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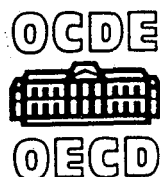
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This paper is one of four in this Working Paper Series, focusing on financial liberalisation, along with those of Kupiec, Driscoll and Blundell-Wignall and Browne. It surveys recent work, both theoretical and empirical, on the question of market efficiency in various asset markets. A number of studies of behaviour in the foreign exchange market, which provide evidence of departures from efficiency, are described. The paper summarises and discusses the implications of research on the effects of noise trading by "irrational" groups of agents, with particular reference to the stock market. The housing market is also considered as an example where pronounced price "bubbles" have appeared. The paper concludes with a discussion of the potential welfare impact of departures from efficiency in the foreign exchange market, where it is argued that the case for some form of intervention is strongest.

Le présent document constitue l'une de quatre études de cette Série consacrée à la libéralisation financière, avec celles de Kupiec, de Driscoll, et de Blundell-Wignall et Browne. Il rassemble les conclusions des travaux récents, théoriques et empiriques, qui examinent ce problème sur certains marchés d'actifs et décrit un certain nombre d'études de comportement sur les marchés de change, qui témoignent d'actes contraires à la notion d'efficience. Ensuite, il présente et débat des implications de la recherche sur les effets induits par les "bruits" de certains groupes d'agents "irrationnels", en se concentrant plus particulièrement sur les marchés de valeurs mobilières. Le marché du logement est également considéré, en tant qu'exemple de marché où d'importantes "bulles" spéculatives se sont formées. Le document se termine par des commentaires sur les effets potentiels, en termes d'avantages collectifs, des phénomènes de non efficience observés sur les marchés de change, et conclut à la supériorité de certaines formes d'intervention.

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INTRODUCTION

A major consequence of financial liberalisation in a regime of floating exchange rates has been to increase the influence of financial markets on the determination of exchange rates. This is immediately obvious from the pattern of currency trading which now prevails, where the value of transactions vastly exceeds the value of international trade in goods and services; and it has led to the "asset price" view of exchange rate determination, which applies to exchange rates the same theory and techniques already used to analyse the price of bonds and equities.

Some observers have been led to conclude that the relevant criterion for assessing the volatility of freely floating rates is the comparison with these other financial markets; see for example Bergstrand (1983), Goldstein (1984) and Frenkel and Goldstein (1989), where it is pointed out that the volatility of exchange rates is typically less than that of other financial assets.

Others have gone further to suggest that efforts to reduce exchange rate volatility can only succeed by transferring this volatility to other asset markets. Thus the rise and fall of U.S. stock prices in 1987 and the subsequent rise and collapse of the Nikkei index of 1989 have both been attributed to the efforts to stabilise the dollar under the Louvre Accord (see, for instance, the Economist, 14th April 1990).

These views, that exchange rate volatility must be accepted as the necessary cost of allowing markets to operate freely, that the cost is in fact fairly reasonable, and that efforts to reduce it will be counterproductive have been sharply challenged by Paul Krugman (1989b). He argues that they are based on a false analogy; for

"there is a fundamental difference of interpretation when we compare the volatility of exchange rates with that of stock prices. Any proposal to limit stock price variability is in effect a proposal to restrict and/or regulate markets, while a fixed (exchange) rate system is just as much a free market as a floating rate system." (pp. 62)

The crux of his argument is that the exchange rate is the relative price of two fiat moneys, whose supplies are determined essentially by public policy. Furthermore, the decisions of two monetary authorities to vary the quantities of fiat money so as to stabilise their exchange rate is no more a violation of free markets than would be the decision to adopt a common currency. His conclusion is that "a floating exchange rate regime has no better claim to the allegiance of the market faithful than a fixed rate regime."

Even if one grants that floating rates have no superior claim a priori, the practical question remains to be answered: how well have foreign exchange markets actually worked? Have they behaved as "efficient financial markets", or not? If indeed they have, then observed volatility will reflect the behaviour of fundamentals, including in particular the conduct of monetary policy. If on the other hand one concludes that foreign exchange markets are not efficient, this must call into question the logic of leaving exchange rates to be determined exclusively by market forces.

Below, we ask whether what we observe is consistent with market efficiency. Specifically we ask how well the forward market predicted the future spot rate and, if there are errors, whether they are serially correlated. Though the focus of attention is on exchange rates, the issues raised -- how well financial markets function, whether they exhibit departures from fundamentals and, if so, whether they are prolonged -- can be posed for many other asset markets. Recently, indeed, Cutler, Poterba and Summers (1990a) have sought to establish whether observed departures from fundamentals show any common pattern across a wide set of financial markets. Specifically, they examine data from thirteen countries on the performance of equity and bond markets since 1960; at U.S. data on house prices and "collectables" over a couple of decades; and at the behaviour of ten exchange rates (and of the price of gold) since floating began in 1974.

To get our discussion of foreign exchange rates into some perspective, it is as well to indicate right away that they did not find that financial markets in general operate like the text book paradigm of an efficient market. Instead, they found that there were excess returns available in these financial markets which were positively serially correlated at high frequency, and negatively correlated at longer horizons. (They also found that the deviations of asset values from proxies representing fundamentals were useful in predicting excess returns). They note that "these patterns emerge repeatedly in our analyses of stocks, bonds, foreign exchange, real estate, collectables and precious metals and they appear too strong to be attributed only to small sample bias", and they conclude that "the pervasive nature of these patterns suggests that they may be due to inherent features of the speculative process, rather than the variation in risk factors which affect particular markets." Cutler, Poterba, Summers (1990a). In a later paper they go on to suggest that the patterns of correlation in returns referred to earlier could be explained by the presence of "feedback traders" whose demand for assets is based on the history of past returns rather than expectations of future fundamentals. These and other possible explanations of inefficiency in financial markets will be discussed below.

The fact that these authors use such an extended data set may lend added credibility to their findings; but it does presumably imply that their findings are not to be attributed to financial liberalisation per se. The data used come from countries that have liberalised to different degrees; and the regression models are fitted to markets which experienced changes in the extent of financial regulation over the time period studied. What their results do surely illustrate, however, is that efficiency gains sought by extending the reach of financial markets may be accompanied by the risks of increased exposure to speculative activities which undermine the efficiency of these financial markets themselves.

To reduce such risks, one would not generally expect official intervention in the market to be called for; rather the creation of a regulatory framework which minimises the source of such inefficiencies. There may indeed be a process of "learning by liberalising" involved here. It was only after losses exceeding their original investments had been suffered by early shareholders of firms that went bankrupt, that liability was limited in publicly quoted companies, while deposit insurance of banks had its origins in the bank failures of the 1930s. It was the heavy involvement of U.K. banks in property speculation (which accompanied the moves to stimulate competition in banking in 1971) that led to increased prudential control by the Central Bank.

Though exchange rates may share the same speculative dynamics as other markets, it appears that the case of the exchange rate is different. For the argument that the floating of currencies is not actually necessary for the free functioning of international markets, but reflects rather the desire for national monetary independence, surely implies that the monetary authorities should be much more directly involved in foreign exchange markets if they are seen to be inefficient. We consider in particular the experience of the dollar in the mid-1980s to see whether the co-ordinated intervention which it triggered can be justified as a response to an observed market inefficiency.

We conclude that the appropriate response to market inefficiencies must differ across markets, and that the exchange rate is an interesting special case where the costs of ignoring speculative swings justify official intervention. How this is best organised is a matter for debate.

