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2 Sterling Misalignment and British Trade Performance

Charles R. Bean

2.1 Introduction

The possibility of Britain's participation in the Exchange Rate Mechanism of the European Monetary System has once again been the subject of speculation. In many respects this would represent the quite natural outcome of a continued evolution towards a more pragmatic approach to the conduct of monetary policy which has increasingly emphasized a broader range of financial indicators, including the exchange rate. This retreat from the purist monetarist perspective of the early years of Mrs. Thatcher's administration has been prompted on one hand by the difficulties encountered in controlling the original target aggregate, £M3, and on the other by the excessive volatility of the exchange rate and accompanying swings in competitiveness. The aim of this paper will be, first, to try to shed a little light on the reasons for this exchange rate volatility and, second, to ask whether it has done any lasting damage to British industrial performance.

Table 2.1 presents data on the nominal and real exchange rate (measured by relative producer prices) since the advent of floating, together with a number of other macroeconomic indicators. The 17% nominal appreciation of sterling between 1978 and 1981 in particular stands out. Associated with this there was a 23% deterioration in competitiveness and a contraction in manufacturing output of 14%. While manufacturing output has since recovered somewhat as competitiveness has improved, it is still well below its 1978 peak. The reduction in overall economic growth is, by contrast, less pronounced, and national income now stands

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Table 2.1 **Selected Macroeconomic Indicators**

	Nominal Effective Exchange Rate (1975 = 100)	Relative Producer Prices (1980 = 100)	GDP at Factor Cost (1980 Prices, 1980 = 100)	Manufacturing Output (1980 = 100)	Gross Oil Production (1980 prices, as % of GDP)	Unemployment (U.K.) (%)	Retail Price Inflation (%)
1973	111.8	75.7	94.5	114.2	—	2.4	9.1
1974	108.3	75.7	92.9	112.8	—	2.4	16.0
1975	100.0	79.0	92.0	105.0	0.0	3.7	24.2
1976	85.7	74.2	94.4	107.0	0.5	5.0	16.5
1977	81.2	79.0	96.9	109.0	1.6	5.3	15.9
1978	81.5	81.7	99.7	109.7	1.8	5.2	8.3
1979	87.3	89.4	102.4	109.5	2.7	4.8	13.3
1980	96.1	100.0	100.0	100.0	3.7	6.0	18.1
1981	95.3	100.8	98.7	94.0	4.9	9.3	11.9
1982	90.7	97.7	100.3	94.2	6.2	10.9	8.7
1983	83.3	91.0	103.8	96.9	6.3	11.9	4.6
1984	78.8	87.7	106.7	100.7	7.2	12.4	5.0
1985	78.7	90.0	110.5	103.9	6.7	12.9	6.1

Sources: Central Statistical Office, *Economic Trends Annual Supplement 1987* and *Petroleum Economist*.

more than 11% above its 1979 value. Unemployment, however, has risen remorselessly and only very recently has shown signs of falling.

While the facts of the recession are clear, its causes are open to debate. The appreciation of sterling and the associated squeeze on the tradable sector could be the result of at least two forces. First, it coincided with the adoption of contractionary fiscal and, more particularly, monetary policies by the newly elected Conservative administration. In a world of sluggish wage or price adjustment, an unexpected reduction in monetary growth is likely to produce an initial overappreciation of the exchange rate and a contraction that is concentrated in the tradables sector (see Dornbusch 1976 and Buiter and Miller 1981a, for instance). Buiter and Miller (1981b) cite this as a primary cause of the downturn beginning in 1979. On this explanation the appreciation of sterling was a temporary misalignment associated with the transition to a new, low-inflation, growth path.

The second explanation lays the blame on sterling's growing importance as a petrocurrency. The figures for gross oil production in table 2.1 show that between 1978 and 1982 the share of oil increased fourfold.[1] Indeed, by 1985 the United Kingdom, with 6% of free-world output, had become the fourth largest producer in the non-Communist world, after the United States, Saudia Arabia, and Mexico. In the space of ten years, the United Kingdom had been transformed from total dependence on imported oil into a significant net oil exporter. Further, the doubling of oil prices in the wake of the Iranian revolution significantly increased the value of this oil wealth. The "Dutch disease" literature suggests that the discovery and exploitation of such natural wealth will require an appreciation of the real exchange rate if the benefits of the resource discovery are to be enjoyed. The result will be a contraction in the output of nonoil tradables coupled with an expansion in nontradables production. Forsyth and Kay (1980), among others, have attributed the strength of sterling at the start of the 1980s to the importance of oil. On this explanation the appreciation of the exchange rate represented a reassessment of underlying fundamentals, rather than a temporary misalignment, and the accompanying unemployment was a purely temporary phenomenon associated with the process of structural change.[2]

In an attempt to disentangle the relative importance of these two explanations for the dramatic movements in the real exchange rate, I have conducted a few counterfactual simulations with a small empirical macroeconomic model of the United Kingdom. The results, presented in the first part of the paper, suggest that the presence of oil and the second oil price shock can account for something like a 12-percentage-point appreciation of both nominal and real exchange rates between 1978 and 1980. Contractionary monetary policy alone does not seem capable of explaining the rest, however. A combination of restrictive monetary policy and adverse supply-side movements can, on the other hand, provide an explanation of both the appreciation and the rise in unemployment.

Whatever the causes of the appreciation, it still prompts questions about the magnitude of the costs imposed on the economy. To the extent that demand and activity are transitorily reduced below equilibrium levels, there is a temporary welfare loss. However, temporary fluctuations in exchange rates may well have permanent effects on the economy. Such hysteresis effects have recently attracted attention in the context of labor markets (see Blanchard and Summers 1986, Gregory 1986, and Lindbeck and Snower 1986, for instance). In these models the current "natural rate" of unemployment may depend on the past history of the unemployment rate; for example, because the currently employed ("insiders") do not take account of the wishes of the unemployed ("outsiders"), or because firms use the unemployment history of a worker as a screening device, or simply because the human capital of the unemployed depreciates.

Similar hysteresis effects could arise in traded-goods markets for a number of reasons. On the demand side, customers may develop brand loyalty through purchasing a commodity and thus be more inclined to repeat the purchase. On the supply side, producers may experience significant costs in entering export markets, for example, in setting up distribution networks (see Baldwin and Krugman 1986) or more generally in increasing their market share. Once producers have left the market it may be difficult to reenter. In the face of a temporary appreciation, producers may then be inclined to cut margins and even incur losses in order to maintain market share. Both casual empiricism and the available aggregate data suggest that this was indeed the case during the 1979–82 period.

The view that hysteresis effects may be important in traded goods markets has also been voiced by industrialists themselves. Thus Vickers, in giving evidence to a House of Lords Select Committee set up to investigate the decline in British manufacturing, expressed the view that "The withdrawal by the UK from a number of important sectors of manufacturing industry represents a permanent loss to the UK economy. . . . Once a company, or country, has opted out of a particular industry it is virtually impossible ever to reenter."

The second half of this paper supplements this superficial evidence of the importance of hysteresis effects with econometric evidence concerning U.K. export performance since 1900. I find evidence of such effects on both the demand and supply side of the market. The paper concludes with a brief discussion of some of the policy implications.

2.2 The 1979–81 Appreciation: Oil or Tight Money?

It is not my intention to provide a comprehensive survey and assessment of the Thatcher years in general and the 1979–81 recession in particular. That has been done by others, for example, Buiter and Miller (1981b, 1983) and Matthews and Minford (1987). Rather I want to focus on the behavior of the exchange rate, supplementing existing, often informal, discussions with some pseudoeconometric evidence from a small annual macroeconometric model of the United Kingdom. The model lies somewhere between the small analytical and numerical simulation models with plausible parameter values on the one hand, and the large empirical macroeconomic forecasting models on the other. The former frequently lack realism, while the latter often lack theoretical coherence. It is not possible here to give a complete description of the model and of the econometric estimates, which are fully reported in Bean, Dinenis, and Probyn (1985), but a brief overview follows. The linearized version used for the simulations is, however, reported in full in the Appendix.

2.2.1 An Overview of the Econometric Model

The model is best thought of as a more developed version of the rational expectations with sluggish wage-price adjustment models in the tradition of Dornbusch (1976), Blanchard (1981), and Buiter and Miller (1981a). Supply is disaggregated into three sectors: manufacturing (corresponding to nonoil tradables), nonmanufacturing (corresponding to nontradables), and oil and gas (exogenous). Firms operate in a monopolistically competitive environment treating factor prices, initial holdings of inventories, and the capital stock as given. Technologies are of the CES variety. On the basis of factor prices and expectations about the level of demand and competitors' prices, they choose appropriate levels of factor inputs, price, and output. The elasticity of demand, and hence the mark-up, is constant. If sales expectations are not realized, then there is an unanticipated buildup or rundown of inventories of finished goods. There is no rationing in the goods market.

The wage equation, which thus determines the level of unemployment via labor demand, is of the Sargan (1964) real-wage-resistance type. Consequently, changes in the wedge between the consumption and product wage will affect the NAIRU. However, in the short run the nominal wage is predetermined, and an acceleration in inflation will produce a fall in real wages.

