - \beta_S)H]\hat{b}$$

The first term in this expression, ξ_B, captures the direct de-industrialisation brought about by the resource movement effect of the boom, which tends unambiguously to raise real wages. (Recall that, in the model of Section III, the benzene and

[24] Perfect substitutability of domestic and foreign bonds requires that the home interest rate i equal the world rate i^* plus the expected rate of exchange-rate depreciation plus or minus an appropriate risk premium. As in Dornbusch [1976], it can be shown that under perfect foresight (or "rational expectations") the expected exchange rate is proportional to the gap between the long-run and current exchange rates. Hence, provided the risk premium remains constant, the M'M' locus is more steeply sloped than when i equals i^* : from (3) and (4), a given increase in e reduces the real money supply as before and in addition it lowers the expected rate of depreciation (or raises the expected rate of appreciation). This raises the domestic interest rate, increasing the demand for money and so requiring a larger fall in P_S to restore money-market equilibrium. Note that, by contrast with Dornbusch's model, this change in assumptions does not affect the SS locus, since, in order to facilitate the comparison between fixed and floating exchange rates, we have assumed that the demand for services depends directly on real balances rather than on the real interest rate.

services sectors do not use any common factors, so that this effect is not present.) The second term captures the spending and indirect resource movement effects. Its sign depends on the difference between ξ_S, which measures the services sector's contribution to the economy-wide elasticity of demand for labour and β_S, the share of services in national expenditure and output.[25] There is clearly no presumption as to the sign of this difference; if it is negative, real wage stickiness may give rise to unemployment in the short run.

As for the nominal wage rate, the expression for its change when the money supply is constant is as follows.[26]

$$(7) \qquad \hat{W} = [(\xi_B - \theta_B) + (1-\alpha)\boldsymbol{\theta}_B + (\xi_S - \beta_S) H] \hat{b}$$

By contrast with equation (6), there is no term tending unambiguously to raise the nominal wage rate. Unemployment is therefore even more likely to occur if this variable is sticky.

The implications of wage stickiness may be examined in a similar manner to those of price stickiness. The consequences are much the same,

[25] This difference is negative when the services sector is "biased" against labour, in the sense of Ruffin and Jones [1977]. An equivalent criterion is that the supply elasticity of services is less than a weighted average of the supply elasticities of all three sectors: $\xi_S - \theta_S$ is proportional to $\phi_S - \Sigma\theta_j\phi_j$. See Jones and Neary [1982], Section 2.4.

[26] The change in the nominal wage rate, $\hat{W}$, equals $\hat{w} + \hat{e}$. Equation (7) is derived by combining this definition with equations (1), (2), and (3).

except of course that the transitional disequilibrium takes the form of unemployment rather than non-price rationing of services. The case of nominal wage stickiness, in particular, is almost identical to Fig. 4, and overshooting is inevitable provided that the demand for money in equation (3) depends on permanent rather than current income.[27]

In conclusion, although the analysis in this section has assumed that the real side of the economy is characterized by the model set out in Section II, transitional unemployment can also occur in more complicated models. For example, Neary and Purvis [1982] show that if the nominal wage rate is assumed to adjust sluggishly in the model of Section III, transitional unemployment may follow the boom especially if the long-run outcome is a real appreciation.[28] Although further research is needed to establish the robustness of this result, it is clearly an important additional element which must be considered in any full assessment of the costs of the Dutch Disease.

VI. Concluding Remarks

Just as one historian has quipped that the Holy Roman Empire was neither Holy, Roman, nor an Empire, so also the appropriateness of the term

[27] If the demand for money depends on current rather than permanent income, the slope of the MM locus in (W,e) space (i.e., in the diagram analogous to Fig. 4) is ambiguous and so overshooting is not inevitable. A similar ambiguity was noted by Dornbusch ([1976] Appendix.

[28] The likelihood of this outcome is confirmed by the simulation results of Young [1982]. Some slight evidence to the contrary is provided by the simulation results of Bruno and Sachs [1982], whose model resembles that of Section III except that capital moves over time between the manufacturing and services sectors rather than between manufacturing and benzene. Their results (Table 6) show a steady rise in the real wage so that stickiness of this variable cannot generate unemployment. However, they also show significant overshooting of the real exchange rate. It remains an open question whether the addition of a monetary sector and nominal wage stickiness to their model would also imply overshooting of the nominal exchange rate and/or transitional unemployment.

