3. THE TRANSMISSION OF MONETARY POLICY THROUGH INTEREST RATES - POLICY RATE EFFECTS ON OTHER INTEREST RATES, ASSET PRICES, CONSUMPTION AND INVESTMENT

This chapter is concerned with how and why central banks change their policy rates (3.1), and what happens when they do. An overview of those effects is presented in 3.2. Impacts on other interest rates are explored in 3.3, while 3.4 and 3.5 look at repercussions on consumption and investment. Chapter 4 then extends the analysis to other variables.

3.1 THE PROMPTS FOR OFFICIAL INTEREST RATE CHANGES

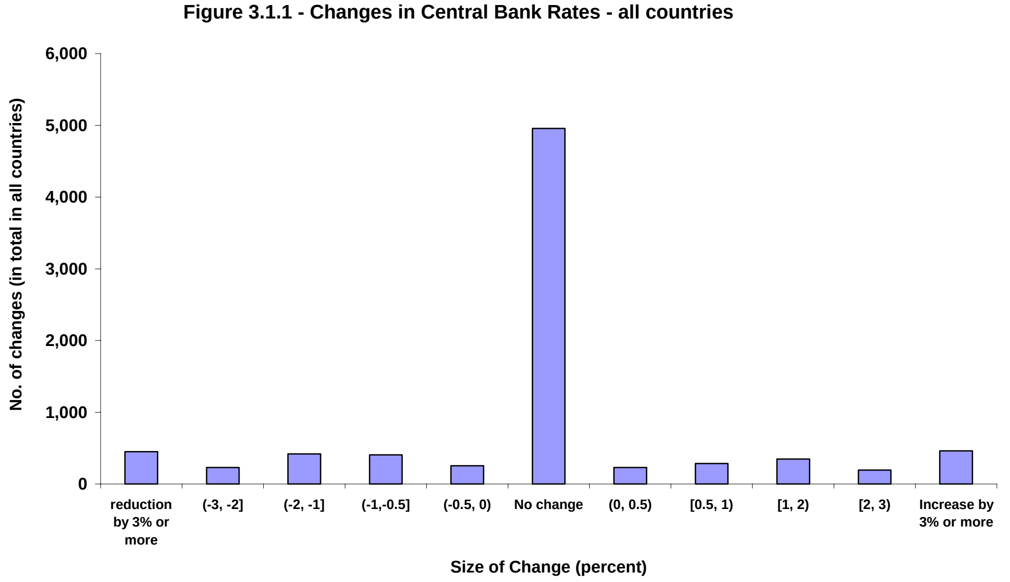
Most monetary policy decisions mean changes in central bank interest rates. Much of this volume is concerned with tracing their effects. It helps to begin by studying those interest rate changes. This section gives, first, a statistical picture of *how* these interest rates moved in as large a spectrum of countries as available data allow. The next step is to ask *why* they moved. So most of this section is devoted to uncovering information about central banks' reaction functions. But interest rates change for a reason – often, to stabilise the macroeconomy in the face of shocks. So it is useful to see *why* they change. Hence the first paradox of monetary policy: perfectly successful stabilisation would mean that the instruments of monetary policy were completely powerless and unnecessary!

As Charts 3.1.1-6 reveal, the modal event is for the central bank interest rate not to change. When changes occur, over the 21 years studied, they usually exceed 100 basis points. Quarterly changes of at least 300 basis points seem the rule in much of Latin America, and in transition countries too. Many African and Asian countries, on the other hand, appear loath to change interest rates at all.

Short-term official interest rates are the main instrument of monetary policy. In some countries these are set by the central bank; in others by the finance ministry; and in some, by the two institutions in concert or at least in consultation with each other. These two chapters examine the consequences of such interest rate changes: what happens to other interest rates, to key elements of aggregate demand, and to inflation. The dependability, magnitude and speed of these repercussions will be explored, with analysis and some econometric evidence drawn from a wide variety of countries' experiences.

So what prompts changes in official interest rates? There are really four main influences here. These are current levels, or forecasts, of inflation; current levels, or forecasts, of the output gap (that is, the difference between the economy's level of real income, and its estimated potential); where available, the market's expectations of future policy rates; and official interest rate changes abroad.

Charts 3.1.1-6: Quarterly Changes in Official Interest Rates, 1980-2000 (and shorter periods in some countries)