Domestic demand comprises consumption, investment, and government spending, which is exogenous. The consumption function is based on a standard life-cycle permanent-income model, implicitly with backward-looking expectations formation. It relates consumption to post-tax nonproperty income, interest rates, and net worth (including housing). A noteworthy feature of the results is the very strong negative impact of nominal rather than real interest rates (see Bean 1987, which also reports tests of Ricardian debt neutrality). This appears to be a rather robust feature of the data. It presumably reflects the interaction of credit rationing effects with the increased front-end loading of real mortgage repayments as interest rates rise (see Jackman and Sutton 1982).

Investment depends on "Tobin's Q," but the equations are rather novel in incorporating time-to-build lags. These make investment a function, not of the current real stock price, but of lagged expectations of the current stock price (see Dinenis 1985).

To obtain the demand for domestically produced goods, two further equations are added describing the split of domestic and foreign demand between domestic manufacturing, domestic nonmanufacturing, and foreign producers. The arguments in these equations are the various relative prices, as well as domestic and foreign demand.

The financial sector of the model comprises a conventional demand for (outside) money equation and a series of arbitrage relationships equating short-term interest rates with the expected returns on long bonds, equities, and foreign assets. Rational expectations in asset markets are assumed throughout.

The model was estimated on postwar annual data by both single equation and systems instrumental variables techniques. The complete model has 25 state variables, 21 of which are predetermined and 4 of which are non-predetermined (the exchange rate, the long interest rate, and manufacturing and nonmanufacturing stock prices). The simulations reported here were carried out using Buiter and Dunn's (1982) SADDLEPOINT program for simulating linear rational expectations models, which itself is based on the methods of Blanchard and Kahn (1980).

2.2.2 North Sea Oil

I start by considering the impact of oil on the exchange rate. However, before presenting the numerical results, it is worthwhile briefly summarizing the salient points of the theoretical literature (see Bean 1987 for an extensive bibliography). This falls into two parts, one of which deals with the medium- and long-term equilibrium implications, and the other of which deals with the problem of short-run adjustment when factor markets do not clear.

As far as the equilibrium implications are concerned, there are two primary channels through which the discovery of a natural resource affects the economy. The first is via a spending effect, whereby the resulting increased demand for consumer goods falls partly on nontradables and domestically produced tradables. The result is a rise in the price of nontradables to tradables and, if domestic and foreign tradables are imperfect substitutes, an improvement in the terms of trade. Associated with this will be a shift in resources from tradables to nontradables production.

The second channel is a resource effect whereby changes in the demand for factors of production lead to changes in factor rewards and a consequent change in supply in different parts of the economy. The magnitude and direction of this effect depends critically on the mobility of labor and capital and the capital intensity of the industries involved. However, for the case of North Sea oil this channel is likely to be relatively unimportant, since oil extraction utilizes very little labor, and the required capital can be obtained from abroad.

As far as short-run adjustment is concerned, Eastwood and Venables (1982) have discussed the issue in a Dornbusch-style model. They point out that one would not expect the discovery of oil to lead to a general recession because the requisite deterioration in competitiveness occurs instantaneously via a nominal exchange rate appreciation rather than domestic price adjustment. Only if there is a lag between discovery and the resulting increase in demand will a recession occur, because forward-looking behavior in exchange markets brings forward the competitiveness deterioration ahead of the increase in demand. In view of the backward-looking nature of the consumption function in the model used for the simulations and the fact that the government did not deliberately cut taxes and increase the budget deficit ahead of extraction, this is an important proviso.

Table 2.2 presents the results of a counterfactual simulation designed to answer the question: How did the discovery of oil and the increase in oil prices affect the exchange rate and the level of activity? In the base case oil production is set to zero, and real oil prices are held at their 1973 level. The table then gives the percentage changes in some key variables from this base scenario as a result of the discovery of oil and the two oil price hikes. I have assumed that the volume of reserves and production were correctly evaluated (their value, net of extraction costs, varies with the oil price and the exchange rate and is assumed to be zero prior to the first oil price shock); each of the two oil price shocks were unanticipated and regarded as permanent; real government spending and tax rates are kept constant (so the budget deficit and the stock of government debt vary endogenously); monetary

Table 2.2 **Effects of North Sea Oil and Oil Price Shocks (Percentage Changes)**

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Nominal exchange rate	6.2	7.0	7.4	8.4	9.5	10.6	22.7	23.4	24.3	24.6	25.0
Real exchange rate	8.2	7.7	7.1	7.2	7.4	7.9	19.3	19.5	20.4	20.7	20.7
Manufacturing employment	1.0	−2.0	−0.5	−0.1	−0.1	−0.2	1.3	−1.8	−1.4	−1.7	−1.7
Services employment	−1.0	−0.5	−0.8	−0.7	−0.6	−0.5	0.3	1.0	1.2	1.1	1.1
Consumer price inflation	1.2	−1.1	−1.2	−1.0	−0.8	−0.7	−1.9	−0.5	0.0	−0.1	−0.1

policy is nonaccommodatory; and effects on world activity and interest rates are ignored. The assumptions on fiscal and monetary policy are certainly debatable, but it is not clear what other assumptions would be more appropriate.

Turning to the figures themselves, we see that the effect of the second oil price shock is to produce an 11% appreciation of the real exchange rate (12% nominal) in 1980, that is, it explains a little less than half of the real appreciation that actually occurred. This is in the same ball park as many previous estimates (see Bean 1987 for a survey), although rather smaller than those furnished by Forsyth and Kay in their seminal piece. There is no subsequent depreciation, but this is because the real oil price has been held constant after 1980. In practice, of course, it has now roughly halved. The model suggests that a permanent 10% fall in oil prices produces a real depreciation of 1.25%, so that around a 7% real depreciation since 1981 could be expected from the subsequent decline in oil prices. The simulation also displays an Eastwood-Venables-style recession in the interregnum between discovery and exploitation. In the post-1980 period, when most fields had come on stream, we find the classic Dutch-disease scenario of a contraction in manufacturing output and an expansion in services employment. (The rather peculiar increases in manufacturing employment in 1974 and 1980 are due to the fact that the model treats oil and labor as substitutes in production and that a deterioration in competitiveness only affects demand with a lag—a somewhat dubious property of the model.) Thus while the discovery and exploitation of oil and sterling's status as a petrocurrency help to explain the decline in manufacturing, they do not seem to adequately explain the overall increase in unemployment. One possibility is that the model simply underestimates the problems of absorbing unemployed workers from manufacturing into the services sector because of skill and regional mismatch. The other explanation lies in the contractionary policies pursued by the Conservative government, a question to which I now turn.

2.2.3 Monetary Policy and the Exchange Rate

The 1980 appreciation of sterling is frequently attributed to the adoption of a more restrictive monetary stance by the authorities as part of a wider counterinflationary strategy involving both a reduction in government expenditure and a reduction in the government deficit. Buiter and Miller (1981b) provide an eloquent exposition of this viewpoint. If inflation adjusts sluggishly, a reduction in monetary growth will, they claim, lead to an increase in domestic real interest rates and a temporary appreciation of the real exchange rate. On this view, the reduction in current and future monetary growth announced as part of the government's Medium Term Financial Strategy (MTFS) provided the immediate catalyst for the appreciation of sterling and the attendent recession (contractionary fiscal policy had a role to play here as well). Buiter and Miller attribute the lion's share of the blame here and ascribe only a subsidiary role for oil.

How well does this story stand up? To begin with, there is some debate over whether monetary policy was indeed contractionary. As table 2.3 makes clear, the growth of £M3, the government's chosen target aggregate, was actually fairly rapid through 1980 and 1981, and certainly well above the target ranges of 7–11% and 6–10%, respectively. However, the growth rate of M1, and especially the monetary base, was much more modest. Coupled with the rise in short-term interest rates that occurred, it is difficult not to believe that some monetary deceleration had taken place and that the disparate signals given by the various monetary aggregates was the result of innovations taking place within the financial sector (such as changes in the saving behavior of the private sector and in the pattern of corporate finance). The ex post reduction in nominal GDP growth also supports this view.

While it is not difficult to sustain the argument that a monetary deceleration had indeed occurred, the consequences of it are more debatable. Buiter and Miller (1983) note that there are problems in their earlier view inasmuch as the ex post real interest rate differential actually moved significantly against the United Kingdom in this period (see table 2.4).[3] Further, the question arises as to whether there is enough nominal rigidity in the economy to explain the facts.

Table 2.4 presents the estimated effects on the same set of key variables of the (unanticipated) introduction of a disinflationary program in which the rate of monetary growth is reduced by 1 percentage point per year for five years (starting in 1980), after which the rate of monetary growth is permanently lower by 5 percentage points. This sort of gradualist approach represents the intention, if not necessarily the execution, of the monetary side of the MTFS. It is assumed that the program is credible, so that agents in financial markets, who are endowed with rational expectations, correctly foresee the implications. This is not, of course, true of wage bargainers who have backward-looking inflationary expectations. The nominal exchange rate appreciates 17% on impact, but the real exchange rate appreciation is a more modest 9%. The overshoot predicted by the Dornbusch-Buiter-Miller approach is present, but it is not very pronounced. More noticeable is the significant reduction in inflation and a modest expansion in overall employment (although manufacturing employment shows a small decline after the first year as J-curve effects work through). The reason for this is that although there is a degree of nominal inertia in the wage equations, it is really not that significant. Wage demands moderate

Table 2.3 **Selected Monetary Indicators**

	Rate of Growth of Monetary Base	Rate of Growth of M1	Rate of Growth of £M3	3-Month Interest Rates	Rate of Growth of Nominal GDP	Ex Post Real Interest Differential
1978	15.0	16.3	15.6	11.9	15.4	—
1979	10.1	9.1	13.2	16.5	15.1	1.4
1980	5.6	4.0	18.7	13.6	16.4	7.4
1981	1.1	11.0	13.5	15.4	9.2	2.5
1982	3.8	11.3	14.6	10.0	8.5	−0.3
1983	6.4	8.4	5.9	9.0	9.2	—

Sources: Financial Statistics (various issues), *Economic Trends Annual Supplement,* 1987, and Buiter and Miller (1983).