"Dutch Disease" as a description of the phenomena we have examined in this paper is open to question. Dutch economists will no doubt debate for some time the relative contribution of the discovery of natural gas to the recent difficulties of their manufacturing sector.[29] As in other countries which have enjoyed sudden increases in real income, it is arguably the manner in which the resulting tax revenues were spent rather than the resource boom itself which was the main cause of the loss of manufacturing competitiveness.[30]

More generally, the models of this paper show that a decline in the relative size of non-booming sectors which are exposed to foreign competition is a necessary component of the economy's adjustment towards a higher level of real income. Attempting to resist this trend amounts to foregoing some of the benefits of the boom.[31] Hence, de-industrialization following a resource boom is a "disease" requiring treatment only if a large manufacturing sector is desired for the sake of some non-economic objective, or if distortions (such as wage stickiness) impede the smooth reallocation of resources. Since the considerations

[29] Early contributions to the debate include Blackaby [1978] and OECD [1979].

[30] To the extent that this reflects a higher marginal propensity to consume services by the public sector relative to the private sector, it can be accommodated within our theoretical framework by suitably redefining the parameter η implying a larger spending effect. However, this also raises the issue of the efficiency of government spending, which we have not touched on in this paper.

[31] This point has been stressed in the UK context by Forsyth and Kay [1980].

which should guide intervention in such circumstances have been extensively discussed in the context of adjustment to import competition, we shall not repeat them here.[32] Suffice it to say that, in attempting to determine the nature of the pressures on the manufacting sector caused by a boom, it is necessary to keep in mind all the issues on which the different models in this paper have focussed.

[32] See, for example, the contributions to Bhagwati [1982].

APPENDIX

We wish to show that the decomposition of the real effects of a boom introduced in Section II continues to apply in a general production model with any number of goods and factors. We use the same notation as the text, although the greater generality of the model is reflected in the fact that each of the benzene, manufacturing and services sectors may now contain any number of sub-sectors. We shall assume that the boom does not change the mix of commodities produced: this implies that the number of domestic factors of production must be at least as great as the number of distinct productive activities in the traded goods sectors.

It is convenient to characterise the production side of the economy by using the national product function of Samuelson [1953]:

$$(A.1) \qquad g(p,v,b) = \underset{x}{\text{Max}} \; [p'x: F(x,v.b) \leq 0]$$

Here v is a vector of fixed factor endowments; b is a scalar shift parameter which represents the boom; and p is a vector of prices which, in turn, may be partitioned into three sub-vectors:

$$(A.2) \qquad p' = \{p_B \; p_M \; p_S\}' \; .$$

(Note that all vectors are column-vectors and that the symbol ' denotes a transpose.) The output vector x is partitioned conformably and the aggregate production possibilities set defined by the constraint $F(x,v,b) \leq 0$ is assumed to be convex.

We are interested in the effect of the boom on manufacturing output. By a standard property of the national product function (see Dixit and Norman

[1980]), the level of manufacturing output equals its derivative with respect to p_M:

$$(A.3) \qquad x_M = g_M \equiv \frac{\partial g}{\partial p_M}$$

(Function subscripts corresponding to a given sector are used throughout to denote the vector of derivatives of the function with respect to the vector of that sector's prices.)

The vector of services prices, p_S, is not exogenous, but adjusts to ensure that the markets for services clear domestically. To take account of this, we need to characterise domestic demand behaviour, which is most conveniently done in terms of the expenditure function:

$$(A.4) \qquad E(p,u) = \underset{x}{\text{Min}} \, [p'x: U(x) \geq u] \ ,$$

and the indirect utility function:

$$(A.5) \qquad u = V(p,e) \ .$$

Here u and e are the levels of aggregate utility and expenditure respectively. (For simplicity, we assume that it is unnecessary to disaggregate the consumer sector.)