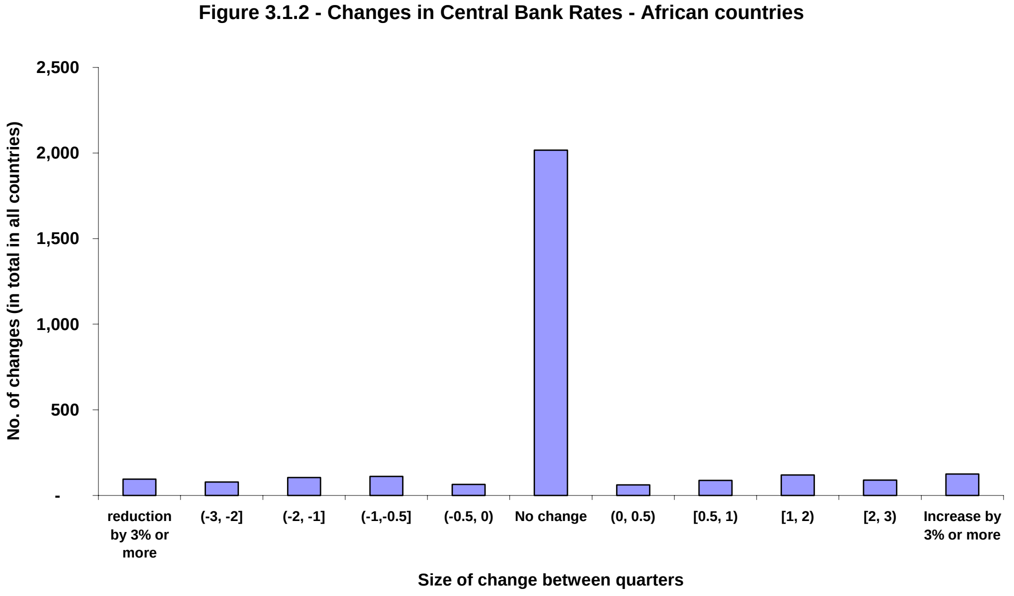


Figure 3.1.3 - Changes in Central Bank Rates - Asian countries

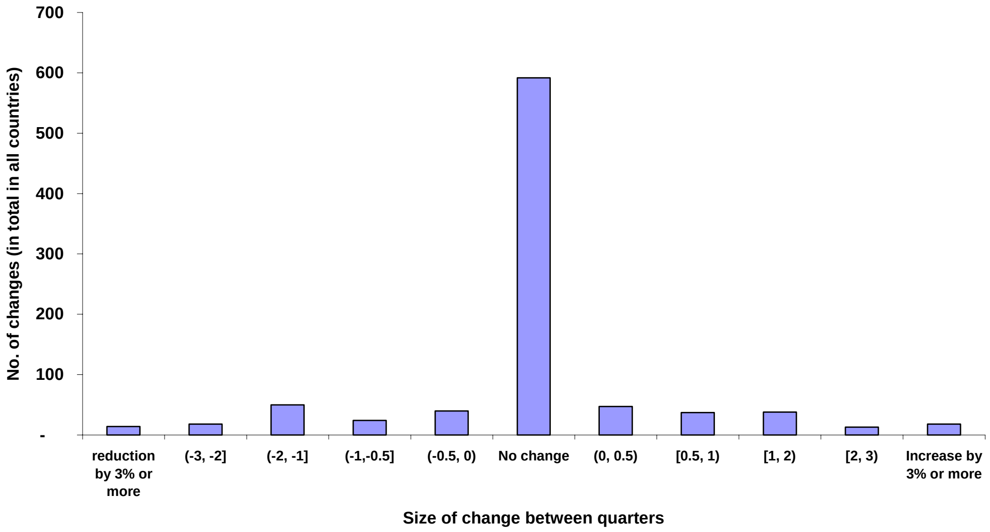


Figure 3.1.4 - Changes in Central Bank Rates - Latin & Carribean countries

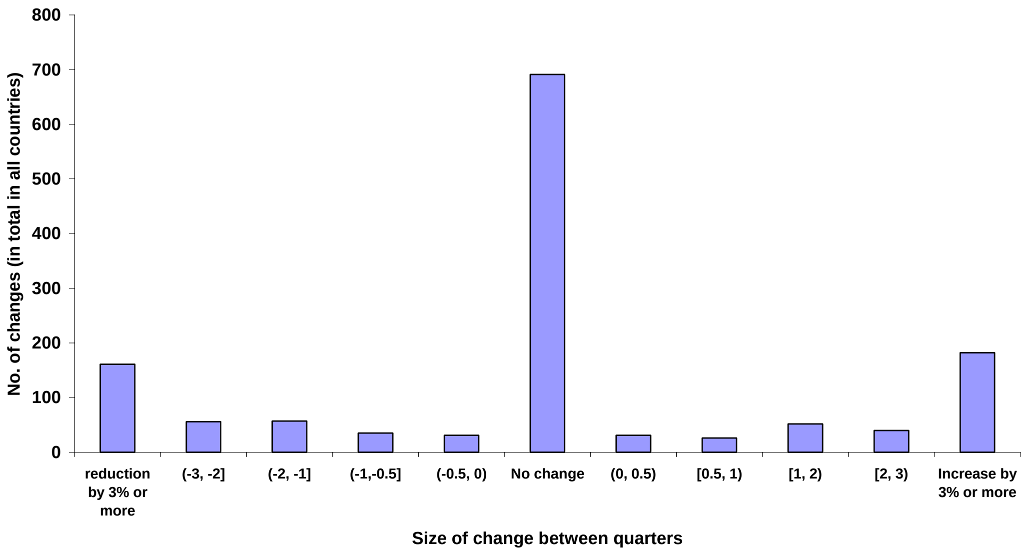


Figure 3.1.5 - Changes in Central Bank Rates - OECD countries

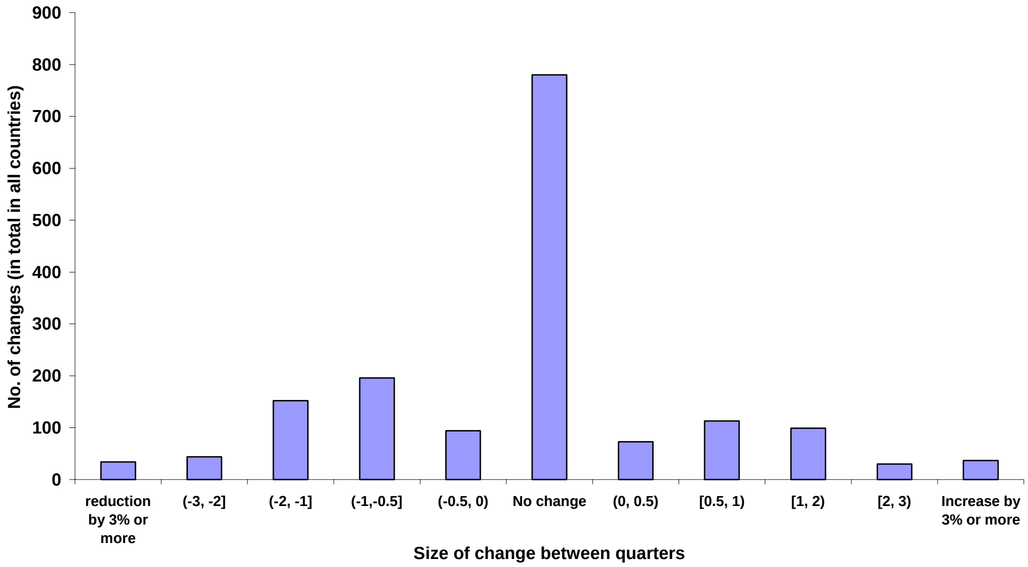
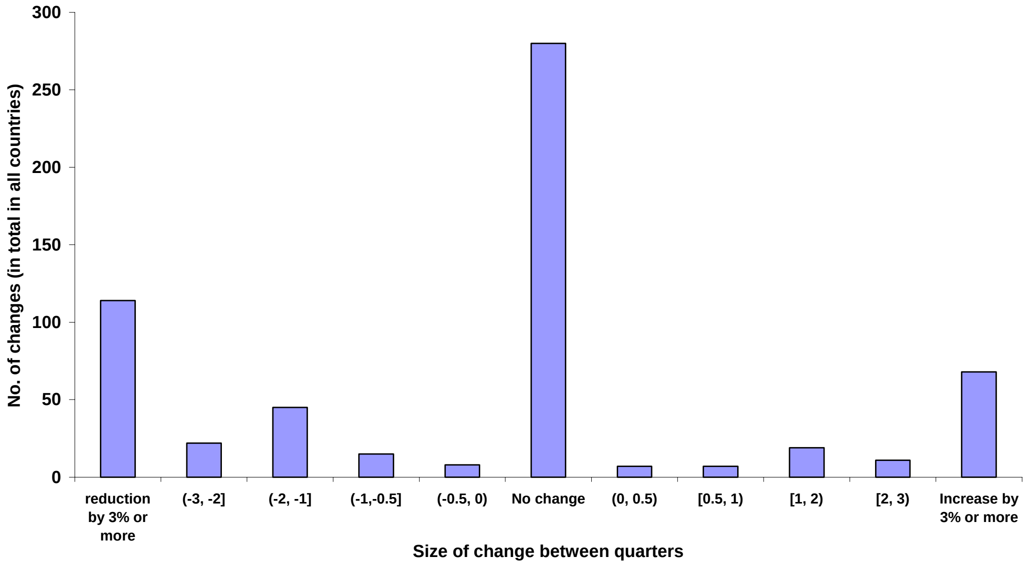


Figure 3.1.6 - Changes in Central Bank Rates - Transition countries



Nominal, official short-term interest rates ("policy rates") are raised primarily to moderate the rate of inflation. This is especially true for central banks with an explicit inflation target. With inflation above target, or thought soon to climb above it, interest rate increases are needed to dampen inflation by squeezing domestic expenditure. This is the second paradox of monetary policy. If nominal interest rates are now too high (because inflation and inflation expectations are too high), central banks may need to *raise* them further, to reduce inflation (and interest rates too) later on. So, in the war against inflation, high nominal interest rates are both an admission of defeat – recognising the unwelcome reality of excessive inflation – and the key weapon that can lead to eventual victory.

Inflation matters, too, for central banks which target other variables, such as the exchange rate, or some measure of the supply of money. Domestic macro stability is the final aim of money and exchange rate targeters just as for inflation targeters. Keeping the exchange rate on track will become increasingly difficult if domestic inflation persistently outpaces inflation abroad (by a larger margin than could be ascribed to other developments, at least). Adhering to a monetary target will also prove harder and harder if inflation is too rapid, because the demand for monetary aggregates will run away. In both cases, higher policy rates are needed. With output above potential, the monetary authorities will seek to stabilise it, both for its own sake and because a positive output gap threatens inflation, or indeed increasing inflation.

The third likely influence on official interest rates is the market's *expectation* of future policy rates. In many countries, something about these expectations can be gleaned form term structure data for treasury bill and money market interest rates (and government bond markets). When markets anticipate a policy rate rise in the near future, a decision to leave them unchanged, contrary to these expectations, may have numerous effects – some undesirable, some deliberately sought. There may be sudden negative pressure on the exchange rate. The prices of other assets, such as equities and long-term bonds, may jump. The demand for domestic dwellings may strengthen, reflecting the unexpectedly generous supply and terms of credit. Domestic aggregate demand will be buoyed up, with positive effects on labour demand, money wage rates, and the prices of goods and services in the medium term.

A fourth and final possible prompter for higher official interest rates at home is changes in policy rates (now, and expected in the future) *abroad*. In countries that attempt to target the exchange rate, the monetary authorities will watch international interest rate differences keenly. If rates rise abroad but not at home, and with no controls on international capital movements, capital may flee overseas, possibly in vast amounts. Even countries that maintain a freely floating exchange rate will not be indifferent to the domestic inflation and output consequences of large exchange rate depreciation (or appreciation), operating through the home currency prices of traded goods and those sectors' labour demand and pay settlements. Furthermore, when a major central bank abroad increases its policy rate, it reveals something about its own intentions, expectations and information. The domestic authorities may draw inferences about world trading conditions affecting many of its domestic firms. A rate cut abroad could signal a downward revision in expected world trade growth. Stabilising domestic output and inflation may call for a domestic official rate reduction in those circumstances.