Table 2.4 **Effects of Progressive Reduction in the Rate of Monetary Growth (Percentage Changes)**

	1980	1981	1982	1983	1984
Nominal exchange rate	17.2	21.9	25.8	31.0	36.4
Real exchange rate	9.2	7.7	7.9	7.0	7.0
Manufacturing employment	1.2	−1.1	−0.6	−0.6	−0.8
Services employment	0.5	1.2	1.5	1.8	1.9
Consumer price inflation	−9.0	−5.2	−5.3	−5.3	−5.4

along with the fall in import prices, resulting in a further fall in consumer prices and a decline in nominal interest rates. Because nominal rather than real interest rates influence consumer demand (see above), the latter actually rises. A long-run real appreciation is necessary to accommodate this increase in consumer demand. While the simulation therefore goes some way to explaining the behavior of the exchange rate, it does not seem to capture the rise in unemployment. Thus, on the basis of this simulation at least, monetary policy does not seem capable of bearing the full weight of the story.[4]

A central feature of the argument is obviously the low degree of nominal inertia in wage-setting behavior. A considerable amount of recent research has confirmed the view that the European economies in general, and the United Kingdom in particular, suffer from real, rather than nominal, wage rigidity (see for instance Branson and Rotemberg 1980, Grubb, Jackman, and Layard 1983, and Newell and Symons 1986). Indeed, Layard and Nickell (1986), in one of the most complete recent studies of United Kingdom labor market behavior, actually find no nominal inertia whatsoever in their annual wage equation. If anything, the degree of nominal inertia present in the model used here is actually rather greater than independent evidence suggests.

Of course one can always appeal to Lucas critique type arguments for doubting the relevance of econometric estimates for simulating policy shifts in the face of a change in regime. However, one would normally have expected them to overstate, rather than understate, the amount of nominal inertia in the face of an announced, credible, program of disinflation. I am therefore rather inclined to discount this explanation.

An alternative view is to lay the blame not solely at the door of restrictive monetary policy, but to a combination of restrictive monetary policy and adverse developments on the supply side. The winter of 1978–79 saw the breakdown of the Labor government's "social contract" with the unions and a wave of strikes, particularly in the public sector, resulting in significant wage increases for large groups of workers. While this winter of discontent was a major political factor leading to the election of Mrs. Thatcher, the Conservatives agreed to honor the increases granted to public sector workers. This in turn led to further private sector wage demands, and the result was a significant acceleration in the growth of average earnings from an annual rate of 12.3% over 1976–78 to 17.2% over 1978–80. The growth in real earnings was less marked—around 2% in 1979 and 1980—but since then the real incomes of those in work have continued to rise, along with the level of unemployment.

Layard and Nickell (table 10) estimate that between 1975–79 and 1980–83 the NAIRU rose by around 2 percentage points, a significant part of which is attributed to the breakdown in incomes policy, a resurgence in union militancy, and increased structural mismatch. Now one would expect an adverse movement in aggregate supply such as this to lead not only to a decline in employment, but also to a crowding out of net exports via an appreciation of the real exchange rate. Table 2.5 therefore reports the effects of a permanent fall in the NAIRU of 2 percentage points, starting in 1979. The result is a 12% appreciation of both real and nominal exchange rates (with a small overshoot), as well as a decline in employment which is heavily concentrated in the traded goods sector.

I conclude from this that while the monetary contraction alone does not seem to be a major factor behind the sterling appreciation, a combination of tight monetary policy and a deteriorating supply-side position can explain a real appreciation of upwards of 12%, to add to the 12% or so attributed to oil. Together this is of the same order of magnitude as that actually experienced. Most of this movement is, however, due to changes in underlying fundamentals, and only a very small part represents a temporary misalignment due to Dornbusch-style overshooting.

However, aside from any qualms one might entertain about the model—and there are many—one must also feel rather uncomfortable with this sort of ex post historical exercise, because there are just too many degrees of freedom around in the way of exogenous shocks and expectations of future variables to impose much discipline on the researcher. By a judicious choice of these, one can always fit the facts.

Table 2.5 **Effects of a 2 Percentage Point Increase in the NAIRU (Percentage Changes)**

	1979	1980	1981	1982	1983
Nominal exchange rate	11.6	11.1	10.1	9.5	9.2
Real exchange rate	11.6	12.4	11.9	10.4	9.6
Manufacturing employment	−1.1	−5.2	−4.9	−4.3	−4.1
Services employment	−0.8	−1.7	−2.4	−2.6	−2.4
Consumer price inflation	−1.2	1.1	0.3	−0.3	−0.5

Consequently I remain cautious about the conclusion that overshooting due to the monetary contraction was not a major feature of the appreciation. Rather the results represent just a little bit more evidence to add to the growing pile on exchange rate misalignment and the economic consequences of Mrs. Thatcher.

This analysis ignores the possibility of a misalignment other than as a result of the interaction of a contractionary monetary policy and nominal inertia. An alternative viewpoint is that the appreciation of sterling was simply the consequence of a bubble (rational or otherwise). There is now an extensive empirical literature rejecting uncovered interest parity (see, e.g., Fama 1984 and the references therein), although the absence of a well-formulated alternative hypothesis makes it difficult to know how bad an assumption it is or how to interpret the findings of Meese and Rogoff (1983) that a random-walk model of the exchange rate seems to dominate any other explanation. Evans (1986) does, however, report evidence that at least in the 1981–84 period the sterling-dollar rate was subject to a bubble, and Meese (1986) also reports evidence suggesting that both the sterling-dollar and dollar-deutschemark rates have been subject to bubbles since the advent of floating. Finally, Frankel and Froot (1985) construct an account of the 1981–84 period, which in part relies on irrational speculation. Consequently it would be rash to conclude that the greater portion of the 1979–80 sterling appreciation was necessarily a response to movements in fundamentals. While a bubble could account for the behavior of the exchange rate, however, it does not simultaneously seem capable of explaining the concomitant rise in unemployment given the limited nominal inertia in wage setting.

2.3 Permanent Effects from Transitory Exchange Rate Fluctuations

Whatever the cause of a movement in the real exchange rate, it will usually be accompanied by changes in the real economy. The 1979–81 real appreciation has now been largely reversed, but the possibility remains that it may have had a lasting impact on British trade performance. In this section I shall examine the empirical evidence for such hysteresis effects.

2.3.1 Demand Effects

Quotes like that of Vickers in their evidence to the House of Lords Select Committee and the observation that industrialists attach a great deal of significance to maintaining their market share suggest that hysteresis effects in goods markets are likely to be important. Within the industrial organization literature there is a considerable body of work discussing the advantages that accrue to incumbent firms. On the demand side one can think of at least three arguments as to why hysteresis effects might arise. First, incumbents may produce such a wide variety of differentiated products that it may be difficult for new entrants to find a niche (Schmalensee 1978). Second, uncertainty about product quality may lead consumers to stick with products that they have already purchased, rather than trying out the brands of new firms (Schmalensee 1982). Finally, there may be significant costs in some industries in switching suppliers (Klemperer 1987). All of these suggest that the demand for a firm's product may depend on its previous level of sales.

Rather than subscribe to any one particular theory for such state dependence, I shall use an eclectic, although rather ad hoc, approach and simply assume that consumer tastes are related to the past history of consumption. To motivate matters, suppose a representative consumer's tastes over the domestic product, X, and the foreign product, X^*, are given by:

$$(1) \qquad U = A(X_{-1})X^{\rho} + B(X^*_{-1})X^{*\rho} \qquad (\rho < 1)$$

with A', B' >0. Then, assuming the consumer ignores the effect of current choices on future tastes,[5] the relative demands are given by:

$$(2) \qquad (X/X^*) = (A/B)^{\sigma}(P^*/P)^{\sigma}$$

where P and P^* are the prices of the two products and $\sigma = 1/(1 - \rho)$ is the elasticity of substitution. It remains to parameterize A and B. It is convenient to write $A = A_0X^{\theta}$, $B = B_0X^{*\theta}$, in which case:

$$(3) \quad \Delta(x - x^*) = \sigma (a_0 - b_0) + \sigma(p^* - p) + (\sigma\theta - 1)(x_{-1} - x^*_{-1})$$

where Δ denotes the difference operator and lowercase letters will henceforth be used to denote logarithms. Thus when $\theta = 1/\sigma$, we have pure hysteresis, and a transitory increase in the relative price of X will have a permanent effect on its share.