1. MARKET EFFICIENCY

Various different notions of market efficiency as applied to asset markets have been proposed. The one which has most frequently been subjected to empirical testing is that embodied in the martingale model of asset prices. It thus forms a natural starting point for any general assessment of the market efficiency hypothesis, in the context of foreign exchange and other asset markets.

The martingale model

The martingale model of asset prices is due to Samuelson (1965), whose original results were worked out in the context of futures markets, but which he (Samuelson (1973)) and others have shown to have much broader application. A stochastic process x_t is a martingale with respect to an information set I_t if

$$E(x_{t+1} | I_t) = x_t$$

and is a generalisation of a simple random walk process. In other words, the expected value of x next period, given all currently available information, is equal to its currently observed value. In order to see the implications of this model in the context of the foreign exchange market, suppose that agents have homogeneous (rational) expectations, are risk neutral, and face nominal interest rates of i and i^* on one-period domestic and foreign bonds. If s is the domestic price of foreign currency, then arbitrage will ensure that

$$E_t(s_{t+1}) + i_t^* s_t = (1 + i_t) s_t \quad [1]$$

Suppose that foreign bonds are denominated in units of the foreign currency. Then, if v_t denotes the (random) present value in domestic currency of a holding of b_t foreign bonds,

$$v_t = \prod_{\tau=1}^{t-1} (1 + i_\tau)^{-1} s_t b_t \quad [2]$$

Suppose all interest payments are reinvested in bonds. Then it must be true that

$$s_{t+1} b_{t+1} = (s_{t+1} + i_t^* s_t) b_t \quad [3]$$

Now consider the value of $E_t(v_{t+1})$. We find that

$$\begin{aligned} E_t(v_{t+1}) &= E_t \left[\prod_{r=1}^t (1 + i_r)^{-1} s_{t+1} b_{t+1} \right] \quad [4] \\ &= E_t \left[\prod_{r=1}^t (1 + i_r)^{-1} (s_{t+1} + i_t^* s_t) b_t \right] \\ &= \prod_{r=1}^t (1 + i_r)^{-1} (1 + i_t) s_t b_t \\ &= v_t \end{aligned}$$

using [2], [3] and [1] respectively to derive the first, second and third equalities.

Note that this model does not predict that the exchange rate process itself is a martingale. For this to be true it is necessary that $i_t = i_t^*$ for all t , as we see from equation [1]. The discounted present value of a portfolio of foreign bonds with all accrued interest reinvested is a martingale. Therefore testing whether the exchange rate, or the log of the exchange rate, follows a martingale has nothing very much to do with a test of market efficiency, even within the confines of the martingale model. Accepting the null hypothesis will in general be inconsistent with market efficiency, and as Hodrick (1987) argues, such tests can really only be viewed as exercises in data description.

An alternative formulation of equation [1] gives

$$E_t(s_{t+1}) - s_t = (i_t - i_t^*) s_t \quad [5]$$

Arbitrage will ensure that $(i_t - i_t^*) = f_t$

is equal to the current forward discount, or the discount on the current spot price of foreign exchange in a contract which specifies delivery one period hence. Thus we obtain

$$\frac{E_t(s_{t+1}) - s_t}{s_t} = f_t \quad [6]$$

or expected depreciation is equal to the forward discount. It is this form of the model which is often subjected to empirical test. Since agents are assumed

to have rational expectations, a simple test uses a regression equation

$$\ln (s_{t+1}/s_t) = a + bf_t + \epsilon_t \quad [7]$$

with a null hypothesis of $a = 0$, $b = 1$. In other words, the realised rate of depreciation is equal to the forward discount plus a random error term ϵ^t .

While the martingale model was for a long time judged to be a very good representation of the behaviour of stock prices, it has never performed very well when applied to the foreign exchange market. The model as presented in equation [7] is almost invariably rejected by the data, and the coefficient b often turns out to be negative (1).

This has proved to be something of a puzzle for researchers, and four distinct lines of argument have been advanced to explain these results. We will classify them under the following headings: i) time-varying risk premia; ii) the "peso problem"; iii) rational bubbles; and iv) departures from rational expectations. (The first three explanations which are consistent with market efficiency are considered in this section. Departures from market efficiency will be the subject of the next section).

Time-varying risk premia

If we jettison the assumption that agents are risk neutral, then the simple arbitrage relationship in equation [1] no longer holds, and it becomes necessary to introduce a risk premium into the equation. This is typically done by generalising the capital asset pricing model (CAPM) to an international context. To date, the results stemming from this approach are not encouraging (2). In particular, if we concentrate upon the behaviour of the dollar against the mark between 1980 and 1985, we find that it sold consistently at a forward discount during the period of its meteoric rise to 1985 (see Figure 1). This requires one to accept that dollar-denominated assets were perceived as relatively more risky than alternative assets while the dollar was rising. This interpretation runs directly counter to the popular perception of the dollar as a "safe haven" during the period 1980-1985.

The relative implausibility of this argument, and the poor performance of international CAPM, indicate that appealing to time-varying risk premia does not provide a satisfactory explanation for the data.

The "peso problem"

The peso problem refers to the statistical difficulty which arises in any attempt to capture the effects of an event anticipated with small probability. It is so-called after the behaviour of the Mexican peso over the period 1955-76. Despite being pegged to the dollar throughout this period, it sold at a significant forward discount. The explanation advanced for this was that the market had a continuing perception that there was a small probability that the authorities would announce a large devaluation. Such infrequently occurring events may not occur at all in sample, and it is difficult therefore conclusively to refute an argument that the market was discounting such an event.

In the case of the rise of the dollar between 1980 and 1985, one might argue that the market attached some probability to action by the United States government aimed at correcting the deficit, and thereby returning the dollar to its long-run equilibrium level. This would explain the persistent forward discount on the dollar throughout this period. However, as Krugman (1989a) and others (Dornbusch (1982) and Frankel (1985)) have observed, it is possible to do a rough calculation of the likelihood that such an effect was in operation. Suppose that during the period 1980-85 the fear in the market was that the dollar would fall to its 1980 level against the mark and that it attached a probability Π_t to this eventuality. Risk-neutral arbitrage now dictates that

$$(1 - \Pi_t) E_t (s_{t+1}) + \Pi_t s_0 + i_t^* s_t = (1 + i_t) s_t \quad [8]$$

or

$$E_t (s_{t+1}) - s_t + \Pi_t (s_0 - E_t (s_{t+1})) = (i_t - i_t^*) s_t \quad [9]$$

where the expectation $E_t (s_{t+1})$ is taken conditional upon there being no collapse of the dollar. The expected capital gain from holding a portfolio of mark-denominated bonds now contains the additional term $\Pi_t (s_0 - E_t (s_{t+1}))$, where for our purposes s_0 is the 1980 dollar-mark exchange rate. We can solve for Π_t as

$$\Pi_t = \frac{(i_t - i_t^*) - (E_t (s_{t+1}) - s_t)/s_t}{(s_0 - s_{t+1})/s_t} \quad [10]$$

Krugman (1989a) observes that from 1980 to 1985 the average annual rate of dollar appreciation against the mark exceeded the interest differential by 13.7 per cent. Over the same period the dollar exceeded its 1980 level against the mark by an average of 33 per cent. Thus an average value for Π_t can be computed as $\Pi = 13.7/33$. The probability of not observing a collapse in five years is $(1 - \Pi)^5 = 0.068$. This turns out to have been an "unlikely" event, casting some doubt on the explanation.