The demand for services equals the vector of derivatives of the expenditure must equal national product. Hence, the requirement that services be non-traded may be written as follows:

$$(A.6) \qquad g_S(p,v,b) = E_S[p,V\{p,g(p,v,b)\}] \ .$$

This may be differentiated to evaluate the effects of the boom on the equilibrium prices of services:

$$(A.7) \qquad dp_S = (g_{SS} - E_{SS})^{-1} (m_S g_b - g_{Sb})\, db.$$

(This is a generalization of equation (2) in the text.) Here we have introduced m_S, to denote the vector of marginal propensities to consume services:

$$(A.8) \qquad m_S = E_{Su} V_e \quad .$$

Making use of (A.7) we can now calculate the total effect of the boom on manufacturing output by differentiating (A.3) with respect to b:

$$(A.9) \qquad \frac{\partial x_M}{\partial b} = g_{Mb} + g_{MS} \frac{\partial p_S}{\partial b}$$

$$(A.10) \qquad = g_{Mb} + g_{MS}(g_{SS} - E_{SS})^{-1}(m_S g_b - g_{Sb}).$$

The first term in (A.10) represents the <u>direct de-industrialization</u> attributable to the <u>resource movement effect</u> of the boom while the second term measures the impact on manufacturing output of the induced changes in the prices of non-traded goods. These in turn reflect <u>both</u> the <u>spending effect</u> (denoted by $m_S g_b$) and the <u>resource movement effect</u> (corresponding to g_{Sb}). At this level of generality rather few restrictions on the signs of the terms in (A.10) are available other than that the matrix $(g_{SS} - E_{SS})^{-1}$ is positive definite and that the spending effect terms $m_S g_b$ are positive. (The latter assumes that all services are normal in consumption). However, the equation provides a general framework within which the implications of different restrictions on technology may be compared.

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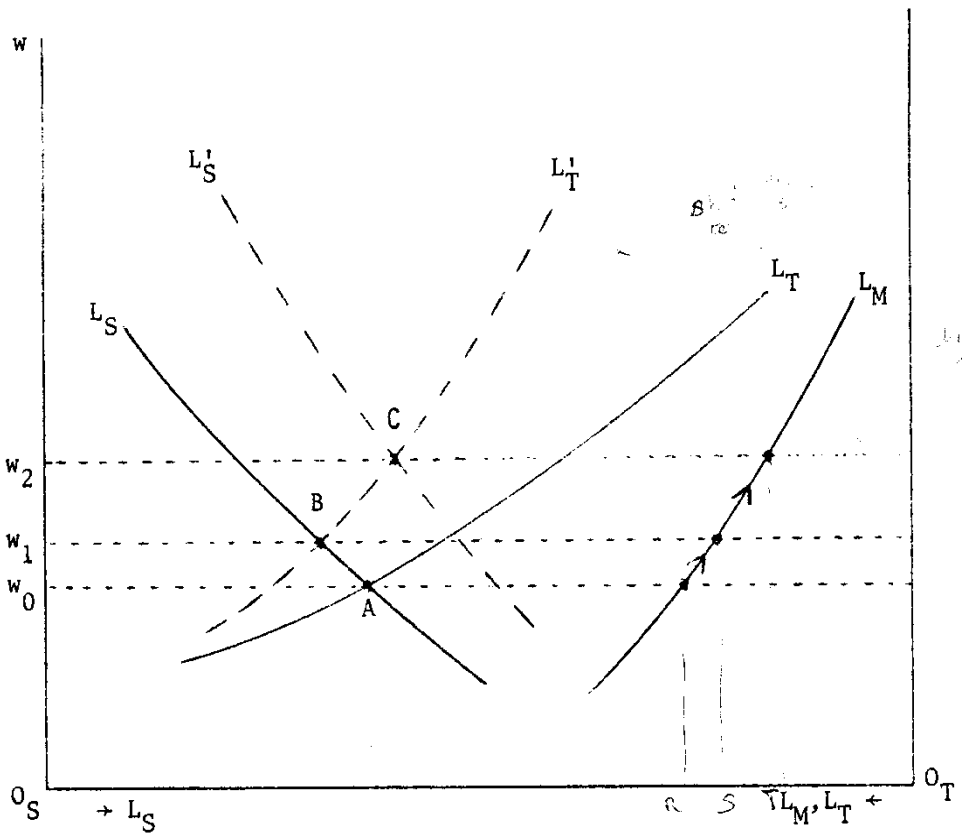