Because we are interested in the question of whether transitory shocks have durable effects, it makes sense to look at evidence over as long a time period as possible. Confining attention to just a few years of data is likely to severely limit the precision with which one can make inferences about such long-run effects. Further, very short-lived fluctuations, for example, lasting a month or so, are unlikely to affect trade permanently, because they can be insured against in the forward market. Rather one is interested in the effect of movements that last, say, a year or two. To this end I shall present estimates using (annual) data on British export performance going back to the beginning of the century taken from Alford et al. (1971). Although the arguments above could equally well apply to the home market, attention is restricted to export markets, because it is impossible to disaggregate the imports of goods data for most of the period between raw materials and intermediate inputs on the one hand and finished goods on the other. By contrast, British visible exports are almost exclusively finished goods (prior to North Sea oil) and hysteresis arguments seem most relevant to this market.

Thus X is the volume of British nonoil visible exports, while as a proxy for X^*, consumption of foreign products in the rest of the world, I use United States GNP (consumption of British products is, of course, only a tiny fraction of this). P is the associated UVI (AVI prior to 1950) converted into dollars at the prevailing exchange rate, whilst P^* is the dollar UVI for world manufactured exports (UN series). Since much of British trade in the early years of the century was concentrated in the colonies and more latterly has been directed to Europe, the use of U.S. data to proxy X^* is obviously less than perfect, but it is impossible to obtain a suitable world GNP variable for most of the period. However, to control for this and the changing structure of British export markets, I have included as an additional exogeneous variable, S, the share of exports to the United States in the total value of British exports. To control for the increasing integration of world markets since the Second World War, I have also included the ratio of world trade in manufactures to world manufacturing output, Z, (both UN series).

The ratio of United Kingdom nonoil exports to United States GNP is plotted in figure 2.1, while the price of United Kingdom exports relative to that of world manufacturers is plotted in figure 2.2. (Note that for convenience the series have been rescaled for the earlier periods.) Figure 2.2 reveals another benefit in looking at a long historical data set; while the 1979–80 appreciation is perhaps the most pro-

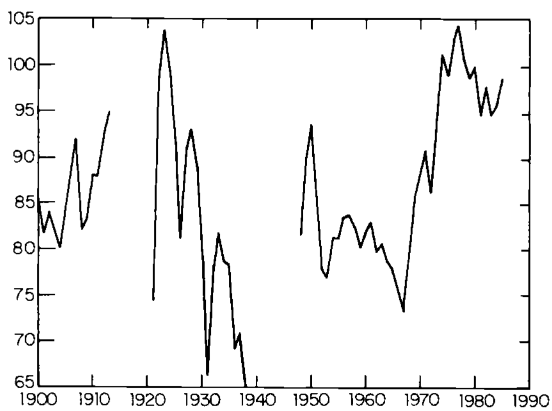

Fig. 2.1 U.K. export share.
Note: 1980 = 33 for data 1900–1913.
1980 = 66 for data 1921–38.
1980 = 100 for data 1948–85.

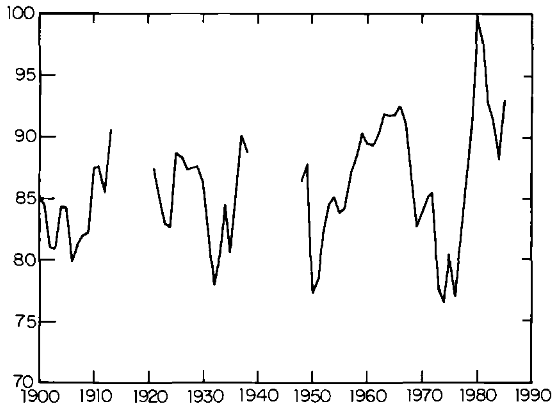

Fig. 2.2 Relative U.K. export prices.
Note: 1980 = 130 for data 1900–1913.
1980 = 100 for data 1921–38 and 1948–85.

nounced fluctuation, there are other periods when relative prices have moved quite sharply. Thus inferences are not likely to be unduly influenced by the experience of a single historical period (and moreover one when many aspects of both the British and the world economy were in a state of flux).

We begin by considering the stochastic properties of the various series in the demand equation. Table 2.6 reports the coefficient φ from the first-order autoregression:

$$(4) \qquad \Delta y = \text{constant} + \pi.\text{trend} + \varphi y_{-1}$$

where $y = x, x^*, x - x^*, p - p^*, s, z$. (In practice we also allow for different intercepts either side of the world wars.) Although the t-statistic on φ does not in fact have a t-distribution under the null hypothesis that $\varphi = 0$, it can nevertheless be used to test this hypothesis if the critical values reported in Dickey and Fuller (1981) are used instead. On the basis of these results, one would probably conclude that x, x^*, and z can reasonably be treated as nonstationary stochastic processes, while $x - x^*$, $p - p^*$, and s are best treated as stationary processes around a deterministic trend.

Having established this, it is then natural to ask whether x, x^*, and z are cointegrated. Two or more series, which are themselves nonstationary, are said to be cointegrated (Engle and Granger 1987) if some linear combination of them is stationary. It is clear from (3) that if $(p - p^*)$ is a strongly exogenous stationary stochastic process and $\theta = 1/\sigma$, then x and x^* cannot be cointegrated. Engle and Granger consider various ways of testing whether two or more nonstationary series are cointegrated. One procedure, which I follow here, is to regress one of the series

Table 2.6 **Stochastic Properties of Various Time Series**

Series	φ
x	−0.103
	(1.64)
$x*$	−0.119
	(2.08)
x-$x*$	−0.264
	(2.83)
p-$p*$	−0.278
	(3.02)
s	−0.334
	(3.77)
z	0.005
	(0.10)

Notes: Sample: 1901–13, 1922–37, 1949–85; t-statistics in parentheses.

on the others and then test whether the residual from that regression is stationary using either the Durbin-Watson statistic (it should be zero under the null hypothesis of no cointegration) or a Dickey-Fuller type test.

The results of carrying out this procedure are presented in table 2.7. Equation (1) gives estimates of the long-run relationship between x, x^*, and z, while equation (2) presents a Dickey-Fuller type test of whether the residual in equation (1), $\tilde{x}$, is stationary, as would be the case if x, x^*, and z are cointegrated. This test is based on the t-statistic of $\tilde{x}_{-1}$, although once again cognizance must be taken of the fact that it does not have a t-distribution when $\tilde{x}$ is a random walk, and that $\tilde{x}$ is also a generated regressor. Engle and Granger provide Monte Carlo evidence on the distribution of both the Durbin-Watson statistic in equation (1) (their ξ_1 statistic) and the coefficient on $\tilde{x}_{-1}$ in equation (2) (their ξ_2 statistic). Using their results we are able to accept, at the 95% level, the hypothesis that x, x^*, and z are indeed cointegrated.

However, the finding that x and x^* are cointegrated does not necessarily imply the absence of hysteresis effects in export markets if $(p - p^*)$ is not strongly exogenous. This may be seen by considering the following example. Suppose that the demand equation is given by:

(5) $$\Delta(x - x^*) = \alpha\,(p^* - p) + u \qquad (\alpha > 0)$$

where u is some stationary stochastic process, and supply is given by:

(6) $$(p^* - p) = \beta(x^* - x) + v \qquad (\beta > 0)$$

where v is another stationary stochastic process. Then it is straightforward to show that

(7) $$(x - x^*) = (u + \alpha v)/[(1 + \alpha\beta) - L]$$

Table 2.7 Cointegration Test for x, x^*, and z

(1)
$$x = -\underset{(0.88)}{0.65} + \underset{(3.93)}{0.62D_1} + \underset{(1.06)}{0.11D_2} - \underset{(0.46)}{0.0016t} + \underset{(5.86)}{0.854x^*} + \underset{(5.13)}{0.517z}$$

Sample period: 1900–1913, 1921–37, 1948–85;
Standard error (%) = 7.64; Durbin-Watson = 0.88.

(2)
$$\Delta\tilde{x} = \underset{(0.39)}{0.0029} - \underset{(4.72)}{0.481\tilde{x}_{-1}}$$

Sample period: 1901–1913, 1922–37, 1949–85;
Standard error (%) = 6.12; Durbin-Watson = 1.37.

Notes: t-statistics in parentheses. D_1 = 1 in 1900–1913 and 0 otherwise. D_2 = 1 in 1921–37 and 0 otherwise. $\tilde{x}$ is the residual from regression 1.

where L is the lag operator. Thus $(x - x^*)$ is a stationary stochastic process even though (5) exhibits a hysteresis effect.

Table 2.8 presents instrumental variable estimates of the export demand equation itself, treating the current relative price as endogenous. Since the United Kingdom is a small supplier at the global level, it seems reasonable to treat p^* as (weakly) exogenous, and so the additional instruments are those factors determining United Kingdom export prices vis-à-vis current and lagged values of wages and raw material prices, relative to the foreign price level, and (economywide) productivity. In addition there are the shift variables s and z, as well as a number of dummies to take account of special factors. These are a dummy for the impact of the general strike (1 in 1926, −1 in 1927); a dummy to take account of the 1972 dock strike (1 in 1972, −1 in 1973); a dummy to partial out the effect of the Korean war (1 in 1951 and 1952); and a dummy to partial out the effects of widespread introduction of restrictive trade measures at the onset of the Great Depression (0.5 in 1930 and 1 in 1931). One might expect this last effect to be picked up by the ratio of world trade in manufactures to world manufacturing output, z, which drops precipitously at this time, but it does not seem to capture everything. In addition, 1908 is clearly an outlier, for some unidentifiable reason, and a dummy taking the value 1 in 1908 and 0 elsewhere is also included. The coefficients on these dummies and the intercepts, which differ each side of the world wars, are omitted from table 2.8 for brevity. I have also generalized the dynamic structure slightly by introducing additional lags on the exogenous variables to produce an error-feedback model.