Transactions costs

It has been customary to dismiss transactions costs as a possible source of divergence from apparent efficiency in foreign exchange markets. The argument has been simply that such costs are too small to account for the observed discrepancies. This position has recently been challenged by Baldwin (1990) who claims that typical transactions costs in foreign exchange markets could lead to a significant "band of inaction" in response to changing interest differentials. While this argument may account in part for the poor performance of forward market efficiency tests, it is not able to explain sustained movements in exchange rates apparently unconnected to changes in fundamentals.

2. DIVERGENCE FROM MARKET EFFICIENCY

We have argued that none of the attempts to explain the results of econometric analysis of foreign exchange markets within the framework of a fully rational, optimising model has been particularly successful. In fact, this is a problem which is by no means confined to the foreign exchange market, as is indicated by the huge volume of work carried out during the 1980s on excess volatility in equity markets. For this reason, we broaden our focus in this section and include discussion of recent work on departures from efficiency in other markets.

Rational stochastic bubbles

In contrast to the peso problem, which seeks to explain certain observations in financial markets in terms of rational maximising responses to anticipated policy intervention, the idea of a rational stochastic bubble represents an attempt to model a "rational" market response to irrational forces. A (rational) bubble in an asset price is present if the price path departs from that consistent with fundamentals, and yet rational arbitrage conditions are satisfied along the path. In a deterministic context, such bubbles are implausible for a variety of reasons, not least the fact that the divergence of the asset price from its fundamental value grows ever larger. Blanchard (1979) proposed the notion of a stochastic bubble which would, with some probability, "burst", after which the asset price would return to its fundamental value. Equivalently, one can think of the bursting of the bubble as an event whose occurrence is governed by a Poisson process with hazard rate Π . The expected duration of the bubble at any point in time is Π^{-1} . In a deterministic "overshooting" model of exchange rate determination one can characterise these bubble paths straightforwardly [see Miller and Weller (1990)]. However, they possess the feature that the longer the bubble persists, the greater the magnitude of the anticipated "crash". Such time series properties are difficult to reconcile with data from the foreign exchange market and this has led some to reject this explanation in favour of a "fads" or "noise trading" alternative (3).

Models of noise trading and feedback trading

Because the arguments which underpin the efficient markets model are still deeply ingrained in the thought processes of many economists, and because the recent models which incorporate heterogeneous groups of market participants are still relatively unfamiliar, we will present in some detail the results which emerge when one allows a role for either the actions of noise traders or feedback traders.

i) Allowing for noise traders

Black (1986) argues that there exists a class of investors who irrationally perceive random fluctuations in asset prices to be a source of information on which they can trade profitably. He terms this group "noise traders". The standard response to such an observation from a proponent of the efficient market hypothesis is that if such a group were sufficiently large to influence market prices, then the presence of sophisticated arbitrageurs would drive them from the market. The noise trader would on average be buying high and selling low, and would be expected to make losses; in other words, there

exists a powerful market selection mechanism which operates in favour of rational arbitrageurs and against noise traders.

A weakness in this Friedmanesque argument was pointed out by Figlewski (1979), who showed that if arbitrageurs were risk averse, and had to bear both fundamental risk and risk induced by noise traders, then the strength of the selection mechanism would be severely attenuated. The recent work of De Long et al. has raised further doubts as to the general validity of appeals to a market selection mechanism. They examine an environment in which a group of rational investors with short time horizons transact with noise traders, who persistently make mistakes in predicting the future return on an asset. There is no fundamental risk, so the variability in the asset price is caused solely by the misperceptions of the noise traders.

The most striking conclusion to emerge from the analysis is that if noise traders are on average bullish about the asset in question, they can earn higher expected returns than sophisticated investors. This comes about because the riskiness induced by the presence of noise traders depresses the asset price. If the consequence of this is that noise traders invest more in such assets on average, they can end up with higher expected returns. Thus noise traders may gain simply as a consequence of the risk that they themselves introduce into the market, and not because they unwittingly bear more fundamental risk than rational investors.

The crucial features of the model necessary for the central result are i) time horizons for sophisticated investors that are not "too long"; ii) positive correlation between the incorrect beliefs of noise traders, and iii) a tendency to hold "bullish" expectations among noise traders. The first feature captures an important aspect of reality emphasised by Holtham (1989), and also by Frankel (1988b), namely that money managers have their performance assessed rather frequently, and cannot afford to take a long view, if by the time their positions are showing a profit, they are out of a job.

The second feature is one for which economists will need to turn to other disciplines, in particular psychology, for support. Recent work on the market overreaction hypothesis, stimulated by the work of Kahneman and Tversky, is a good example. Andreassen (1987) has conducted experiments in which he presents subjects with simulated series of stock prices, and they trade for monetary rewards. One group reads headlines, similar to those which appear in the Abreast of the Market column in the Wall Street Journal, that "explain" recent developments. Another group sees only the price series. He finds that the extent to which past price trends are expected to persist depends upon the presence of "news". This confirmed earlier findings that individuals tend to predict in an extrapolative manner if recent movements of a time series seem attributable to a stable underlying cause [see for example, Matthews and Sanders (1984), and Gilovich, Vallone and Tversky (1985)]. However, a recent investigation by de Bondt (1990) suggests that the picture is more complicated. Since 1952 Joseph Livingston, of the Philadelphia Enquirer, has conducted a twice yearly poll of about 40 reputed academic, government and business economists. They are asked for, among other things, seven- and thirteen-month predictions of the S&P 425 index. De Bondt analysis these polls and finds that the predictions are strongly regressive, indicating quite conclusively that this sample was not using a martingale model of stock prices. He also finds, interestingly, that the tendency to display regressive expectations is much

more marked among the professional group than among a naive group of student subjects presented with the same data series.

What are the implications for exchange rate volatility of the presence of noise traders in the market? If the mistakes that noise traders make are temporary and follow a mean-reverting process, then this will induce mean-reversion in the underlying asset price [see Campbell and Kyle (1988), Miller, Weller and Williamson (1989)]. Just as the mean-reversion in stock prices has been difficult to detect [Summers (1986)] (4) so too it was not until recently that evidence of mean-reversion in real exchange rates was reliably identified [Frankel (1988b)] (5). And contrary to what one might expect, wide swings in noise trader sentiment resulting from only a weak autoregressive tendency remain consistent with a situation in which noise traders earn higher expected returns than do sophisticated investors.

If noise traders have autoregressive expectations, the optimal sophisticated investment strategy to employ is a contrarian one. We show how this would operate in the foreign exchange market in Miller, Weller and Williamson (1989), where the "smart money" damps but does not eliminate the exchange rate swings attributable to irrational market sentiment. As De Long *et al.* (1988) observe, their noise trader model "shows precisely why apparent anomalies such as the high dollar of the mid-1980s and the extraordinary price/earnings ratios on Japanese stocks in 1987-88 can persist for so long even when many investors recognise these anomalies. Betting against such perceived mispricing requires bearing a lot of risk, for even if the mispricing disappears eventually it can always become even more extreme in the short run, leading to the demise of the arbitrageur with limited resources or a short time horizon."

ii) Allowing for feedback traders

The work of Frankel and Froot (1987, 1989), and of Cutler, Poterba and Summers (1990a, b) (henceforth referred to as CPS) is relevant here. Frankel and Froot use survey data on exchange rate expectations to examine the familiar finding that the forward discount is a biased predictor of future exchange rate changes. They conclude that expectational errors are responsible for much, if not all, of the bias. In contrast to the standard assumption in rational expectations models, they find a considerable degree of heterogeneity of expectations. They also reveal an interesting pattern to this heterogeneity. Those who make forecasts over longer time horizons i.e. one year or more, tend to have regressive expectations, whereas those who forecast over short horizons (one week to three months) tend to follow extrapolative rules. This fits in rather neatly with the empirical findings of CPS. They find that asset returns tend to be positively serially correlated at high frequency, but (weakly) negatively serially correlated over long time horizons. They also detect a tendency for deviations of asset values from proxies for fundamental values to have some predictive power for excess returns. What is striking about their results is the very wide range of markets in which they detect this pattern. They consider the equity and bond markets of thirteen countries, ten bilateral exchange rates, gold, silver, industrial metals, house and farm prices, and collectables ranging from coins to old masters. They cite a number of reasons why an explanation for their results in terms of changing risk premia is unconvincing.