Figure 1: Spending and Resource Movement Effects of the Boom

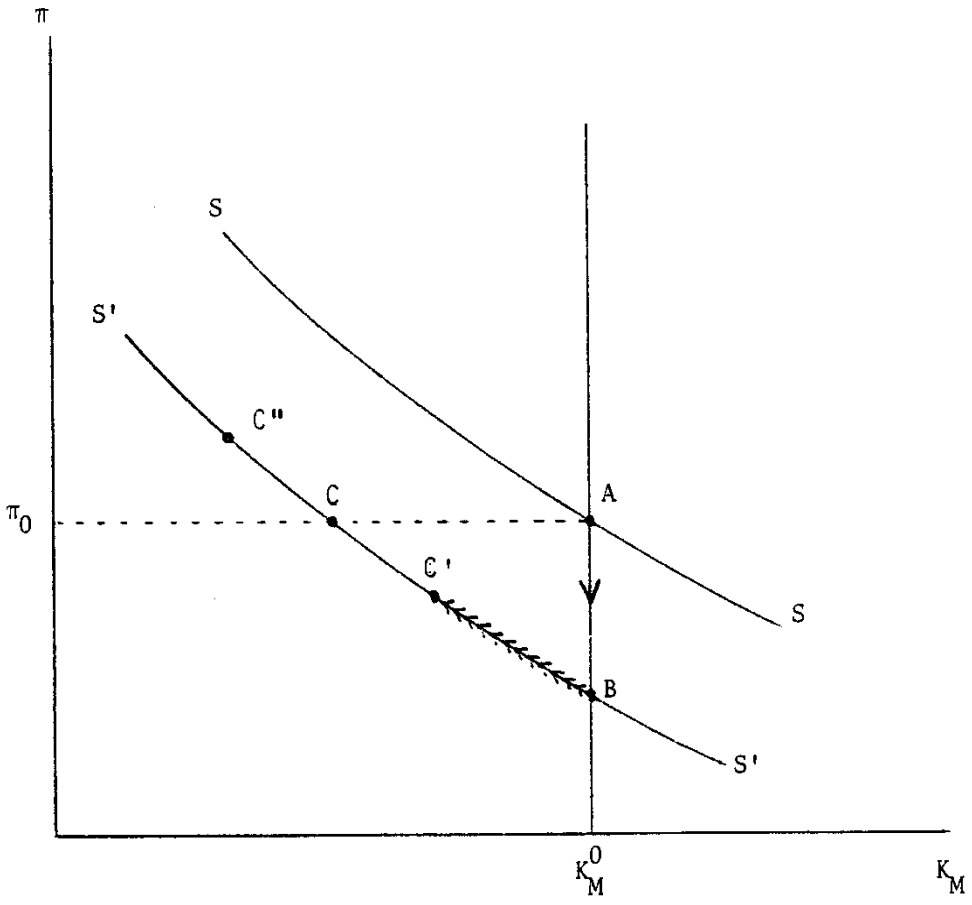

Figure 2: De-industrialization and Dynamic Adjustment

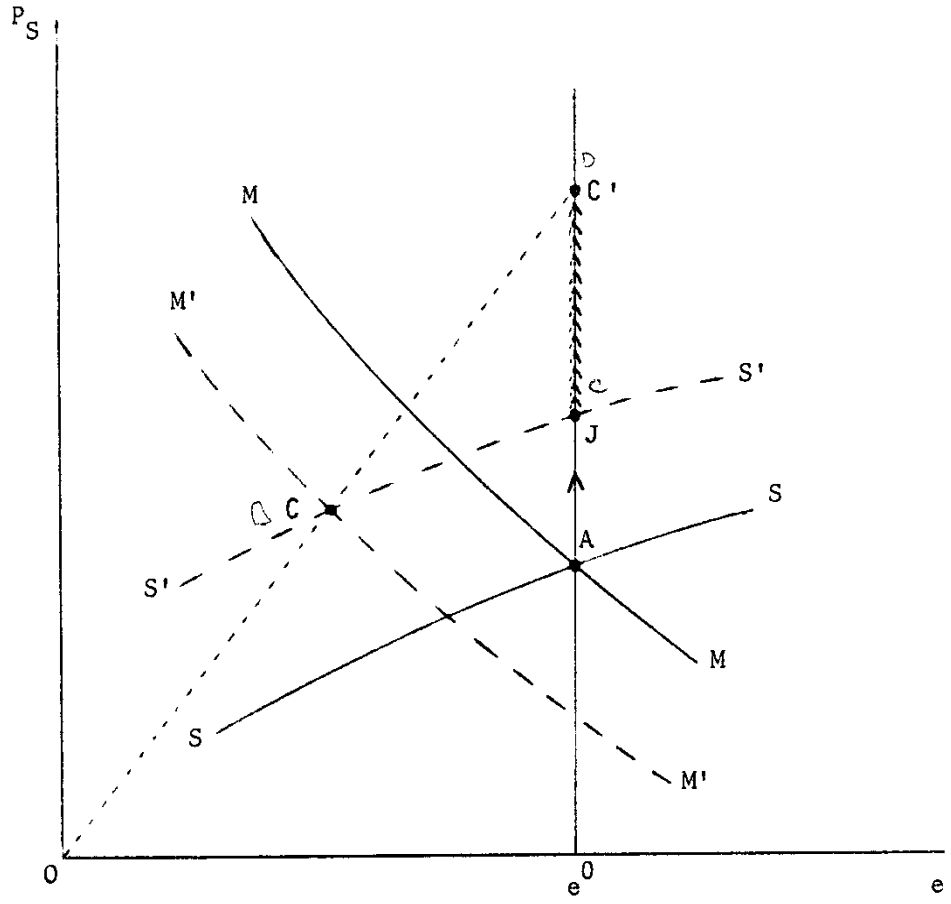