Table 2.8 **Estimates of Export Demand Equation (Dependent variable: $\Delta(x - x^*)$)**

Sample period: 1901–13, 1923–37, 1949–85.

	Equation (1)	Equation (2)
$\Delta(p^* - p)$†	0.388	0.386
	(2.34)	(2.53)
$(p^* - p)$†	0.267	0.255
	(2.86)	(2.79)
Δx^*	−0.636	−0.654
	(4.23)	(5.61)
x^*	0.055	
	(1.17)	
Δs	−0.016	−0.034
	(0.33)	(0.70)
s	−0.053	
	(1.32)	
Δz	0.216	0.151
	(2.07)	(1.47)
z	−0.029	
	(0.38)	
$(x - x^*)_{-1}$	−0.13	
	(1.46)	
Standard error (%)	3.25	3.23
Durbin-Watson	2.15	1.97
Serial Correlation ($\chi^2(2)$)	7.96	3.63
Instrument validity ($\chi^2(m)$)	7.76	12.75
	(m = 5)	(m = 9)

Notes: t-statistics in parentheses. A dagger (†) denotes an instrumented variable. Additional instruments are $(p_m - p^*)$, $(p_m - p^*)_{-1}$, $(w - p^*)$, $(w - p^*)_{-1}$, log (government spending + investment) − log (labor force), log (manufacturing productivity)$_{-1}$, $(p^* - p)_{-1}$. Coefficients on constants and dummies are omitted for brevity. The instrument validity test is due to Sargan (1964), and the LM test for serial correlation is due to Breusch and Godfrey (1982).

Equation (1) of table 2.8 reveals a statistically significant levels effect from relative prices, but the error-feedback term $(x - x^*)_{-1}$ is small in magnitude and rather insignificant. This is certainly very suggestive of a hysteresis effect. Equation (2) omits the error-feedback term, as well as the levels terms in x^*, z, and s. This is easily accepted ($\chi^2(4) = 4.99$) and the coefficient on the level of prices remains highly significant, implying that a transitory movement in relative prices has a permanent effect on the export share. The results in this column imply that each point-year of overvaluation of the exchange rate results in a permanent loss of export share of 0.25%. Thus a 20% overvaluation sustained for two years would result in a loss of share of 10%. This is a pretty large effect, and one might feel hesitant in pinning so much faith in the statistical significance of the error-feedback coefficient. However, even if one settles for equation (1), in which there are no long-run effects from transitory fluctuations in the real exchange rate, adjustment is still very slow—the mean lag is over five years—and from a practical point of view there may be little to choose between pure hysteresis and just very long lags.

2.3.2 Supply Effects

The possibility of hysteresis effects on the supply side of the goods market has been suggested recently by Baldwin and Krugman (1986). They show how significant fixed costs of entry into a market, for example, the cost of setting up a distribution network, can mean that large temporary exchange rate movements have permanent effects on the pattern of trade. To illustrate the argument, suppose the maximum level of profits the firm can earn at any point in time, π_t, is driven by a white-noise process, and the fixed entry cost is N. Let $V_I(V_o)$ be the expected present value to the firm of being in (out) of the market. Then the firm will enter if $\pi > \pi_I$ where $\pi_I = N + \delta(V_o - V_I)$ and δ is the (constant) real discount factor. Similarly the firm will exit if $\pi < \pi_o$, where $\pi_o = \delta(V_o - V_I)$. Clearly $\pi_I > \pi_o$. Thus a sufficiently large deterioration in profitability, for example, due to an overvaluation of the real exchange rate, may lead to profits falling below the critical level π_o and the firm leaving the market. However, it will only reenter if profitability recovers sufficiently to ensure that profitability exceeds the level π_I. If profitability was originally in the range $\pi_o < \pi < \pi_I$, a temporary deterioration in profitability will have a permanent effect. Thus a large temporary undervaluation may be necessary to restore the position ab initio.

A very similar story with essentially the same outcome as above could be told invoking the role of investment by incumbents in deterring entry (Dixit, 1980). Yet another argument for hysteresis effects on the supply side comes from the presence of technical progress through "learning-by-doing" (Kaldor 1966; Van Wijnbergen 1984). If the level of total factor productivity depends on past levels of output, then a fall in output today, due to, say, a loss in competitiveness, will lower productivity in the future and reduce supply for any given level of factor prices.

Baldwin and Krugman go on to consider how their argument is affected if there are many industries with different fixed entry costs and profitability and argue that aggregation will not eliminate or smooth away the discrete trigger feature of the model. Evaluating this model econometrically is not an easy matter, however, especially in the absence of data on entry costs. In order to capture the spirit, if not the letter, of this idea, I have therefore estimated a model of supply behavior in export markets in which producers incur adjustment costs in changing the level of exports, and these adjustment costs may be different according to whether exports are increasing or decreasing. Specifically, suppose a representative exporting firm solves the following problem:

$$\text{(8)} \quad \underset{\{X_s, K_s\}}{\text{Max}} \; E\left[\sum_{s=t}^{\infty} \delta^{s-t}\{P(X_s)X_s - c(X_s, W_s, P_s^M, K_{s-1}) - P_s^K \Delta K_s - g(\Delta X_s)\} \middle| \Omega_t \right]$$

where W is the wage, P^M is the price of raw materials, and P^K is the price of capital. $c(.)$ is a restricted cost function (excluding any adjustment costs) with the usual properties, while $g(.)$ is an adjustment cost function. Ω_t is the information set available to the firm. Then the associated Euler equation for X between t and $t + 1$ is simply (omitting t subscripts):

$$\text{(9)} \quad P(1 - 1/\sigma) = c' + g' - \delta E g'_{+1}$$

where σ is the absolute value of the price elasticity of demand (which will be assumed constant).

To render (9) operational econometrically, we need to parameterize the two components of the cost function. As far as marginal costs are concerned, I assume a Leontief technology in value-added and raw materials, while the value-added function is Cobb-Douglas[6] in labor, L, and capital, in which case:

$$\text{(10)} \quad c' = \alpha(WL/X) + \beta P^M$$

For the adjustment cost function I assume the following form:

$$\text{(11)} \quad g(\Delta X) = \begin{cases} P^*[\gamma^+ \Delta X + (\epsilon^+/2)(\Delta X)^2] & \text{if } \Delta X > 0 \\ P^*[\gamma^- \Delta X + (\epsilon^-/2)(\Delta X)^2] & \text{if } \Delta X < 0 \end{cases}$$

where $\gamma^+ > \gamma^-$ and $\epsilon^+ > \epsilon^-$ captures the idea that producers may face higher costs in entering new markets or expanding in existing ones than in exiting or contracting. It is natural to assume that such costs are incurred as expenditure abroad, and hence I have written them as proportional to P^* (which also serves to eliminate heteroscedasticity from the final estimating equation).

Finally, I assume that the real interest rate is small so that $\delta \approx 1$ to give:

$$\text{(12)} \quad P/P^* = \mu\alpha(WL/P^*X) + \mu\beta(P^M/P^*) - \mu\gamma E(\Delta D_{+1}) - \mu\epsilon E[\Delta(D_{+1}\Delta X_{+1})] - \mu\epsilon^- E(\Delta^2 X_{+1})$$

where $\mu = \sigma/(\sigma - 1)$, $\gamma = \gamma^+ - \gamma^-$, $\epsilon = \epsilon^+ - \epsilon^-$ and D is an indicator variable such that $D = 1$ if $\Delta X > 0$ and $D = 0$ otherwise.

The presence of the indicator variable complicates estimation a little, and I have adopted the following reasonable, but somewhat ad hoc, estimation strategy. First, suppose $\gamma = \epsilon = 0$. Then (12) can be estimated with standard instrumental variable techniques replacing $E(\Delta^2 X_{+1})$ by its realization $\Delta^2 X_{+1}$ and using elements of the information set Ω_t as instruments (e.g., McCallum 1976 and Wickens 1982). However, the projections of ΔD_{+1} and $\Delta(D_{+1}\Delta X_{+1})$ on Ω_t are nonlinear and in particular have the character of a switching regression model. On the basis that the asymmetric adjustment costs probably have second-order effects on the evolution of X, at least in the region of the null $\gamma = \epsilon = 0$, I have therefore constructed instruments for these terms as follows. First I projected ΔX_{+1} and ΔX on the information set to obtain $\widehat{\Delta X}_{+1}$ and $\widehat{\Delta X}$. I then constructed proxy indicator variables $\hat{D}_{+1}$ and $\hat{D}$ such that $\hat{D}_{+1} = 1$ if $\widehat{\Delta X}_{+1} > 0$ and 0 otherwise, and $\hat{D} = 1$ if $\widehat{\Delta X} > 0$ and 0 otherwise. Finally, $(\hat{D}_{+1} - \hat{D})$ and $(\hat{D}_{+1}\widehat{\Delta X}_{+1} - \hat{D}\widehat{\Delta X})$ were added to the instrument set.