First, standard models of financial economics do not lend support to the existence of sizeable risk premia (6). Mehra and Prescott (1985) showed that the average excess return on the U.S. stock market is far greater than can be explained by plausible levels of risk aversion, given the observed volatility of U.S. equities. Second, given the widely varying nature of the different markets considered, it is unlikely that a single risk factor could account for the pattern of returns in all of them. Third, in the case of equities, adding a measure of the volatility of the asset returns has little effect upon the magnitude of the coefficients linking deviations from fundamentals and subsequent returns.

For these reasons, CPS conjecture that they have uncovered a basic feature of the speculative process, and in a separate paper they present a simple model aimed at reproducing their findings (CPS (1990b)). There are assumed to be three distinct groups of traders in the market for a speculative asset. One bases its current demand for the asset on a rational expectation of next period price. A second bases its demand upon fundamentals, observed with some lag. This feature is intended to capture the idea of less than instantaneous dissemination of information about fundamentals in the market, or possibly of some process of learning. A third group demands the asset on the basis of an extrapolation of past trends in prices.

Because news is incorporated into prices less than instantaneously, speculators following positive feedback rules will make profits, and will increase the variability of the asset price. So profitable speculation is in this instance destabilising. In addition, the observed pattern of positive autocorrelation over short time horizons and negative autocorrelation over long horizons is generated.

3. ASSET PRICES AND SPECULATION: THREE CASE STUDIES

The U.S. dollar in the mid-1980s

As already noted with reference to Figure 1, forward rates have not proved efficient predictors of future spot rates in the foreign exchange market, with the dollar specifically standing at a forward discount against the DM throughout the period 1980 to 1985, despite the continued appreciation of the U.S. currency (by about 35 per cent against the DM over the period). Expressed in the terminology of Cutler et al., this was a period when dollar holders enjoyed considerable "excess returns" where the latter are defined as the gap between the actual appreciation and the market's forward discount [see Figure 1(b)]. Although these "excess returns" were to be largely wiped out by a run of losses as the dollar fell against the DM from 1985 to 1987, it is the serial correlation present in these runs which is the key piece of evidence against the postulate of efficiency.

As we have reported, Cutler et al. find characteristic patterns of serial correlation in excess returns common to many asset markets which they attribute to the activities of speculators. They point out, moreover, that

"very small deviations of returns from the martingale assumption can imply large deviations of asset prices from fundamental values" (1990a, p. 20).

which suggests an immediate test of their hypothesis: namely, does one observe such obvious mispricing of assets in practice? Focusing first on the foreign exchange market, and on the dollar in particular, we consider whether it is reasonable to believe that the run of "excess returns" shown in Figure 1 did in fact cumulate so as to cause a significant "misalignment" of the dollar as Williamson in particular has argued; or whether the movements of the dollar can be interpreted simply as the necessary counterpart of shifts in intertemporal absorption, as others have suggested.

How did Williamson conclude that the dollar was misaligned? In his influential analysis of the exchange rate system (Williamson (1985)), he defined a misalignment as "a persistent departure of the exchange rate from its long-run equilibrium level", where the latter, dubbed the fundamental equilibrium exchange rate (or FEER), was in turn described as the rate

"which is expected to generate a current account surplus or deficit equal to the underlying capital flow over the cycle, given that a country is pursuing "internal balance" as best it can and not restricting trade for balance of payments reasons."

In the monograph cited Williamson sought to estimate FEERs (and misalignments) for most of the G7 countries. His calculations for the United States are shown in Figure 2(a). The FEER for the United States shows little change over the period from 1976 to 1984 while the actual real exchange rate moved outside the 10 per cent zone after 1982, with a misalignment estimated at 23 per cent in 1983Q2 and at 37 per cent by the end of 1984 (Williamson (1985), tables 11 and 13 respectively). To bring the dollar down from what was for him an unsustainable level Williamson called for a change in the mix of U.S. policy (easier money, and tighter fiscal) and a co-ordinated bout of sterilised intervention against the dollar.

One of the main criticisms of Williamson's position was that the theoretical basis for his estimate of "sustainable" capital flows used to define the FEERs was undermined by the increasing deregulation of capital markets; and, in practice, overseas lenders proved perfectly willing to finance the growing U.S. deficit. An alternative interpretation of the facts was espoused by many observers who dismissed Williamson's theory and conclusions and argued instead that the rise in the dollar signified a temporary shift in U.S. absorption, with a temporary deficit being willingly financed by overseas lenders.

This alternative interpretation of the facts was however called into question at the time by Krugman who reasoned that

"An exchange rate above its sustainable level only "made sense" if it (was) associated with an interest differential large enough to compensate investors for an exchange rate decline that is sufficiently rapid to prevent runaway growth in foreign debt" [Krugman (1989a)].

and found that the dollar failed this test. (The fact that the dollar subsequently reversed the rise of the early 1980s without any profound changes in private and public savings and/or investment behaviour must further

undermine the view that the dollar's movements were simply tracking temporary shifts in desired absorption.)

Krugman's calculations supported the position taken by Williamson but were free of any restrictive assumption as to the size of sustainable capital flows. He assumed only that deregulated capital markets were willing to finance any trajectory of deficits -- so long as debt was not set to explode. As his conclusions on the dollar proved correct, it is instructive to see how he diagnosed that it was buoyed up by a speculative bubble.

The methodology was simple enough; first to estimate the downward trajectory for the dollar implied by the term structure of real interest rates at the time, and then to see whether this was consistent with a finite level of the U.S. debt/income ratio. The result:

"the calculation for early 1985 suggested that the existing real interest differential was so modest compared with the dollar's strength that the market was implicitly forecasting a runaway growth in debt. Since this could not have been right, the dollar was on a speculative bubble" [Krugman (1989a)].

The fact that the subsequent fall of the dollar was associated with a series of negative "excess returns" (shown in the right-hand side of Figure 2) serves only to confirm his diagnosis.

With the benefit of Krugman's logic (backed by now with the power of hindsight!) it seems reasonable to conclude that

- 1) the serially correlated excess returns shown in the Figure were indeed symptomatic of a speculative bubble, which involved a significant departure of the dollar from its fundamental value;
- 2) that it was nevertheless possible to diagnose such a bubble even under the assumption that capital markets were deregulated.

The welfare costs of such speculative excess will be considered later after looking at episodes in other markets. But it is interesting to note that the dollar corrected its misalignment without a crash, and that the most significant policy changes involved sterilised intervention rather than shifts in the mix of domestic policy.