The probability and size of an official interest rate change at home are largest when all four prompts point in the same direction. If interest rates abroad have just risen, if treasury bill and money market term structure data (where available) point to market expectations of interest rate rises in the near future, and if domestic output and inflation appear abnormally high, the monetary authorities at home will usually wish to raise rates. A combination of recent rate cuts abroad, a downward sloping term structure at the short end, and abnormally low inflation and output will point to the need for an official interest rate cut. Sometimes the prompts may point in different directions. Decisions will then be challenging and less easy to predict. The character of target regime, if there is one, will become important: inflation targeters are likely to pay most attention to inflation outturns and predictions, while for exchange-rate targeters, it is probable that official interest rate developments abroad will matter most.

What do these interest rate data tell us? Some impression of the central authorities' reaction functions can be conveyed by econometric evidence. We ran regressions for changes in official interest rates against changes in inflation, changes in the current output growth rate relative to trend, and interest rate changes by the US Fed (in the case of Austria, Belgium, and the Netherlands, the Bundesbank rate). The main results for the largest available sample of thirty-seven countries, estimated on quarterly data from the start of 1983 to the end of 2000, are as follows.

Changes in inflation are found to have a positive effect upon interest rate changes in all but six countries. In twelve, this effect is significant. It is highest in Chile and Israel, the only countries where nominal interest rates rise more than one-for-one with current inflation, and about a half (and significant) in Britain, Portugal, Australia, New Zealand, Mexico and Thailand. Changes in current inflation have a smaller, but still significantly positive effect in the US, Finland, Germany and Turkey. The measured effect of inflation on official interest rates may be weak, as preemptive action may already have been taken. This observation also holds for output growth.

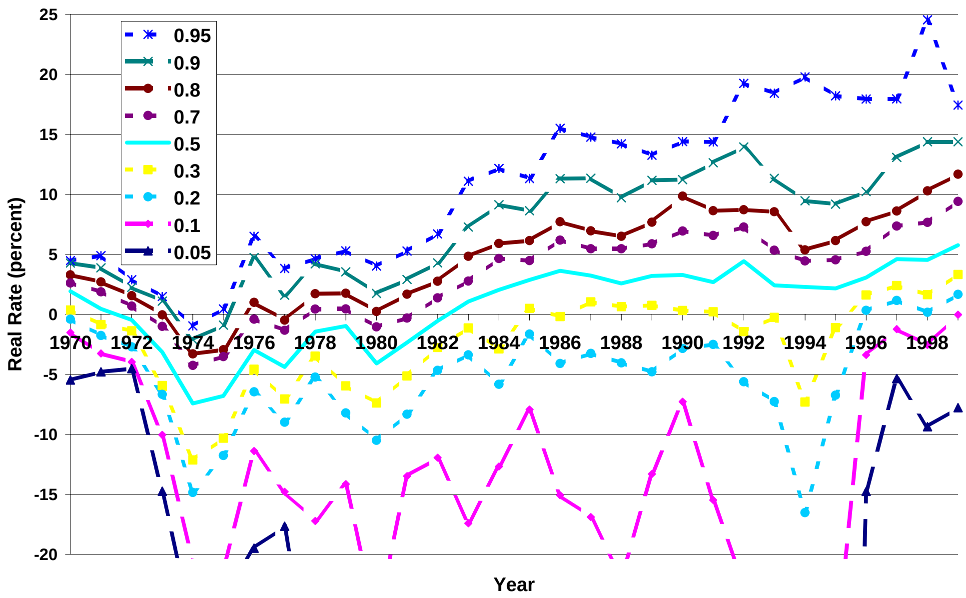
Output growth has a significantly positive impact in Australia, Costa Rica, the Netherlands, Switzerland and the US, and nearly so in Belarus, Britain, South Africa and Spain. The effect is positive but insignificant in many others. But in half the sample it is negative. Of these three countries, Germany, Peru and Turkey, display significantly negative coefficients. What could explain this? In some cases, at least, it may be that the onset of a financial crisis triggers a simultaneous fall in output and rise in interest rates. The same responses would follow a serious, adverse, domestic supply shock (and that could of course easily prompt a financial crisis, too).

Thus far, our results match those of many other recent empirical investigations of the hypothesis that central banks follow some reaction function, such as a Taylor Rule. The studies by Clarida et al (1998, 1999, 2000) are celebrated examples. Our canvas, however, is as broad as possible. Another thing that is new in this Report is the inclusion of other central banks' interest rates in the regressions. We find that the US rate (or for Austria, Belgium and the Netherlands, the German rate) has a significantly positive effect for fourteen countries. In some cases, such as Costa Rica, Latvia, and South Africa, it is the lagged foreign rate that works this way; for others, the foreign rate appears to exert an immediate effect. For Canada, the coefficient on the US rate exceeds unity. This exposes two possibilities, not mutually exclusive. One is that for much of the period, the Bank of Canada was reluctant to see sharp changes in the exchange rate with her overwhelmingly preponderant trading partner. The other is that the Canadian and US business cycles are so closely integrated that the shocks prompting the Fed to change interest rates south of the border have a simultaneous appearance, and effect, north of it.

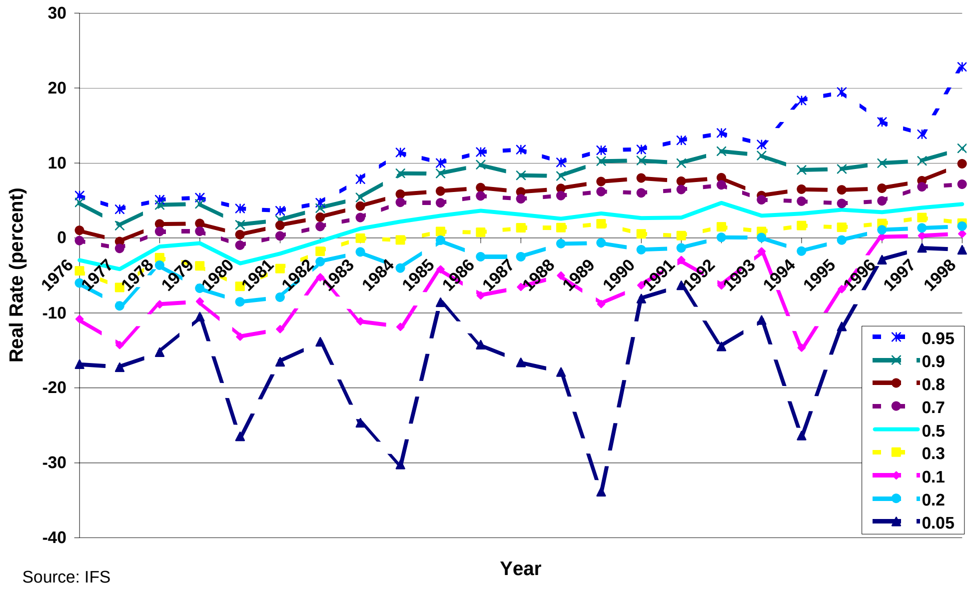
Finally, we take a brief look at the distribution of *real* central bank rates in recent years. Two samples are examined: first, an unvarying population of 56 countries with continuous reporting from 1976 to 1998 (supplemented with occasional interpolation), and second, a varying population of 116 countries from 1970 to 1999. Median and other quartile data are reported for these two samples in Charts 3.1.7 and 3.1.8. The constant population group displays a positive time trend, flattening off in the 1990s. The median central bank's policy rate fluctuated between 1% and 4% below the rate of inflation in the later 1970s and early 1980s, but then climbed to some 3% to 4% above inflation by the late 1980s, where it remained. There is minimal evidence of convergence. The distribution points to a negative skew, with volatile but heavily negative real interest rates for the bottom tail, at least until the late 1990s. The varying population group presents a more complex picture of apparently growing divergence for much of the period. The negative real rates for the whole distribution in 1974-5 betray the effects of the first oil shock. About one quarter of the distribution exhibits negative real rates in all but the last few years, suggesting that financial repression has been widespread in many emerging economies.