I have not included the dummies added to the demand equation in either the regressor or instrument sets, on the grounds that the occurrence of strikes, wars, and so forth, is largely unpredictable, but in any case it makes little difference to the results. The measure of wages, W, is an earnings series relating to males in manufacturing, converted to dollars. However, since productivity in export (for which read manufacturing) industries (X/L) is unavailable for the full sample, I have proxied it by economywide productivity. Because current productivity may not be weakly exogenous in (12), I have also instrumented the current labor cost term (a full list of instruments appears in the table). The raw material price variable, P^M, is a series relating to worldwide primary product prices. (P/P^*), (WL/P^*X), and (P^M/P^*) have all been normalized to unity in 1980 to aid interpretation.

Equation (1) of table 2.9 presents estimates of the basic model. Since there is strong evidence of serial correlation, and the instruments are unlikely to be strongly exogenous, I have used the forward-filtering technique of Hayashi and Sims (1983), rather then conventional methods, to produce corrected estimates. Of course this serial correlation could be symptomatic of a variety of possible misspecifications, but it is rather difficult to relax the dynamic specification yet still retain the interpretability offered by the theoretical model.

Both ΔD_{+1} and $\Delta(D_{+1}\Delta X_{+1})$ have the a priori expected signs, although only the former borders on significance. There is thus some weak support for the idea of asymmetric adjustment costs. The coefficients on labor and raw material costs both seem plausible, but the equation diagnostics are only barely satisfactory.

Table 2.9 **Estimates of Export Supply Equation (Dependent variable: (P/P*))**

Sample period: 1901–12, 1922–37, 1949–84.

	Equation (1)	Equation (2)
(WL/P^*X)†	.937	0.212
	(23.61)	(1.36)
(P^M/P^*)	0.076	0.011
	(4.38)	(0.64)
ΔD_{+1}†	−0.031	−0.037
	(1.73)	(1.33)
$\Delta(D_{+1}\Delta X_{+1})$†	−0.002	−0.005
	(0.60)	(0.61)
$\Delta^2 X_{+1}$†	0.003	0.008
	(0.70)	(0.92)
$(P_{+1}X_{+1}/X)$†		0.761
		(4.91)
Standard error (%)	3.99	7.44
Durbin-Watson	1.38	1.89
Instrument validity $\chi^2(m)$	22.32 (m = 13)	7.08 (m = 12)
Serial correlation $\chi^2(2)$	–	5.47

Notes: t-statistics in parentheses. A dagger denotes an instrumented variable. Additional instruments are constant, trend, (W/P^*) × (government spending plus investment/labor force), $(WL/PX)_{-1}$, $(P^M/P^*)_{-1}$, X^*_{-1}, X^*, X^*_{-1}, S, S_{-1}, Z, Z_{-1}, $(\hat{D}_{+1} - \hat{D})$, $(\hat{D}_{+1}\widehat{\Delta X}_{+1} - \hat{D}\widehat{\Delta X})$. Equation (1) is estimated using the Hayashi-Sims (1983) forward-filtering technique with serial correlation parameter of 0.623.

This version of the model does, however, ignore the sort of hysteresis effects investigated in section 2.3.1. If firms realize that a loss of market share now will result in a lower level of demand, at given prices, in the future, then they presumably will take this into account in their current pricing behavior. In particular, suppose demand is given by equation (3). In that case, if the firm disregards any effect of its own actions on competitors' prices and output, the Euler equation (9) becomes:

$$(9') \qquad P(1 - 1/\sigma) + \delta\theta\, E(P_{+1}X_{+1}/X) = c' + g' - \delta E g'_{+1}$$

yielding:

$$(12') \qquad P/P^* = \mu\alpha(WL/P^*X) + \mu\beta(P^M/P^*) - \mu\gamma E\,(\Delta D_{+1}) - \mu\epsilon E[\Delta(D_{+1}\Delta X_{+1})] - \mu\epsilon^- E(\Delta^2 X_{+1}) - \mu\theta E(P_{+1}X_{+1}/X)$$

Equation (2) of table 2.9 therefore augments the basic model with a term in $(P_{+1}X_{+1}/X)$. This has the merit of eliminating the serial correlation, but unfortunately the new term turns out to have a (significant) positive rather than a negative sign. Clearly this casts some doubt on the validity of the theoretical model. However, the other coefficients remain generally consistent with the view that it is more costly to increase exports than to reduce them. Nevertheless, more work is required to provide convincing evidence of such effects.

2.3.3 Policy Implications

The models of sections 2.3.1 and 2.3.2 are somewhat different in their implications, in that the model of 2.3.1 can produce truly permanent effects from a transitory displacement of the real exchange rate (when $\sigma\theta = 1$). By contrast, the stationary long-run equilibrium in the model of 2.3.2 is independent of the form of the adjustment costs, which only affect the transition path, with adjustment being slower in an upward direction than in a downward direction. In that sense the implications are rather different from those of Baldwin and Krugman. However, whether transitory shocks really do have permanent, or just long-lived, effects seems largely immaterial in practice.

The welfare implications are harder to draw out, however, because they require some knowledge of the causes of the fluctuation in the real exchange rate. If it is the consequence of a bubble, say, or money wage rigidity coupled with a contractionary monetary policy, then state dependence in foreign trade merely perpetuates and accentuates the welfare losses due to the original market distortion. On the other hand, the moral is less clear if the fluctuations are due to changes in real fundamentals, such as the discovery of North Sea oil. For if private agents correctly perceive the future implications of current actions (and the quote by Vickers in the Introduction suggests they may do) then there is apparently no need for any special action by governments.

North Sea oil actually provides a very interesting example, since it in fact represents a temporary rather than permanent change in the United Kingdom's industrial structure. An obvious, and increasingly relevant, question is: What happens when the oil runs out some time early in the next century? Hysteresis effects may mean that the restoration of the status quo ante is not a viable option. This seems to suggest that subsidization of the nonoil tradables sector or a policy of encouraging a weak exchange rate is desirable. But if firms are aware of the problem and correctly internalize the costs of reentering foreign markets, the benefits of learning-by-doing, and so forth, there is no role for government intervention during the interregnum whilst the oil is extracted.

This is, I would argue, too sanguine a view, since it ignores market imperfections elsewhere in the economy. In particular, consumption-smoothing arguments dictate that the benefits of oil be shared with future generations, yet the available evidence does not seem to support such ultrarational behavior by households. As a result, the level of private consumption and the current real appreciation are likely to be excessive,[7] and net investment of the proceeds from oil by the government, either directly in real public or private sector capital or indirectly through a lower budget deficit, would seem to be called for. This would automatically limit the extent of any current real appreciation and the contraction in the nonoil tradables sector.

I conclude, therefore, that hysteresis effects in trade may be a cause for concern, not only when there are temporary misalignments due to irrational speculative behavior or sluggish adjustment of nominal wages, but also when the economy is subject to temporary real disturbances. The models and estimates of this section are admittedly crude in the extreme, but the results seem sufficiently promising (if that is the right word) to suggest that further empirical work, most probably at an industrial level, would be fruitful.

Notes

1. This slightly overstates the importance of oil, because extraction costs have not been deducted. However, since marginal operating costs in 1985 were around 25% of the output price, the bias is not that significant.

2. The subsequent depreciation can, of course, be attributed to the fall in real oil prices since 1980.

3. However, Branson (1983) in his comments points out that the force of this objection is much reduced if one treats the acceleration in inflation over 1979–80 as largely unanticipated.

4. Of course contractionary fiscal policy may have raised unemployment. I have carried out a simulation of the 1979 budget (a three-point cut in the standard rate of income tax, and an increase in VAT [value added tax] from 8.5 to 15% coupled with a 1% reduction in government expenditure in the first year and 2% thereafter). The consequence is a fall of 0.5 to 0.75% in employment, but concentrated entirely in services, and a real appreciation of 4%.

5. There is obviously a certain amount of irrationality about this, but I believe it is probably more realistic than the alternative of assuming that that consumer takes into account the effect of current purchases on his future tastes.

6. I have also experimented with CES technologies, but Cobb-Douglas seems to work as well as anything.

7. If households were ultrarational then they would increase current savings out of the windfall income from oil in order to finance higher consumption in

the future. This would automatically tend to limit the current appreciation of the real exchange rate and so eliminate any reentry problems.