The stock market crash of 1987

The stock market crash of October 19, 1987 reduced the market value of the 6,000 firms publicly traded on the U.S. market by approximately half a trillion dollars. The Dow Jones Industrial Average dropped over 20 per cent, and provoked equally calamitous collapses on stock markets around the world. Yet there was no dramatic news about the course of economic fundamentals which would have justified these events as a rational readjustment of equity prices.

The Report of the Presidential Task Force on Market Mechanisms (commonly known as the Brady Report) produced specifically with a view to providing recommendations on how to avoid a recurrence of the events of Black Monday, chose to concentrate largely on technical issues concerned with the smooth

functioning of the market during turbulent conditions, without really attempting to get to grips with the underlying causes of the turbulence. While it is no doubt true that a number of factors were implicated, there is a strong case for suggesting that the actions of those in the market who were engaged in portfolio insurance were one of the important causes.

Portfolio insurance is a trading strategy which is still relatively unfamiliar. It can be understood by considering the effect of purchasing a put option on a stock. The put confers the right, but not the obligation, to sell the stock for a specified price (the strike or exercise price) up to some terminal date. It therefore provides the holder with insurance against the effects of a fall in the price of the stock below the exercise price. Options on the S&P 500 are traded, permitting insurance of an index portfolio. However, an alternative to trading these options directly which was popular amongst large fund managers (at least until the crash) was so-called synthetic portfolio insurance. This consisted of a dynamic trading strategy for S&P 500 futures contracts which approximated the pay-off of the Black-Scholes "hedge portfolio", which contributes the theoretical basis for modern option pricing theory.

This strategy dictates that one sell futures in a declining market, and buy in a rising market, introducing possible problems of instability during periods of rapid price change. It has been estimated that of the record 162,000 S&P 500 futures contracts traded on October 19, portfolio insurance accounted for 12 to 24 per cent [Commodity Futures Trading Commission quoted in Duffie (1989)]. The market value of these contracts at Monday's closing price was approximately \$16 billion.

The trades occasioned by portfolio insurance are "informationless", in that they are not driven directly by news, but only by observable price movements. Grossman (1988) was the first to point out the potential problem for market stability that this kind of activity may generate. Large trades by portfolio insurers will move prices, and if other market participants are unaware of the precise extent to which such trades are taking place, they may mistakenly conclude that they are caused by news about fundamentals. This will lead to an increase in price volatility, and in certain circumstances can produce a large, discontinuous price adjustment.

Grossman's paper actually appeared in the summer of 1987 before the October crash, and was subsequently seen as a remarkably prescient diagnosis of market conditions leading up to Black Monday.

The only recommendation in the Brady Report so far implemented, however, is the introduction of so-called circuit-breakers. These consist of rules specifying a sequence of responses to various given intra-day declines in the S&P 500 and Dow Jones Industrial Average. The responses involve delays in the execution of program trades, and suspension of trading for varying lengths of time depending upon the magnitude of the drop in the relevant index. Such measures are by no means uncontroversial, and a plausible case can be made that they may in fact hamper the smooth functioning of the market by delaying the incorporation of relevant information into prices (Grossman has indeed criticised them in just such terms). Recent evidence supports this view (see Wall Street Journal, August 29, 1990: "Program Traders Move Off Exchanges"). The response of large program traders to the imposition of circuit-breakers has simply been to set up a private market off the exchange.

In our view, probably the most important lesson to be learned from this interpretation of events is the need for "transparency". Indeed, Leland, and his associates, who have been the main commercial source of portfolio insurance programmes, have introduced the notion of "sunshine trading", whereby the timing of large, informationless trades is announced sometime in advance to the market. By this means, the market is able to discount the impact of such trades, which would otherwise be a source of excess price volatility.

The principle of transparency clearly has application in other asset markets, not least that for foreign exchange. Central bank secrecy surrounding its operations in the market hampers the free flow of information, and may exacerbate the volatility and misalignment it is presumably trying to prevent.

The housing market in the United Kingdom and the United States

There is good reason to suppose that the market for residential housing would operate less efficiently than markets for financial assets. For most, trading in the housing market is motivated by important considerations in addition to the desire for a profitable investment, and the role of professional speculators in real estate is curtailed by the presence of substantial inventory and transactions costs. But casual observation suggests that the housing market is prone to sudden periods of dramatic price inflation unrelated to any significant change in economic fundamentals.

The issue of whether the housing market is efficient had received relatively little attention until the recent work of Muellbauer (1989) for the United Kingdom, and of Case and Shiller (1988, 1989) for the United States. We turn first to the work of Muellbauer. Figure 3 shows two periods during which the price of land and houses increased sharply relative to personal disposable income. The first was associated with the easing of credit controls (and of macroeconomic policy generally) in the early 1970s. As regards the more recent boom which saw land prices more than double and house prices rise by almost 50 per cent relative to income, Muellbauer claims that it is clear evidence "that growing financial liberalisation since 1981 has had important effects on house prices".

From his econometric work, Muellbauer found evidence of what Hendry (1984) had earlier described as a "frenzy effect":

"it appears that when prices are rising rapidly, this itself feeds further speculative rises as buyers become desperate about being left behind." Muellbauer (1989)

In related work Muellbauer has found that "equity withdrawal" prompted by such high property values helps to explain the recent boom in U.K. consumption.

To check these speculative elements in the United Kingdom housing market, Muellbauer suggests two specific reforms:

- a) restoration of a tax on domestic property (to be based explicitly on market values);
- b) an increased margin requirement for mortgage borrowers -- designed partly to reflect the higher asset price volatility since liberalisation.

In fact, the government has chosen to use interest rates as the means of checking the house price boom. This has certainly had the desired effect (with prices falling by 25-30 per cent in the South East), but it has been criticised for the effect it is having on domestic investment.

Does the U.K. government really want to replace its exchange rate commitments by a house price target? If not, there would appear to be a good case for structural reforms in the United Kingdom housing and mortgage markets.

Case and Shiller, in their investigations of local housing markets in the United States are agnostic about the events which may trigger a housing boom, but cast doubt on any central role for macroeconomic or demographic variables, citing the fact that "boom", "post-boom" and stable conditions can occur simultaneously in separate regions for which the macroeconomic and demographic environment is very similar. However, they do uncover evidence of significant inefficiency, and it seems highly probable that even if the process of financial liberalisation was not responsible for the initiation of local house price bubbles, it would have had some impact upon their magnitude and duration.

4. WELFARE COSTS

The case for regulations or other interventions must rest upon the presence of significant identifiable welfare costs which can be alleviated by such interventions.

For the discussion which follows we review the three markets considered earlier beginning with the stock market where the case for intervention is rather weak and ending with currency markets where the case for intervention in theory and in practice is most convincing.

The stock market

The costs of prolonged deviations of equity prices from their fundamental values are obvious enough, ranging from the welfare losses stemming from misallocation of investment funds to the social costs of bankruptcies, unemployment and retraining consequent upon a financial collapse. They are difficult to quantify with any precision, and are at least to some extent inherent in a property-owning democracy. Clearly there is an overwhelming case for regulations to prevent fraudulent dealing and insider trading in financial markets. But, just as in goods markets, there are limits beyond which one would not advance the principle of consumer protection against that of "caveat emptor", so too in financial markets there is a fine line to be drawn between welfare-enhancing and welfare-reducing regulation.