The climb in most central bank real interest rates from the later 1970s reflects a variety of influences. Four stand out. First, the normally positive level of real interest rates was restored after the 1970s oil price shocks. Second, the 1980s (and the 1990s) saw serious attempts to cut inflation in many countries, broad success in achieving this aim, and yet some lingering fears, in official quarters as well as the financial markets, that higher inflation might return. Third, several developing countries' central banks became increasingly aware of the drawbacks of policies of financial repression, which had usually held official real interest rates to negative values. Finally, economic growth rates increased, particularly in much of Asia and, at least after 1992, the United States. Although growth and real interest rates are often interdependent, faster given increases in labour productivity, and in the labour force, should both exert a positive long-run effect on real interest rates. Armed with some impression of how central bank interest rates have moved across the world, and why they moved when and where they did, we are now ready to examine what effects these interest rate changes had. The rest of this chapter explores different facets of this.

Fiqure 3.1.7 Quantiles of Real CB rates of 116 countries (1970 – 1999) (varying population)



Fiqure 3.1.8 Quantiles of Real CB rates of 56 countries (1976 - 1998)



3.2 INTEREST RATES AND PRICES: AN OVERVIEW OF EFFECTS

The previous section examined what prompts official interest rate changes. It is now time to look at their effects. The first stage involves the repercussions that official interest rate changes have on other interest rates, and the demand for, and prices of, various assets.

At the core of Stage 1 is the close link that official interest rates display with other market interest rates. In many countries there are bills issued by government (the finance ministry, or Treasury) or, in certain cases, by central banks themselves. The typical bill carries no coupon; it matures for a certain sum, say \$100 or £100, three months or ninety days after it is issued. It is sold below par at a price of x, perhaps in an auction, and if its term to maturity is the fraction θ of one year, the annualised rate of interest on the bill, $\boldsymbol{r_T}$, is calculated from the formula $(1+\boldsymbol{r_T})^{\theta} = \boldsymbol{V}/\boldsymbol{x}$, where V is the price on redemption. Statistically this rate of interest is usually very close to the official interest rate, call it $\boldsymbol{r}_0$. To be precise, the expected average value of $\boldsymbol{r}_0$ over the bill's life, call it $\boldsymbol{Er}_0$, will be given by the approximation $\boldsymbol{Er}_0 \approx \boldsymbol{r_T} + \boldsymbol{n}$, where *n* equals the "normal" excess of $\boldsymbol{r}_0$ over $\boldsymbol{r_T}$. This might lie between about 10 to 30 basis points. The gap between $\boldsymbol{Er}_0$ and $\boldsymbol{r}_0$ should be modest.

So r_T will generally be very close to r_0. Newly issued treasury bills, sold after r_0 has altered, will usually respond about one-for-one. The only cases where they will not are when the rise or fall in r_0 has already been anticipated, or when the market expects the latest change in r_0 to be reversed very quickly. In many economies, money market interest rates can be observed. These rates will behave very much like r_T, varying a little if terms differ. Money market rates will respond to r_0 in similar ways. Funds placed in money markets are very close substitutes for treasury bills.

Financial institutions borrow or lend in money markets. Most also hold treasury bills, which they can augment or run down at will. Retail banks set interest rates on various classes of deposits and loans. These loans consist, in the main, of secured loans to companies, often at variable interest rates, and mortgages, some at fixed interest and some at variable interest, issued to households purchasing property. For retail banks, r_T (or its money market equivalent) reflects the marginal cost of issuing a loan. The expected marginal revenue from loans will equal the interest rate on loans, r_L, with adjustment for management costs, any monopoly power, and a margin for expected default. When r_0 rises, r_T rises too, and we should expect r_L to rise quite soon as well, though not always quite one-for-one. A profit maximising retail bank will seek to equate the expected marginal revenue from its variable-rate loans with r_T (or its money market equivalent).

Analogous links can be derived between r_T and r_D, the interest rate offered on a typical deposit. Generally r_D will be somewhat lower than r_T, and particularly so for modest deposits or deposits with chequing rights. Part of the gap can be explained by deposit management costs, and part by the extent of any monopsony power the retail bank enjoys.

The links between r_D, r_L and r_0 are examined in more detail below. They form a key element in the transmission mechanism for monetary policy, because they represent the financial system's main monetary interface with firms and households determining their expenditure plans.

There are other links that matter too, in this connection. In many developing countries, government and public corporations typically conduct most of their borrowing abroad, usually in the medium of US dollars. But in a growing number of both developing and transition economies, and in advanced industrial countries, public agents issue some bonds in domestic currency to domestic portfolio-holders, such as insurance companies. Conditions vary, but most such bonds will be repaid in nominal terms at a specified future date, perhaps five or ten years ahead. Setting aside risks, tax complications and the possibility of illiquidity in thin markets, there should exist a close association between bond yields and the average rates of interest expected on a sequence of three-month treasury bills held over the bond's life.

If $\boldsymbol{r}_0$ is raised by 100 basis points now, and this comes as a complete surprise, the current $\boldsymbol{r_T}$ on the next issue of treasury bills will rise, by something close to 100 basis points if the change of $\boldsymbol{Er}_0$ is close to the change of $\boldsymbol{r}_0$. What will happen to the price of a five year bond, $\boldsymbol{x_B}$? Suppose market's expectations of future values of $\boldsymbol{r_T}$, in three, six, nine and up to fifty-seven months' time, are unchanged. In that case, the average value of $\boldsymbol{r_T}$ expected over the full five years will have risen by roughly 5 basis points (ie 100/20). Ignoring coupons, the market price of the five year bond will be related to the annualised five year bond interest rate, $\boldsymbol{r}_5$, by the formula $(1+\boldsymbol{r}_5)^5 = \boldsymbol{V_B} / \boldsymbol{x_B}$, where $\boldsymbol{V_B}$ is the bond's future value at redemption. In this case, $\boldsymbol{r_B}$ will have risen by 5 basis points, so that $\boldsymbol{x_B}$ should fall by about a quarter of 1%. The longer the term to maturity, the less sensitive the bond's price will be to the current $\boldsymbol{r_T}$.

At the other extreme, market participants may think that the treasury bill rate will stay up at its new high level throughout the next five years. In this admittedly rather unlikely case, $\boldsymbol{r}_5$ will jump by some 100 basis points, not the mere 5 basis points in the previous case when all future $\boldsymbol{r_T}$'s were unaffected by the rise in $\boldsymbol{r}_0$. With $\boldsymbol{r}_5$ up by 100 basis points, $\boldsymbol{x_B}$ will fall by twenty times as much as in the previous case – by very nearly 5%. So how much bond prices react to changes in $\boldsymbol{r}_0$ depends on two things above all; how long the new higher official interest rates are expected to persist, on average; and on the bond's life. They will also react to changes in expected inflation. If an official interest rate increase is interpreted as a major assault on inflation, which is expected to succeed, bond interest rates would rise at the shorter end and fall at the long end of a maturity spectrum.

Similar observations apply to the price of equities. The equity – interest rate link is explored further below. One key to unlock them, in the simplest case, tax and risk considerations aside, is the equation

$$\boldsymbol{P_E}(1+\boldsymbol{R}_1) = \boldsymbol{d}_1^{\boldsymbol{e}} + \boldsymbol{P}_{\boldsymbol{E}1}^{\boldsymbol{e}} \qquad (3.2.1)$$

Here, P_{E1}^{e} is the current expectation of the (real) price of equities is in the next period, say a year's time; d_1^e is the current expectation of the (real) dividend payment then; and R_1 is the current real interest rate over the period. This equation suggests that the proportionate fall in P_E now approximates to the rise in the expected value of all future real interest rates, and the proportionate change in all future ratios of d to P_E. How much today's official policy rate rise reduces current equity prices depends on the extent to which this raises real interest rates, and how long for. The impact may well be modest, particularly if ex-ante real interest rates at home have to match those abroad with free international capital mobility. Equities are internationally traded assets in that case. Real estate is different. Here international trade is usually negligible. Domestic official interest rate decisions, and the supply of domestic credit to which they are often (negatively) linked, can make for powerful repercussions. Again, a closer look at this relationship is provided below, in section 3.5.