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Appendix
Listing of the Macroeconomic Model

The equations of the log-linearized model are:

(1a) $pm = 0.19pe + 0.08pn + 0.73(wm + ty) + 0.17(ym - km_{-1}).$

(1b) $pn = 0.12pe + 0.6pm + 0.28(wn + ty) + 0.27(yn - kn_{-1}).$

(2a) $ym = 0.57c + 0.2g + 0.83(km - km_{-1}) + 2.06(kn - kn_{-1}) + 0.295(p^* + e - pm)_{-1} - 0.133sm_{-1}.$

(2b) $yn = 0.664c + 0.232g + 0.962(km - km_{-1}) + 2.38(kn - kn_{-1}) + 0.133(p^* + e - pm) + 0.376(pm - pn) - 0.072sn_{-1}.$

(3a) $(lm - ym) = 0.19pe + 0.08pn - 0.27(wm + ty) + 0.17(ym - km_{-1}).$

(3b) $(ln - yn) = 0.06pe + 0.32pm - 0.38(wn + ty) + 0.14(yn - kn_{-1}).$

(4a) $km = km_{-1} + 0.018E_{-1}qm.$

(4b) $kn = kn_{-1} + 0.0122qn + 0.0125E_{-1}qn.$

(5a) $sm = 0.974ym + 0.394sm_{-1}.$

(5b) $sn = 0.543yn + 0.667sn_{-1}.$

(6a) $\mathrm{E}qm_{+1} = i + pc - pc_{+1} + 1.05\,qm - 0.2ym + km - 0.929km_{-1}.$

(6b) $\mathrm{E}qn_{+1} = i + pc - pc_{+1} + 1.05qn - 0.374yn + kn - 0.925kn_{-1}.$

(7a) $wm = 0.73wm_{-1} - 0.21wm_{-2} + 0.79pc - 0.31pc_{-1} + 1.4l.$

(7b) $wn = 1.1wn_{-1} - 0.5wn_{-2} + 0.5pc - 0.1pc_{-1} + 1.2l.$

(8) $c = 0.94yp + 0.06a_{-1} - 0.45i.$

(9) $a = a_{-1} + 0.7i_{-1} - (pc - pc_{-1}) + 0.21(yp - c) + 0.09(qm - qm_{-1}) + 0.21(qn - qn_{-1}) - 0.7(i^L - i^L_{-1}).$

(10) $ws = 0.58ws_{-1} + 0.3(wm - pc) + 0.7(wn - pc) - 0.174(wm - pc)_{-1} - 0.406(wn - pc)_{-1} + 0.42l_{-1}.$

(11) $cg = 0.087(wm - pc) + 0.203(wn - pc) + 0.29rr - 0.94l.$

(12) $yp = 0.82ws + 0.18cg + \eta(xo + e - pc).$

(13) $Ee_{+1} = e + i - i^*.$

(14) $Ei^L{}_{+1} = 1.1i^L - 0.1i.$

(15) $m - pc = 0.24y + 0.48(m - pc)_{-1} - 1.3i.$

(16) $y = 0.3ym + 0.7yn.$

(17) $l = 0.3lm + 0.7ln.$

(18) $pe = 0.32(pr + e) + 0.16(po + e) + 0.16pm + 0.36pn.$

(19) $pc = 0.35pm + 0.55pn + 0.1(p^* + e) + tx.$

An *m* after a letter denotes a manufacturing variable while an *n* after a variable denotes a nonmanufacturing variable. The variables are:

a = real private wealth at end of period.
c = real private consumption.
cg = real current grants.
e = nominal dollar exchange rate (price of foreign currency).
g = real government spending.
i = nominal short-term interest rate.
i^L = nominal long-term interest rate.
ki = capital stock at end of period (i = m, n).
li = employment ($i = m, n$).
l = total employment.
m = nominal money stock.
pi = price of output ($i = m, n$).
p^* = price of foreign manufactures (dollars).
po = price of oil (dollars).
pr = price of nonoil raw materials (dollars).
pe = price of material inputs.
pc = consumer price index.
qi = Tobin's Q ($i = m, n$).
rr = replacement ratio.
si = stock of inventories at end of period ($i = m, n$).
tx = expenditure tax rate.
ty = income tax rate (including employers contributions).
wi = post-tax nominal wage ($i = m, n$).
ws = real post-tax wages and salaries.
xo = value of oil rents (dollars).

yi = output ($i = m, n$).
y = total (nonoil) output.
yp = private post-tax nonproperty income.

Equations (1), (2), (3), (4), and (5) determine prices, output, employment, the capital stock, and inventories in each sector. Equations (6) are arbitrage relationships determining stock prices, while equations (7) determine wages. Equation (8) is the consumption function, and equation (9) determines the level of real wealth as a function of stock prices, interest rates, and savings. Equations (10), (11), and (12) determine wages and salaries, current grants, and hence personal disposable income. The coefficient $\eta = 0.037$ when the United Kingdom is considered to be an oil producer and $\eta = 0$ when the United Kingdom is considered not to be an oil producer. Equation (13) is the uncovered interest parity condition, (14) is the arbitrage condition for long bonds, and (15) is a conventional demand for money function. Equations (16) to (19) are quasi-identities determining total output and employment and the price of inputs and consumer prices. All variables are in logarithms except the interest rates and Tobin's Q.

Comment Willem H. Buiter

This is a very interesting paper which opens up a range of important theoretical, empirical, and policy issues. In my comment I can only hope to explore the tip of this rather large iceberg.

The paper falls into two parts that are connected fairly loosely. In the first part, the linearized version of a small econometric model of the U.K. economy, specified and estimated by the author, is used to evaluate the contributions of monetary policy, the discovery and exploitation of North Sea oil, and a number of adverse supply shocks to U.K. economic performance over the period of 1978–81, with special reference to the real exchange rate. The second part is a theoretical and empirical exploration of the significance of hysteresis, or path dependence, in various dimensions of U.K. economic behavior, that is, of the phenomenon that temporary shocks may have permanent consequences. Weaker interpretations of this concept characterize as hysteretic any high degree of persistence of shocks to the demand for and supply of U.K. output, to equilibrium output, to the trade balance, and so forth. I discuss these two main sections of the paper in turn, after some brief comments on the econometric model.

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The Model

The econometric model is a IS-LM, aggregate demand–aggregate supply model with rational expectations in the (efficient) financial asset markets, some real and financial asset dynamics, and a rather rich supply side. The three-sector model of production distinguishes a manufacturing sector, a nonmanufacturing sector, and an oil sector. The manufacturing-nonmanufacturing split corresponds to the traditional traded-nontraded goods distinction. Oil production is exogenous. Apart from the familiar caveat that many of Britain's services are highly traded (financial, shipping and other international transportation, tourism, education, etc.) this sectoral disaggregation is appropriate and important for understanding the recent behavior of the U.K. economy.

The government budget identity is not considered explicitly. This can be justified on the grounds that, in the model, the U.K. economy is specified as a small open economy on the financial side. Capital mobility is perfect, interest-bearing financial claims at home and abroad (including government debt) are perfect substitutes, and the world rate of interest is taken to be parametric. These assumptions are appropriate, however, only if the U.K. government is, and is perceived to be, solvent. If current and prospective future deficits imply some risk of partial or complete repudiation or default, the assumption of a perfectly elastic world supply of funds schedule will cease to be correct. It should therefore be checked, in the simulations, that the behavior implied for public debt and deficits is indeed consistent with solvency. Cuts in tax rates that are never (expected to be) reversed or balanced by future spending cuts or increases in future seigniorage are, for example, likely to be inconsistent with solvency (pace the Laffer curve and/or "fiscal increasing returns").

The Sterling Real Exchange Rate 1979–81

Between 1978 and 1981, sterling's real exchange rate (as measured by relative producer prices) appreciated by 23%. Using different price or cost indices, the real appreciation (and the subsequent real depreciation) can be made to look even more dramatic, reaching over 40% for the IMF's series for normalized relative unit wage costs in manufacturing.

Four possible causes of this appreciation can be distinguished: monetary policy shocks, fiscal policy shocks, oil, and adverse supply shocks.

In spite of the erratic and high growth rates of the U.K. government's initial monetary target, sterling M3, there can be little doubt that money became tight in Britain shortly after the new Conservative administration assumed office in 1979. The degree of tightening, actual and expected, remains hidden in the entrails of the behavior of the narrow monetary aggregates (M_0 and M_1), nominal and real interest rates, and so forth. It would of course be improper to infer the degree of monetary tightness from the behavior of the exchange rate if our aim is to assess the effect of tight money on the exchange rate. Tight money should only have first-order real effects, including effects on the real exchange rate, if there is nominal inertia or stickiness in the wage-price mechanism. Empirical evidence suggesting that the degree of nominal inertia in the United Kingdom (and in most other European economies) is very limited would, if it were convincing, weaken or even undermine completely the monetary interpretation of the real appreciation. On the other hand, the fact that the real appreciation was temporary and has by now been reversed to a large extent is consistent with a monetary interpretation.

Fiscal policy works the wrong way, at any rate with regard to the behavior of the real exchange rate. With a floating exchange rate and a high degree of international capital mobility, tight fiscal policy causes a real (and a nominal) depreciation. The real depreciation will in this case be permanent unless the fiscal contraction is reversed. The fiscal contraction in the United Kingdom during 1980–81 was indeed reversed after 1982. While fiscal policy can help explain the depth of the 1979–81 recession in the United Kingdom (and the subsequent recovery) it renders more difficult the explanation of the behavior of sterling.

Bean's model (correctly in my view) ignores any direct supply-side effects of the oil discovery and of the coming-on-stream of oil production. The oil industry certainly faced a perfectly elastic supply schedule of foreign capital and had a very small impact on the demand for nonproduced domestic resources such as labor and land.