Although the events of Black Monday had all the appearance of a major financial catastrophe at the time, their subsequent impact upon the real economy has been astonishingly small. This reveals that governments as well as markets have a capacity to learn from past mistakes -- in this case those made in the aftermath of the 1929 crash. In addition, the financial markets have already innovated around the imposition of circuit-breakers (the one recommendation of the Brady Report so far introduced) with program trading off the exchanges. With the resulting loss of liquidity and increase in default

risk, it is difficult not to conclude that the overall impact of such regulations has been to reduce, rather than to increase the efficiency of the market.

The housing market

The costs associated with a sustained boom in house prices will vary depending upon the speed with which the level of prices readjusts to normal levels, and upon whether prices in nominal terms fall significantly. In an economy where owner occupation is widespread, the wealth effects of a bubble in the housing market can be a potent spur to general inflation, as was the case in the United Kingdom in the early seventies. On the other hand, if such dangers are recognised, the necessary deflation may have to be so savage as to wreak macroeconomic havoc. Again, the experience of the United Kingdom, in this instance post-1987, is a good example. Interest rates were raised dramatically in the latter half of 1988, provoking large nominal price declines and eventually feeding through to a substantial increase in mortgage defaults and repossessions. The particularly worrying aspect of this scenario is that it is the less well-off sections of the population who are disproportionately badly hit, since it is they who are less likely to have access to lines of credit enabling them mitigate the impact of penal interest rates.

Mortgage securitisation, a financial innovation introduced in the United States in the early 1980s, is a means of reducing some of the costs associated with housing booms by permitting diversification of the interest rate risk associated with fixed rate mortgages. It is, of course, a moot point whether the widespread offering of 30-year fixed rate mortgages, in the United Kingdom, for example, where such instruments are still virtually unknown, might not have the effect of increasing the frequency and severity of booms, precisely because of the reduced risk for prospective buyers.

The foreign exchange market

In order to assess the economic costs imposed by the various forms of market inefficiency we have described, it is necessary to maintain the sharp distinction between volatility (high frequency fluctuation around the "true" fundamental value) and misalignment (persistent deviation from fundamentals).

For the foreign exchange market we can get an estimate of the cost of volatility by calculating the risk premium which would be implied by the standard continuous-time portfolio selection model (see, for example Ingersoll (1987) ch. 13). If we treat domestic bonds as the safe asset then the risk premium ρ is given by:

$$\rho = \gamma \omega \sigma^2$$

where γ is the coefficient of relative risk aversion, ω is the proportion of the portfolio held in foreign bonds, and σ^2 is the instantaneous variance of the exchange rate. The parameter γ is typically estimated to lie between one and two. If we pick a value of one half for ω , and $\sigma = 0.1$, implying a standard deviation equal to 10 per cent of the mean over a year [see Frankel and Meese (1987)], we get an upper bound for ρ of 1 per cent per year. This is likely to be a significant overestimate, because it does not take account of the opportunities available for risk diversification or hedging. Couple that

with the fact that the most realistic comparison is not with a regime in which $\sigma = 0$ (permanently fixed rates) but rather with a regime which simply reduces σ , and one is led to conclude that the welfare costs of exchange rate volatility look to be rather small.

However, when we come to consider the impact of persistent deviation of the exchange rate from its long-run equilibrium value, the picture becomes more complex. We must now acknowledge the possibility that firms' investment decisions may be distorted, even if they are perfectly well aware of the fact that a particular value for the exchange rate may be unsustainable. The recent work of Dixit (1989 a,b) sheds light upon the issues involved. What he shows is that a firm contemplating entry into an export market at some fixed cost, and facing a fluctuating exchange rate, will choose to delay entry until the rate has moved to a significantly more favourable level than that which would have triggered entry in the absence of any uncertainty about future exchange rates. By the same reasoning, firms will choose to exit from an industry only when making substantial short-run losses (7). What this demonstrates is that even in a competitive environment, there can be a surprising degree of insensitivity of entry and exit decisions to exchange rate movements. If the exchange rate follows an autoregressive process about its long-run fundamental value, influenced by fads or noise trading then so long as the rate does not stray "too far" from fundamentals, the welfare losses from resource misallocation are likely to be small. However, once the rate has moved sufficiently far in either direction that entry or exit decisions begin to triggered, the effects of these decisions will be long-lasting.

But by no means all investment decisions are of this kind. International portfolio investment which takes place when exchange rates are misaligned can lead to large welfare losses resulting from resource misallocation. A simple example will illustrate the point. Suppose that the exchange rate stands at 200 yen to the dollar, but that its true long run equilibrium value is 150. Then, at the margin, any investment project undertaken in the United States and financed by Japanese investors will displace a project in Japan whose true rate of return is one-third higher. In other words, when the exchange rate falls to 150, the welfare loss resulting from the diversion of resources from higher yielding investment projects in Japan is measured by the full amount of the drop in value of these investments. This loss is not simply a transfer from Japan to the United States, but rather represents the capitalised value of foregone profits stemming from the misallocation of investment resources. A rough estimate of the magnitude to these welfare losses can be obtained by calculating the net increase in the flow of portfolio investment from Japan to the U.S. during the period 1980-85, and multiplying this figure by the average overvaluation of the dollar for the same period. This gives a figure of close to \$40 billion.

Exactly similar arguments apply too to the purchase of U.S. Government securities by the Japanese, to the extent that these purchases diverted U.S. private saving into low yielding domestic investment. It is surely no coincidence that some of the worst excesses of the savings and loan debacle took place at a time when the dollar was most severely overvalued.

These arguments suggest that the welfare costs of exchange rate misalignment are likely to be substantial. One means by which governments can seek to reduce these costs is by announcing limits outside which the exchange

rate will not be permitted to move, as is the case in the exchange rate mechanism of the EMS.

The exact width of the band is probably of less importance than the signal to markets that central banks are willing to act so as to prevent evident departures from fundamentals. The interaction of financial market inefficiencies and hysteresis in goods markets may otherwise develop into a dangerously unstable process, as follows. An increase in the susceptibility of exchange rates to misalignment makes firms less willing not only to enter, but also to exit from foreign markets. This may fool governments and policymakers into thinking either that the exchange rate is responding to fluctuations in fundamentals, when it is not, or that misalignments "don't matter". In each case, policy may contribute to sustaining rather than eliminating a misalignment.

5. CONCLUSIONS

The belief that financial markets conformed rather closely to the textbook notion of efficiency was overwhelmingly dominant among economists until quite recently. Such a consensus no longer exists, and there is a rapidly growing theoretical and empirical literature, which we have selectively surveyed above, which seeks to document and explain market behaviour inconsistent with efficiency.

Financial liberalisation, by increasing the impact that asset markets have upon the economy, may have costs as well as benefits to the extent that the liberalised markets experience episodes during which prices are driven from their fundamental values by irrational market sentiment, investor misperceptions or fads.

We have focused our attention particularly on the markets for foreign exchange, equities, and housing (in the U.S. and the U.K.), since they all provide examples of considerable turbulence during which the influence of fundamentals on prices appeared to be severely attenuated.

In the case of stock markets, we argue that the case for increased regulation is weak. The pace of financial innovation has been hectic during the '80s, and much of it had a very direct impact upon the trading environment surrounding the major stock markets of the world. It is surely not surprising in these circumstances that market participants should undergo a period of heightened uncertainty as they learn about the behaviour of the market in the new regime. What is required is an institutional environment which further enhances the free and timely flow of information. On this count, the one significant regulatory innovation introduced in the U.S. in response to the stock market crash of 1987, namely circuit-breakers, is a retrograde step.