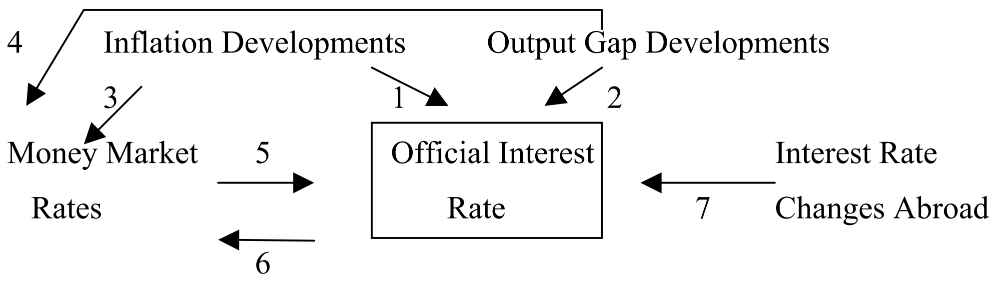
When policy rate changes alter the values of real estate, equity and bonds, they change aggregate net wealth. Bonds may play a rather weak role here, because bonds usually represent a claim by one domestic resident against another (often the taxpayer whose taxes have to service public sector debt). Bonds can matter though, perhaps because most taxpayers are unaware of how government borrowing affects their future net income, but more particularly when the country's net bond holdings are non-zero. Countries with net obligations, public or private, to the rest of the world are impoverished to some degree if the real value of those obligations goes up. The final asset price to consider in Stage 1 is the price of foreign currency. Here a rise in domestic official nominal interest rates should lead, all else equal, to an appreciation under free floating, or perhaps a reduced risk of a devaluation under a regime of adjustable pegs.

Stage 2 is the effect that asset price changes have on expenditure. A fall in P_E implies a higher cost of equity capital for firms. A fall in bond prices raises the cost of debenture (corporate bond) external finance. Firms are likely to react, all else equal, by revising their investment plans downward. Investment expenditure is liable to fall, with a lag. Working capital decisions will be sensitive to short interest rates, and fixed investment to longer interest rates, because prudence enjoins firms to match the maturity structure of obligations with the maturity structure of the assets those obligations finance. For consumers, a fall in net wealth will inevitably constrain consumption spending, but often with a lag (or a phased set of lags) to reflect perception delays, commitments and adjustment costs. There is also some direct impact on consumption plans, through intertemporal substitution, but evidence provided below suggests that this effect is far from robust or large, at least for non-durable spending. Changes in the market value of real estate should have a large and quite protracted affect upon construction outlays by both the household sector (dwellings) and the corporate sector (structures investment).

Summing these effects, together with those on the trade balance emanating from any appreciation in the exchange rate, gives us the impact upon aggregate nominal demand. This should certainly be adverse, all else equal. But it may be modest, and a distributed lag of several quarters, of up to 2 years, could fit the data. One important qualification relates to the factors that triggered the policy rate rise. If it responds to overseas rates, a larger impact may be expected than if the policy rate is raised in the face of a rise in domestic inflation, actual or expected. When an policy rate rise matches a rise in inflation, expected real interest rates will be unaffected - and in this case there is little reason for expecting firms and households to vary their spending plans. To squeeze private sector demand, policy rates have to go up by *more* than the rise in anticipated inflation.

Stage 3 is the impact on prices and wage rates. If money wage rates are given, and the prices of goods and services are freely flexible, there will be some reduction in prices as demand turns down. The factors determining the magnitude of this are examined below. Money wage rates are also liable to change, but probably after lags reflecting pay revision patterns (the frequency of which will depend positively on inflation). Money wage changes, when they occur, will tend to match changes in the prices of goods and services, current and anticipated, after allowance for changes in productivity. But absolute money wage reductions are exceptionally rare even in a low inflation environment (Crawford (2001), Nickell and Quintini (2000)). The pace of money wage increases is reduced when the supply of labour, in aggregate, outstrips labour demand.

A rise in policy rates that translates into changes in real interest rates is liable to raise labour supply for intertemporal substitution reasons. Higher real interest rates offer a stronger inducement to postpone the pleasure from consumption; equally, they may persuade economic actors to advance pain. But the size of this effect is likely to be small, partly because intertemporal substitution effects are modest, and partly because there are sizeable costs of, and practical obstacles to, variations in hours of work. The demand for labour should react much more than its supply. If firms face a weakened demand for their products in domestic or overseas markets, their labour requirements will drop. There is also a direct interest rate channel on labour demand, in the case of industries where labour is engaged *before* the product is completed and sold. Here a higher policy rate should weaken the demand for labour straightaway, because it lowers the discounted present value of the proceeds of output on sale. This effect is explored below. With labour demand down, partly in the near future and partly later on, and the supply of labour if anything possibly increased, unemployment should tend to go up. As it rises, unemployment should exert a dampening effect on pay settlements, and the rate of price inflation should edge downwards in response. A schematic representation of these four stages is as follows. Stage 0 depicts the triggers for official interest rate changes.