Modeling the oil shocks is difficult. Bean's specification seems as reasonable as any: the volume of reserves and production were correctly evaluated but assumed zero prior to the first OPEC oil price shock. Each of the two oil price shocks is viewed as unanticipated, immediate, and permanent. The fiscal aspects of oil are important, since the government appropriated an increasing share of the rents during the period under consideration. This share has reached 80 or 90% by now. In the oil shock simulations, real government spending and tax rates are kept constant. Given the backward-looking nature of the consumption function, anticipated future oil revenues would have influenced consumption today only through their effect on forward-looking financial asset prices. Since only the deficit and the debt are assumed to be affected by the oil revenues, even this financial transmission channel will be inoperative under the assumption of perfect capital mobility. Alternative current and anticipated future responses of spending and/or tax rates could have produced quite different simulation results.

The contractionary effects attributed to oil discoveries or oil price increases (in the case of a next exporter) come either through lags in spending (Eastwood and Venables 1982) or through a wealth effect on the demand for money (Buiter and Purvis 1983). Wealth effects on money demand seem unlikely with Bean's narrow monetary aggregate. Spending lags are more likely, given a backward-looking consumption function, absence of debt neutrality, and a fiscal policy that did not, in the early years of the Thatcher regime, reduce taxes or raise public spending by the annuity value of the increase in oil wealth.

The adverse-supply-shock view of the causes of the real depreciation summarizes the winter of discontent (1978–79) and its aftermath by a 2-percentage-point increase in the natural rate of unemployment. The sign of the effect obviously goes in the right direction (with regard to both the real exchange rate and real output), but it seems sufficiently ad hoc to warrant being treated with caution. Surely by now these temporary effects have worn off after eight successive winters of content and significant legislative initiatives curbing union power. The real exchange rate indeed has come down again, but unemployment and activity have not recovered.

Bean's reminder that the greater portion of the 1979–80 sterling appreciation may have been due to a speculative bubble rather than to a movement of fundamentals is appropriate. A definitive decomposition of the "Thatcher wiggle" in the real exchange rate remains to be done.

Permanent Effects From Temporary Misalignments

The second half of the paper concerns the continuing saga of the unit root, the infestation of martingales and random walks that after affecting observables like the stock market, the nominal and real exchange rates, and consumption, now touches unobservables like the natural rate of unemployment.

Bean investigates whether there is hysteresis, or path dependence, in British trade performance, that is, whether temporary shocks (e.g., to competitiveness) have permanent consequences for British exports, X, relative to world imports X^*. P is the price of British exports, P^* the appropriate foreign price index, and both are measured in terms of a common currency. The (demand) equation that is tested in given in (1).

$$(1) \qquad \Delta(X - X^*)_t = j_0 + j_1(P^* - P)_t + j_2(X - X^*)_{t-1}.$$

If the restriction $j_2 = 0$ is accepted, there is hysteresis in British export demand as there is a unit root in the $X - X^*$ process. The hysteresis issue is then approached by considering whether X and X^* are cointegrated. If $P - P^*$ is strongly exogenous and stationary and if $j_2 = 0$, then X and X^* cannot be cointegrated. Finding that the null hypothesis that X and X^* are not cointegrated cannot be rejected (i.e., that X and X^* are cointegrated) therefore implies (if $P - P^*$ is a strongly exogenous stationary process) that $j_2 \neq 0$. However, John Huizinga (1987) finds that his real exchange rate measure for the United Kingdom (which is similar but not identical to Bean's $P - P^*$ measure) is nonstationary (the univariate representation of his real exchange rate process has a unit root). Doubts must also exist with regard to the strong exogeneity of $P - P^*$. Strong exogeneity of $P - P^*$ is weak exogeneity plus Granger noncausality (i.e., the nonpredictability of $P - P^*$ from past values of the other variable(s), once the predictive content of past values of $P - P^*$ has been allowed for). Granger noncausality can in principle always be tested, (although no tests were reported in the paper), but the assertion that $P - P^*$ is weakly exogenous always relies on a priori assumptions, that is, it can only be tested together with other restrictions on the model. Let $\bar{Z}$ and $\bar{Y}$ be matrices of observations on Z and Y. The joint likelihood function can be written as L $(\lambda_1, \lambda_2; \bar{Z}, \bar{Y})$, where λ_1 contains the parameters of interest and λ_2 the nuisance parameters. $\bar{Z}$ is weakly exogenous if $L(\lambda_1,\lambda_2;\bar{Z}, \bar{Y}) = L_1(\lambda_1;\bar{Y}/\bar{Z})L_2(\lambda_2;\bar{Z})$. In that case the parameters of interest are confined to the likelihood in Y conditional on Z. In a simultaneous demand-supply equilibrium model, weak exogeneity of price with respect to quantity seems unlikely (although this will of course depend on what the parameters of interest are).

If X and X^* are cointegrated, then a linear combination of the two is stationary and the behavior of each of them can be described by an error-correction mechanism.

More precisely, let $I(i)i = 0,1,2\ldots$ denote the order of integration of a stochastic process. $f(I(i))_t$ denotes a stochastic process integrated of order i. A set of variables, each of them $I(1)$ is cointegrated if a linear combination of them is $I(0)$. Let X and X^* both be $I(1)$. They are cointegrated if

$$X_t = a_0 + a_1 X_t^* + f(I(0))_t. \quad (2)$$

In that case there exist error-correction mechanisms

$$\Delta X_t = b_1 f(I(0))_{t-1} + \tilde{f}(I(0))_t \quad (3)$$

and

$$\Delta X^*_t = b_2 f(I(0)_{t-1} + \tilde{\tilde{f}}(I(0))_t \quad (4)$$

where $|b_1| + |b_2| \neq 0$.

This decomposition into error correction and short-run dynamics does not seem to be unique, however. If X_t and X^*_t are cointegrated, for example, so are X_t and X^*_{t-1}, since (2) can be written as

$$X_t = a_0 + a_1 X^*_{t-1} + a_1(X^*_t - X^*_{t-1}) + f(I(0))_t.$$

$X_t^* - X_{t-1}^*$ is $I(0)$ and $a_1(X_t^* - X_{t-1}^*) + f(I(0))_t = \hat{f}(I(0))_t$ is therefore also $I(0)$, as it is the sum of two stationary stochastic processes. The error-correction mechanisms in (3) and (4) therefore can be rewritten as

$$\Delta X_t = b'_1 \hat{f}(I(0))_{t-1} + \hat{\hat{f}}(I(0))_t$$

and

$$\Delta X''_t = b'_2 \hat{f}(I(0))_{t-1} + \hat{\hat{\hat{f}}}(I(0))_t.$$

The decomposition of the ΔX and ΔX^* dynamics into a long-run error-correction component and a short-run disequilibrium-adjustment component therefore seems not uniquely identified, limiting the usefulness of these exercises. More generally, if X_t and X^*_t are cointegrated, so are X_t and X^*_{t-j} for any finite j.

Bean considers equation (1) to be a representation of the demand side of the U.K. export market. The paper also contains a specification and estimate of a supply equation. His discussion in section 2.3.1 shows clearly that hysteresis in the demand side need not imply hysteresis in the equilibrium quantities. It isn't quite clear to me whether we should be interested primarily in demand-side hysteresis, in supply-side hysteresis, or in hysteresis in the equilibrium quantities.

The discussion of the economic mechanisms that might generate hysteresis at times seems to take us far from the narrow or strict definition of hysteresis. A strictly hysteretic dynamic system is one for which the steady-state or long-run values (distributions) of the endogenous variables depend not only on the steady-state values (distributions) of the exogenous variables but also on the initial conditions of the state variables and on the values of the exogenous variables during the adjustment process: how you get there determines where you get to. In discrete time, linear dynamic systems hysteresis is present when there are one or more unit roots. Adjustment costs do not in general imply hysteresis. Irreversibilities may well imply hysteretic behavior, but this is unlikely to show up in the form of a linear process with unit roots. Nonlinearities (such as kinked oligopolistic demand curves) may generate local hysteresis, but not the global hysteresis of linear systems with unit roots. In the end, the paper tries to identify a weaker (and perhaps more relevant) form of hysteresis, that is, long lags and a high (but not perfect) degree of persistence in the behavior of important economic variables.

If we detect hysteresis (even perfect hysteresis), should we worry about the working of the economic system? A priori, the presence of hysteresis in equilibrium prices or quantities is not a cause for alarm and does not indicate a malfunctioning of the economy. Consumption may follow a random walk in economic systems in which the invisible hand is doing a marvellous job. In an economy in which uncovered nominal interest parity holds, the real exchange rate will follow a random walk if the authorities pursue a policy of equalizing ex ante real interest rates at home and abroad. This will be true when the economy is a neoclassical wonderland or a sticky-price, Keynesian unemployment world in which, under a different policy regime (such as a random walk for the level or growth rate of the nominal money stock) overshooting of nominal and/or real exchange rates could occur.

In conclusion, this very interesting paper points towards a range of unresolved theoretical and empirical issues concerning hysteresis: (1) the distinction between strict hysteresis and weaker notions of a high degree of persistence; (2) the distinction between hysteresis in particular decision rules (e.g., demand or supply) (or structural-form hysteresis) and hysteresis in equilibrium variables (or reduced-form hysteresis); (3) the distinction between deep hysteresis (such as the hysteresis in the natural rate of unemployment that may come out of human capital or insider-outsider mechanisms) and shallow hysteresis, such as the hysteresis of the real exchange rate reflecting a particular monetary or fiscal policy; (4) the need for a careful welfare economics of hysteretic behavior. The presence of hysteresis is not prima facie evidence of an externality.

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