The efficiency of the market for residential housing has been relatively little studied, but evidence in both the U.K. and the U.S. points to a susceptibility to economically damaging periods of runaway price inflation. Although there is no evidence to suggest that financial liberalisation increases the likelihood that such bubbles will emerge, the increased availability of mortgage credit may well fuel the speculative fire. Changes in margin requirements for mortgage borrowing and in the tax treatment of capital

margin requirements for mortgage borrowing and in the tax treatment of capital gains on housing are the obvious candidates for consideration in any policy reform.

The markets for foreign exchange constitute the strongest case for institutional reform. Empirical investigation has failed to provide any very convincing evidence that these markets behave efficiently in the short run, and the experience of the last decade has taught us that persistent and damaging misalignments may occur over the longer run. It is not persuasive to argue against intervention to regulate exchange rates using the analogy of commodity markets because, in the case of the foreign exchanges, market supply is a policy instrument under the control of the government. Neither a fixed rate regime nor a system of target zones should be viewed as in any way incompatible with freely functioning competitive commodity markets.

While there is still scope for debate over the precise characteristics of any scheme designed to limit currency misalignments, the costs of such misalignments leave us in no doubt that such a scheme is needed.

NOTES

1. See Levich (1985), Hodrick (1987) and Froot (1990) for detailed surveys of these and other efficiency tests of the foreign exchange market.
2. See Frankel (1982, 1988a), Engel and Rodrigues (1989), Giovannini and Jorion (1989) and Thomas and Wickens (1989).
3. This may be premature, since, as we have recently shown, [Miller and Weller (1990)] introducing stochastic shocks to fundamentals dramatically changes the qualitative behaviour of such bubble paths, which become potentially much less explosive.
4. Kupiec (1989) has presented recent evidence to suggest that mean reversion in stock prices has become more pronounced since the 1987 crash.
5. Early evidence of the existence of predictable excess returns in the foreign exchange market was provided by the work of Dooley and Shafer (1976, 1983). They investigated the profitability of filter rules and concluded "many currencies either were not efficient in their use of price information or real interest differentials were large and variable during the sample period". [Dooley and Shafer (1983) p. 68]
6. The recent work of Wang (1990) suggests that a model in which there are informed and uninformed investors, and the uninformed learn about fundamentals by observing prices, may provide at least a partial resolution of the "equity premium puzzle", and can generate time series behaviour for asset prices similar to that in the feedback trading model of Cutler *et al.* (1990).
7. Dixit shows that, for plausible values, a competitive firm will exit only when it is selling at a price 24 per cent below variable cost.

Figure 1

FORWARD PREMIA AND ACTUAL CHANGES IN THE DOLLAR
vis-à-vis THE DEUTSCHEMARK:
 Quarterly, 1980-September 1989

Figure 1A

FORWARD PREMIA AS PREDICTED BY ACTUAL CHANGE IN U.S. DOLLAR

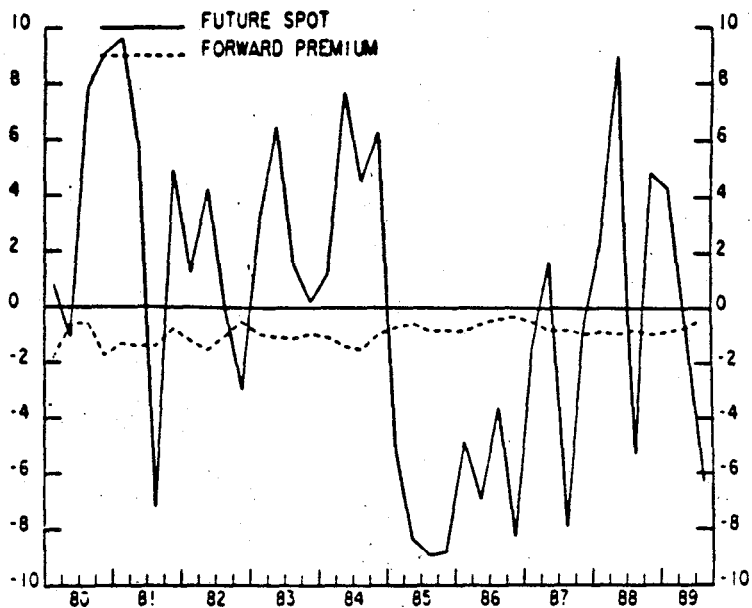


Figure 1B

EXCESS RETURNS ON THE U.S. DOLLAR

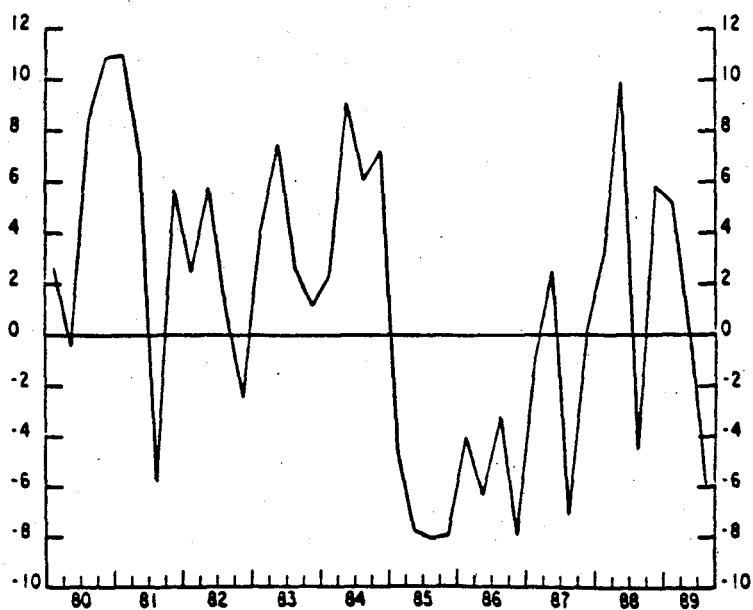


Figure 2A

COMPOSITE REAL EFFECTIVE EXCHANGE RATE, UNITED STATES
(With 20 per cent zone)