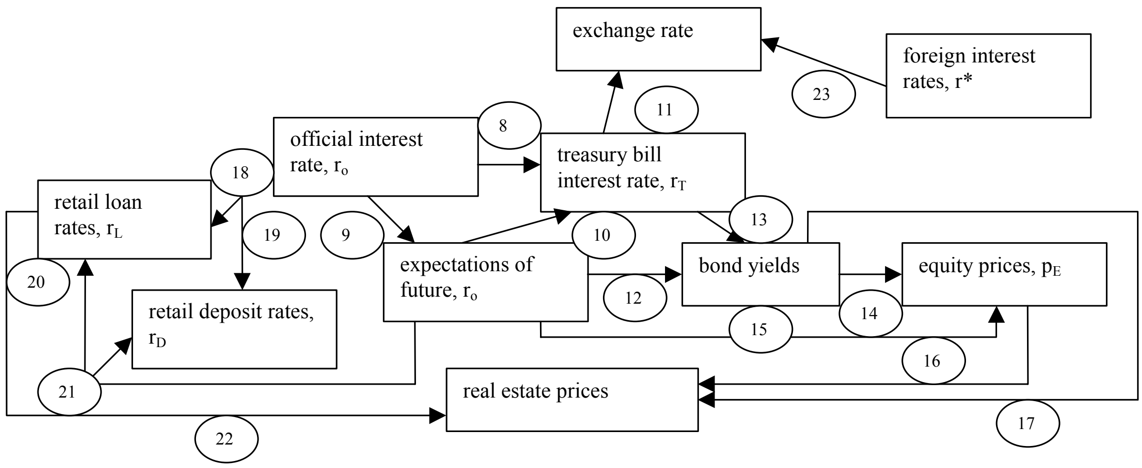


Stage 0: The Triggers for Official Interest Rate Changes

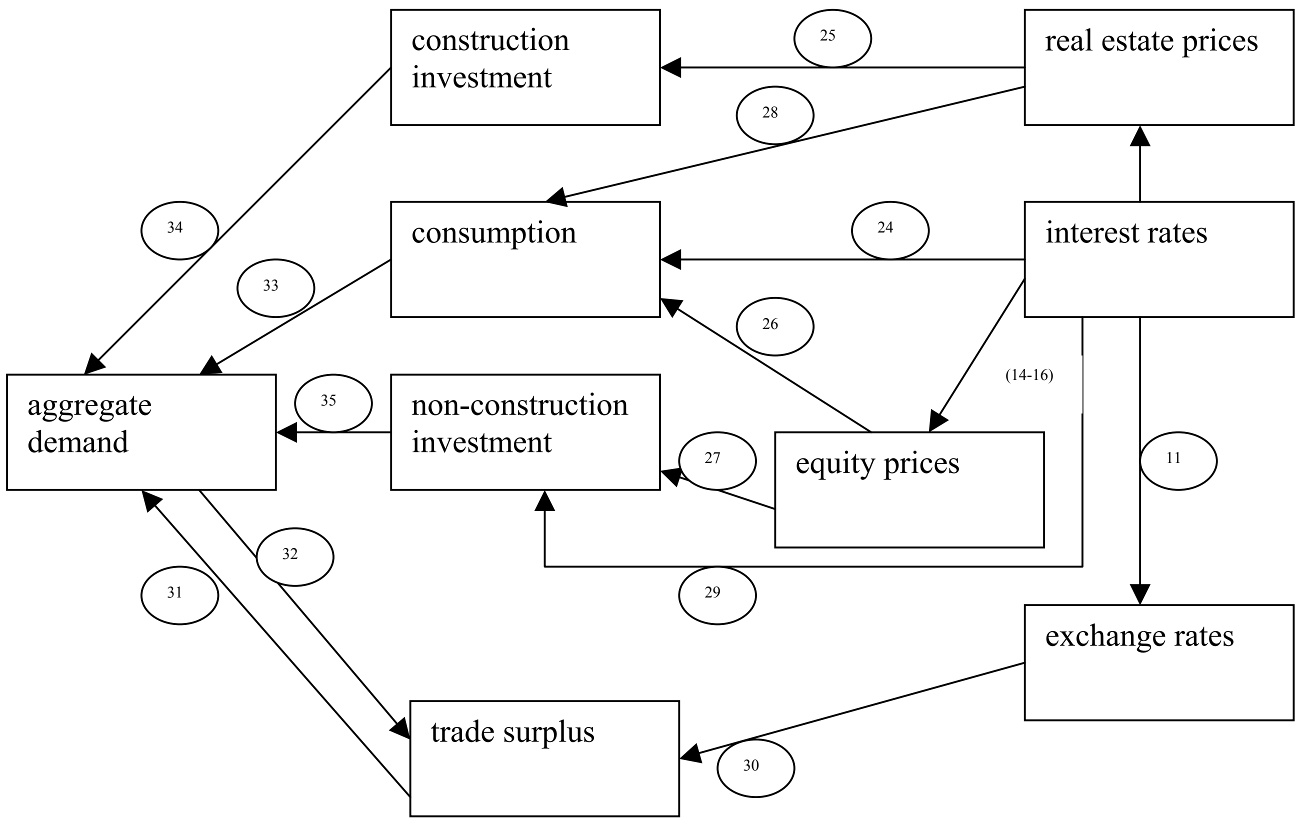
Links 1 and 2 depict the operation of a Taylor Rule on the authorities' behaviour. Both should be positive. Links 3 and 4 arise because market participants may expect changes in the official rate, $\boldsymbol{r}_0$ soon: the Central Bank may take implicit market expectations into account (link 5). Link 6 is a reverse causation channel, from the policy to the money market rate. Link 7 is the influence from foreign interest rates. Evidence on links 3 and 6 is explored on daily data by Haldane and Read (1999), Joyce and Read (1999) and, following them, by Gravelle and Moessner (2000a, 2000b) included in this volume, among others. A central bank with highly transparent policy should display money market rates (and other asset prices) reacting to economic data announcements that could herald imminent central bank interest rate changes – and much less, if at all, to those subsequent policy rate changes. Some of the evidence of recent UK and Canadian experience is consistent with this view. At lower frequencies, links 5 and 6 are impossible to tell apart: they are simultaneous.

Some new multi-country evidence of the strength of links 1, 2 and 7 is reported here. Influence 1 is well attested. Current quarterly inflation changes invariably exert a positive effect on policy rate changes for all countries. But the size of the coefficient varies widely. It is often significant, but usually quite modest in size, well below Taylor's original hypothesis of 1.5. Link 2, by contrast, is often much larger. Almost nowhere is it negative. Official interest rates are highly procyclical. Abnormally rapid growth in output is taken as a signal to put on the brakes. Abnormally slow growth leads to interest rate cuts. Scrutiny reveals that it is *deseasonalised* growth rate abnormalities that tend to exert more effect than deviation in actual growth rates from trend. Turning to influence 7, we proxy foreign interest rate changes by changes in the US Fed rate. The evidence points to a much stronger effect for some countries than others. In Canada and Mexico, where the US accounts for an overwhelming share of overseas trade, the coefficient is large and highly significant. It is also large and significant for some other countries that have maintained a peg to the US dollar for most of the period studied (Argentina, Hong Kong). For many other countries, influence 7 is rather weaker. Some of these, like Australia, appear to respond to US rates rapidly; in some others, such as Sri Lanka, there is clear evidence of a lag. Some non-American economies (such as Ireland) displayed stronger influence from US rates in the later 1990s than earlier. Stage 1 traces the repercussions of policy rate changes on other interest rates or asset yields. Policy rates exert a direct effect on r_T (link 8), and expectations of future policy rates (link 9). When the new value of r_o is expected to be maintained over the next three months, links 8, 9 and 10 will make r_T respond virtually one-for-one with r_o. If the exchange rate floats, and the interest rate change was unexpected, some appreciation should result (link 11). Under an exchange rate peg, the rise in r_o should reduce the risk of a forced devaluation. As the equilibrium exchange rate will be sensitive to the gap between home and foreign interest rates, link 23 matters here, too.