Figure 3: Effects of the Boom under Fixed and Floating Exchange Rates

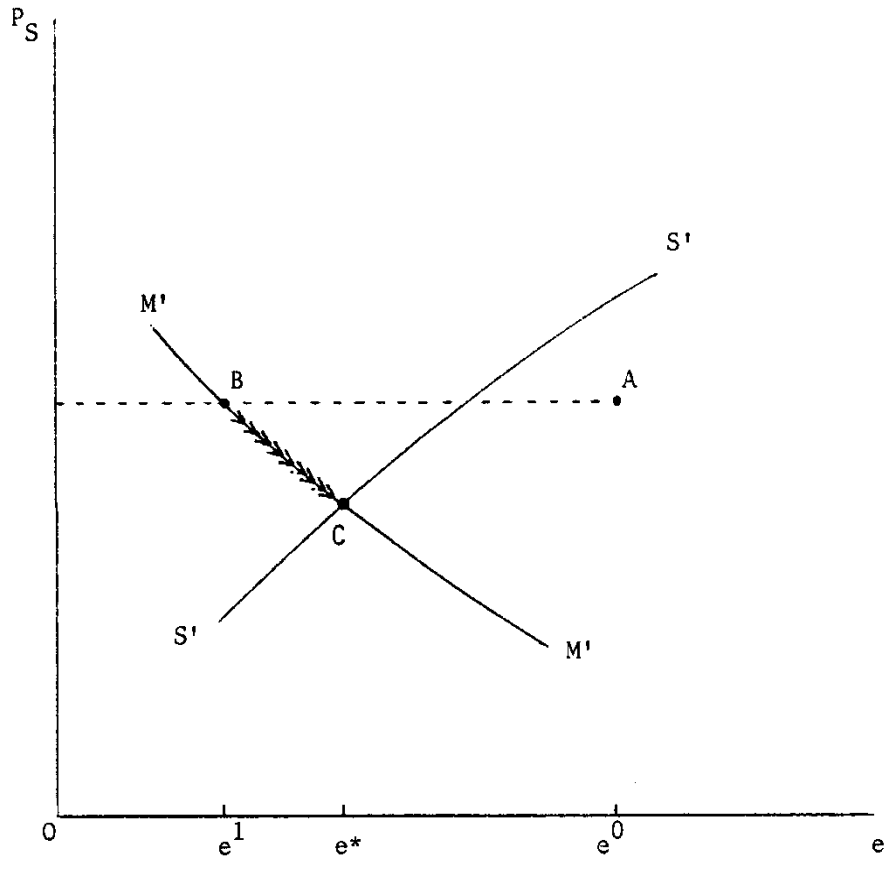

Figure 4: Exchange-Rate Overshooting Exacerbates the Dutch Disease