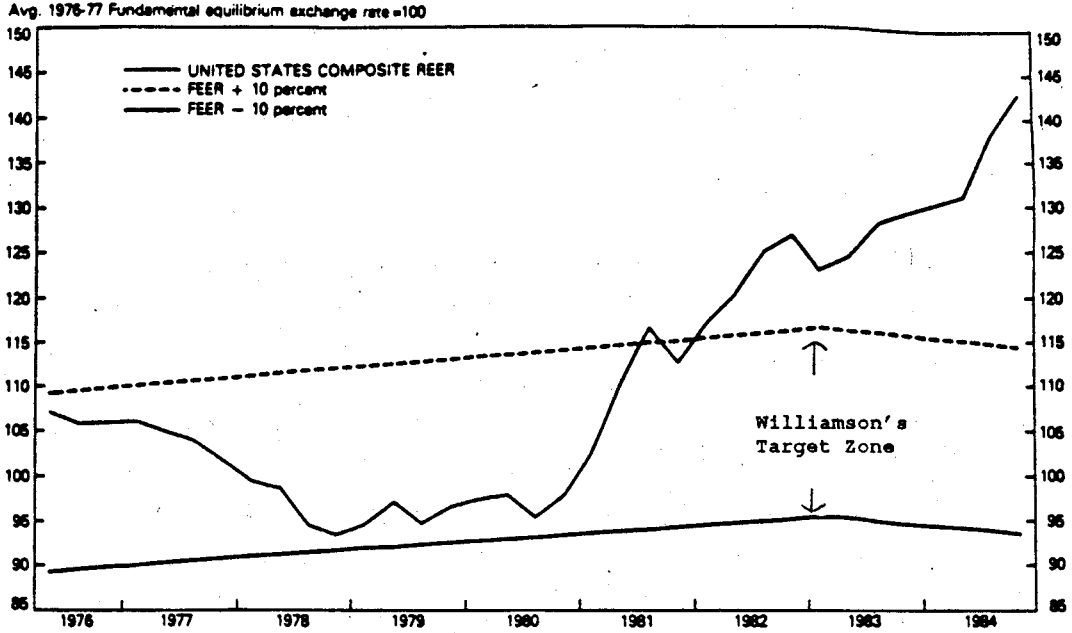
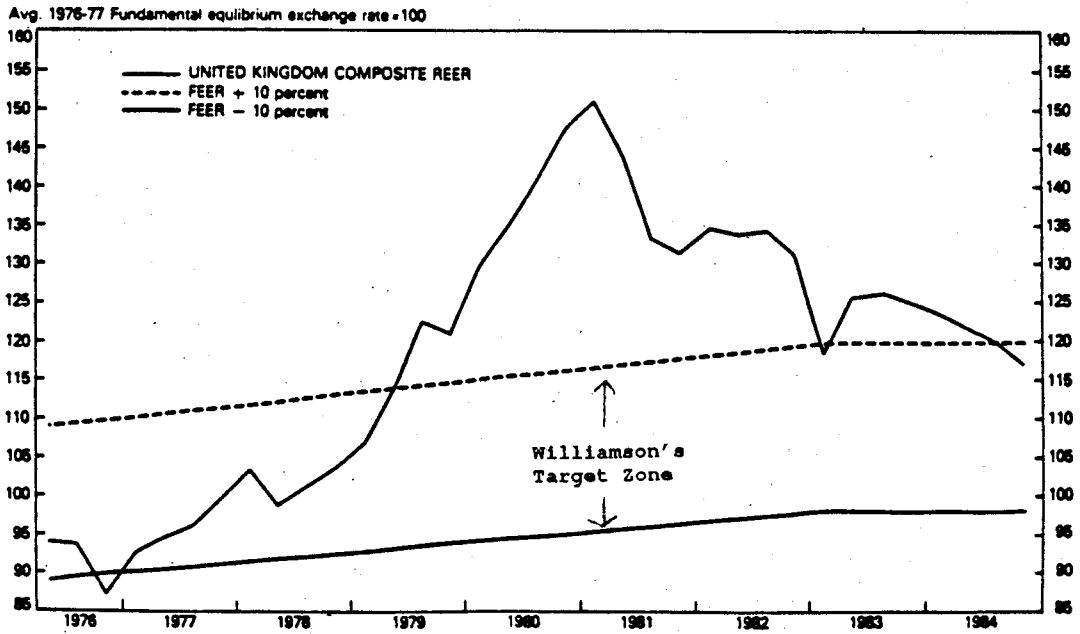


Figure 2B

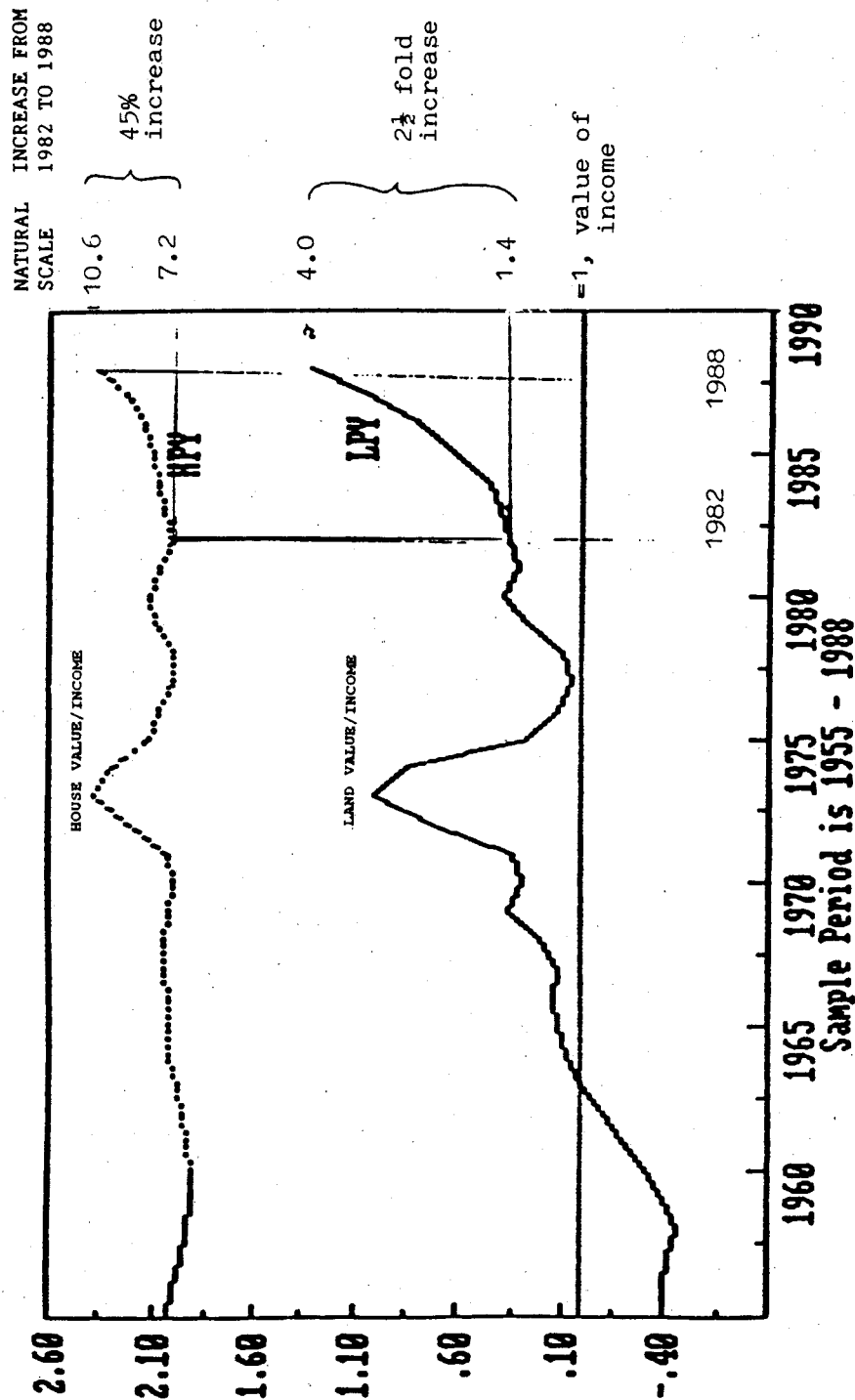
COMPOSITE REAL EFFECTIVE EXCHANGE RATE, UNITED KINGDOM
(With 20 per cent zone)



Source: Williamson (1985)

THE RATIOS OF HOUSE PRICES (HPY) AND LAND PRICES (LPY) TO PER CAPITA PERSONAL DISPOSABLE INCOME (IN LOGS)

Figure 3



SOURCE: Muellbauer (1989)

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