Stage 1: The Repercussions on Other Interest Rates and Asset Prices and Yields

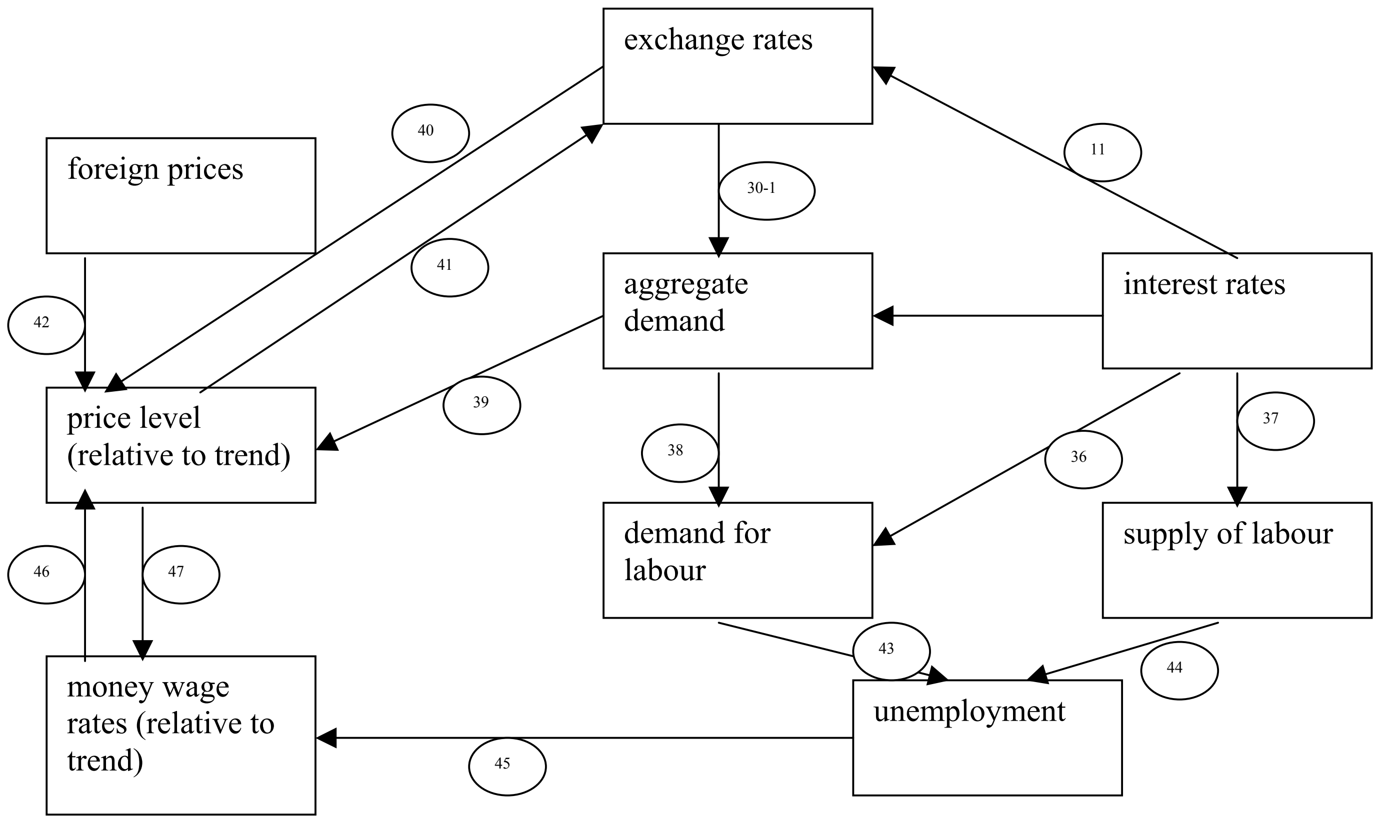


How bond yields react depends on their term to maturity, and on how expectations of future values of r_o over the bond's life vary with a change in r_o (links 12 and 13). Bond yields and beliefs about future r_o impact on equity prices, P_E, (links 14 and 15). Retail rates on bank deposits $r_{D,}$ and loans, r_L react swiftly to r_o (links 18 and 19). They are strongest, and quickest, if the new value of r_o is expected to last. So links 20 and 21 matter, too. Mortgage interest rates, and responses of bond and equity yields, affect real estate markets (links 22, 16 and 17). Stage 2 looks at how all interest rates affect expenditure. There are direct interest rate effects on consumer spending, particularly on durables, (link 24, discussed in 3.4). Real estate prices are associated with construction (link 25: 3.5), and consumption (link 28), via direct wealth effects. Consumers can take out loans secured on property (higher house prices enhance their willingness to do this, and lenders' preparedness to lend). Equity prices also affect consumption via wealth effects (link 26). Non-construction investment spending should react to equity prices (link 27) and interest rates (link 29): equity and bond yields are two key elements in firms' external finance costs. Any change in the exchange rate will affect the external trade surplus (link 30): appreciation would lower it, though possibly after a perverse initial response. If the country has large net overseas assets or debts which are denominated in foreign currency, an exchange rate change alters balance sheets and service income flows. The trade surplus is an element in aggregate demand (link 31). The trade surplus depends upon aggregate demand, as lower domestic spending reduces imports (link 32). So the trade surplus - aggregate demand links run both ways. Links 33, 34 and 35 testify to the fact that consumption, and both construction and non-construction investment, are part of aggregate demand.



Stage 2: The Effects of changes in Interest Rates and Asset prices on Aggregate Demand

Stage 3 involves the last phase of the transmission mechanism of monetary policy. This runs from aggregate demand, interest rates and other affected variables to the *rate of inflation*. A key element here is the repercussions, direct and indirect, that interest rates have on labour markets, and hence on wage rates. Running through the links, we begin with links 36 and 37, which refer to the direct impact of interest rates on firms' demand for labour, and households' labour supply. These are examined in section 3.7. The main effect of interest rates on labour markets comes, though, through aggregate demand, operating upon the demand for labour (link 38). Changes in aggregate demand imply some direct change in the price level, to the extent that it is free to adjust (link 39, in section 3.6). Links 40 and 41 refer to the two-way interaction between the exchange rate and the domestic prices, while link 42 pinpoints the role of foreign prices in affecting domestic prices. This matters for two reasons: first, an import price shock is an example of the kind of shock domestic monetary policy has to contend with; and second, changes in foreign prices may reflect the actions of overseas central banks. Links 43 and 44 identify the impact that the demand for and supply of labour have on the level of unemployment, which affects the rate of money wage increases (link 45). Links 46 and 47 refer to the two-way interaction of the price level and the money price of labour.



Stage 3: The Effects of Changes in Interest Rates, Aggregate Demand and other variables on Unemployment, Wage Rates and Prices

3.3 POLICY RATES AND RETAIL INTEREST RATES

When the central bank alters its policy rate, variable rates on retail financial products should move in sympathy. But they will not necessarily change at once, nor one-for-one with official rates. The transmission mechanism for monetary policy depends critically upon how firms' and households' spending decisions react to the interest rates they face. But the short-term interest rates that confront them are not central bank policy rates, but retail rates on loans and deposits set by commercial banks. Unless competition is strong, a retail bank is unlikely to be an interest rate taker in its deposit and loan markets. But no commercial bank could exert any appreciable influence on the interest rates on treasury bills or short-term government bonds – nor on policy rates. These rates, usually close, represent a benchmark, a guaranteed marginal revenue that a commercial bank can earn on assets.

Ignoring tax and risk and transaction costs, a profit-maximising bank should equate the marginal revenue from other assets (loans, advances and mortgages) to this benchmark rate. If marginal revenues were higher on loans than on treasury bills, for example, the bank could raise its total revenue at no cost by switching from the latter to the former, and would continue to do so until the marginal revenue gap had closed. The benchmark is also a target for the marginal cost of deposits for the profit maximising bank. If marginal deposit costs were above (below) the benchmark marginal revenue on treasury bills, a reduction (rise) in deposits could add to profits.

Loan rates exceed the benchmark rate for several reasons. There are initial costs of processing loan applications, monitoring borrower credit-worthiness and continuing costs of managing loans that have been granted and monitoring interest receipts and repayments of principal. The possibility of default has to be allowed for. On the deposit side, the marginal cost of deposits includes costs of managing deposits, issuing cheque books, cards and statements, effecting transfers and clearing cheques when these activities are, as is usual, not separately charged for. These various costs help to explain why deposit rates typically fall some way short of official central bank interest rates, and why loan rates typically exceed them.

On top of these costs, imperfect competition may be present. If there were just one commercial bank, or a set of banks that colluded as one, loan rates would be surcharged (under profit maximization) by a premium inversely proportional to the interest-elasticity of loan demand (e, defined positive) that the bank or group of banks believed it faced. Deposit rates would be reduced by a discount inversely proportional to the interest-elasticity of deposit supply (E). With n similar banks taking independent quantity decisions on deposits and loans, believing that their rivals' quantities are given, the mark-ups on loan rates become 1/en, and the discounts on deposit rates fall to 1/En. If each bank set its own interest rates on loans and deposits, treating rivals' rates as given, the perfectly competitive outcome should follow, but collusion would enlarge spreads between the two. Market segmentation, all too likely if customers face appreciable costs of switching from one financial intermediary to another, is another force that could increase spreads. At least tacit collusion may be fostered, particularly on the loan side, if a unilateral decision on the part of one bank to cut rates is thought to attract poor quality extra business. Some new loan applicants would have been denied credit by other banks with superior, private knowledge of the greater risks they pose.

As it is costly to change prices, banks may delay before responding to policy rate changes. If they had any reason to expect a reversal in the policy rate change in coming weeks, they might leave their own rates unchanged. There may also be a narrow range within which official rates can move while provoking no retail interest rate response. And in an oligopoly where each bank is always looking over its shoulder to what its rivals are doing, there may be some reluctance, at least for smaller institutions, to initiate an interest rate change – particularly upwards on deposits, or downwards on loans – for fear of triggering a price war. Imperfect competition has recently been introduced into many analyses of international trade and exchange rates, growth, macroeconomics and labour economics; retail banks are not immune from this shift away from the perfect competition paradigm.

Imperfect competition, and other sources of friction, could, therefore, impede the transmission of central bank interest rate changes to the wider economy. So it is valuable to explore the statistical link between official interest rates on the one side, and interest rates on loans and deposits on the other. Here we are following the recent work on British retail interest rates by Heffernan (1997). A wide sample of countries was chosen – all the countries for which International Financial Statistics present data. This was the source employed; occasionally there are discrepancies in definition, as for example in the United States, where deposit rates are on relatively well-remunerated certificates of deposit, as opposed to standard rates on (some definition of) interest-bearing bank deposits reported by most other countries. For deposit rates, there are 133, and ten fewer in the case of loan rates. Our period runs from the start of 1980 to the end of 2000, or the longest sub-period for which figures are available.

Table 3.3.1 Estimate of the long-run passthrough from policy interest rate (gintn) to deposit rates.
Quaterly data. Sample period (1980Q1-2000Q4)

Constant	Trend (98.1)	Policy rate (Gintn)	no.obs

USA	-0.048 (-0.316)	-0.001 (-0.304)	1.096 (33.118)***	82
GBR	-1.803 (-3.447)***	-0.036 (-2.488)**	0.915 (12.574)***	76
AUT	1.205 (1.145)	-0.023 (-1.701)*	0.216 (1.69)*	72
BEL	0.651 (0.905)	0.026 (1.033)	0.743 (3.628)***	84
DNK	1.437 (1.454)	-0.088 (-2.725)***	0.283 (1.197)	78
FRA	0.986 (1.271)	-0.012 (-0.458)	0.409 (2.539)**	84
DEU	-0.257 (-1.783)*	-0.005 (-2.335)**	0.953 (39.45)***	84
ITA	-3.975 (-2.053)**	0.091 (1.98)*	1.148 (4.3)***	73
LUX	2.78 (6.005)***	-0.061 (-2.106)**	0.178 (1.366)	35
NLD	1.581 (0.777)	0.013 (0.483)	0.421 (1.01)	70
NOR	-2.744 (-2.756)***	0.079 (3.718)***	1.288 (8.659)***	80
SWE	0.929 (1.832)*	-0.087 (-5.223)***	0.434 (3.564)***	83
CHE	-0.277 (-1.417)	-0.016 (-3.362)***	0.991 (16.056)***	78
CAN	-0.436 (-1.146)	0.029 (3.551)***	1.124 (16.75)***	84
JPN	-0.048 (-0.658)	0.014 (1.905)*	0.742 (10.465)***	83
FIN	-0.337 (-1.494)	-0.048 (-7.268)***	0.579 (12.735)***	69
GRC	-18.907 (-0.71)	-0.059 (-0.155)	1.724 (1.233)	84
ISL	-7.372 (-1.345)	-0.55 (-2.502)**	0.025 (0.062)	63
IRL	-0.173 (-0.057)	-0.145 (-1.69)*	0.001 (0.002)	84
MLT	7.085 (0.769)	0.011 (0.221)	-0.395 (-0.274)	82
PRT	3.892 (1.743)*	-0.311 (-2.253)**	-0.039 (-0.078)	81
ESP	0.869 (0.942)	-0.028 (-1.29)	0.598 (4.993)***	73
TUR	-9.067 (-0.328)	-0.043 (-0.188)	1.217 (3.102)***	83
AUS	0.022 (0.033)	-0.004 (-0.409)	0.87 (10.365)***	84
NZL	2.114 (3.773)***	-0.024 (-1.834)*	0.611 (8.336)***	71
ZAF	0.459 (0.336)	0.002 (0.126)	0.935 (11.094)***	83
ARG	545.385 (0.961)	-9.676 (-1.063)	0 (1.217)	84
BOL	4.546 (2.847)***	0.016 (0.275)	0.674 (7.102)***	41
BRA	440.443 (1.307)	-1.222 (-0.198)	0.571 (7.138)***	70
COL	1.897 (0.441)	-0.036 (-0.875)	0.804 (5.664)***	58
CRI	-10.551 (-2.069)**	-0.104 (-4.081)***	0.754 (5.142)***	74
DOM	-2.572 (-0.574)	-0.182 (-0.86)	1.213 (3.893)***	17
ECU	76.163 (1.645)	0.701 (1.311)	-0.639 (-0.753)	66
SLV	8.183 (2.265)*	-0.079 (-0.574)	0.272 (0.898)	13
GTM	3.147 (5.236)***	0.38 (18.205)***	0.331 (4.693)***	14
HTI	1.233 (0.946)	0.166 (2.034)*	0.702 (8.315)***	13
MEX	-5.252 (-2.335)**	-0.24 (-4.508)***	0.781 (8.666)***	75
NIC	9.05 (6.157)***	0.107 (2.62)**	0.365 (3.34)***	20
PRY	1.282 (0.231)	-0.041 (-0.576)	0.898 (3.016)***	41
PER	-4.442 (-1.831)*	-0.02 (-0.034)	1.004 (70.38)***	49
URY	12.09 (3.071)***	-0.838 (-2.802)***	0.125 (1.383)	76
VEN	6.673 (1.483)	0.055 (0.609)	0.617 (6.217)***	65
BHS	2.523 (6.647)***	-0.009 (-1.353)	0.495 (5.852)***	82
ABW	18.234 (3.31)***	-0.072 (-4.433)***	-1.546 (-2.483)**	54
BRB	1.698 (5.174)***	-0.004 (-0.84)	0.387 (9.976)***	78
DMA	-46.475 (-1.021)	-0.018 (-1.091)	7.807 (1.098)	74
GUY	-0.232 (-0.097)	-0.03 (-1.072)	0.805 (5.518)***	77
BLZ	5.22 (2.142)**	-0.028 (-0.549)	0.338 (1.026)	82
JAM	-5.499 (-1.077)	-0.149 (-2.857)***	0.898 (4.502)***	83
ANT	2.856 (4.558)***	-0.028 (-5.969)***	0.128 (1.212)	59
LCA	84.028 (5.043)***	0.087 (3.311)***	-10.858 (-4.64)***	74
TTO	6.061 (3.817)***	0.011 (0.566)	0.114 (0.948)	70

BHR	0.326 (0.619)	0.024 (2.229)**	0.88 (7.844)***	53
ISR	4.009 (2.639)**	0.074 (0.673)	0.719 (12.901)***	62
JOR	-5.192 (0)	0.304 (4.846)***	1.879 (0)	20
KWT	-3.415 (-1.398)	-0.038 (-5.531)***	1.318 (3.847)***	76
LBN	-0.059 (-0.024)	-0.063 (-2.754)***	0.724 (5.435)***	73
EGY	6.561 (11.43)***	-0.021 (-3.959)***	0.274 (6.157)***	83
BGD	-0.744 (-0.737)	0.008 (0.727)	1.258 (8.683)***	83
MMR	1.723 (3.482)***	0.029 (6.208)***	0.72 (20.739)***	38
LKA	-1.59 (-0.65)	-0.103 (-5.667)***	0.91 (6.03)***	82
HKG	0.354 (0.037)	-0.075 (-1.057)	0.752 (0.449)	26
IDN	11.779 (2.686)***	0.089 (1.293)	0.499 (2.195)**	79
KOR	4.636 (3.919)***	0.024 (0.925)	0.709 (3.901)***	83
LAO	42.319 (3.048)***	0.227 (1.548)	-0.958 (-2.119)**	30
MYS	0.049 (0.034)	-0.042 (-1.988)*	0.964 (3.83)***	83
PHL	3.911 (1.225)	-0.084 (-2.789)***	0.516 (1.933)*	79
SGP	-0.794 (-1.238)	0.017 (1.12)	1.11 (6.86)***	83
THA	3.065 (2.999)***	-0.032 (-2.444)**	0.621 (6.51)***	84
DZA	8.86 (2.766)***	0.1 (2.284)**	0.187 (0.694)	61
AGO	-22.743 (-0.981)	-7.923 (-4.437)***	1.043 (3.939)***	22
BWA	-3.66 (-3.615)***	-0.066 (-7.778)***	1.031 (12.996)***	81
CMR	1.422 (2.478)**	-0.032 (-12.348)***	0.496 (7.265)***	84
CAF	1.436 (1.934)*	-0.033 (-9.85)***	0.487 (5.387)***	84
TCD	-1.018 (-0.858)	0.007 (1.241)	0.776 (5.589)***	84
COG	2.197 (1.182)	-0.039 (-3.89)***	0.385 (1.617)	84
BEN	-1.622 (-2.244)**	0.029 (2.137)**	0.917 (7.614)***	68
GNQ	1.416 (1.289)	-0.035 (-1.931)*	0.482 (3.391)***	62
ETH	3.409 (5.033)***	0.007 (0.39)	0.701 (9.068)***	57
GAB	2.928 (1.494)	-0.041 (-5.033)***	0.31 (1.251)	84
GMB	6.266 (4.418)***	0.036 (3.119)***	0.506 (5.582)***	73
GHA	5.199 (0.852)	0.045 (0.631)	0.673 (4.661)***	76
GNB	4.968 (1.503)	-0.691 (-3.67)***	0.531 (2.028)**	50
GIN	0.699 (0.066)	-0.328 (-3.182)***	0.647 (1.027)	37
CIV	-1.712 (-2.176)**	0.03 (2.079)**	0.931 (7.141)***	68
KEN	-5.756 (-4.356)***	-0.103 (-9.83)***	0.92 (13.508)***	67
LSO	2.384 (0.52)	-0.058 (-1.538)	0.472 (1.647)	71
MDG	7.414 (1.285)	-0.33 (-2.763)**	0.405 (1.37)	15
MWI	2.223 (0.46)	-0.038 (-0.584)	0.675 (4.569)***	81
MLI	-1.74 (-2.17)**	0.03 (2.068)**	0.936 (7.035)***	68
MUS	0.815 (0.55)	0.015 (1.065)	0.956 (6.502)***	79
MAR	-0.067 (-0.053)	0.006 (0.428)	1.004 (8.732)***	47
MOZ	14.508 (2.933)***	-1.158 (-2.178)**	0.106 (0.574)	25
NER	-2.003 (-2.099)**	0.034 (1.916)*	0.976 (6.13)***	68
NGA	-2.783 (-0.553)	-0.049 (-1.116)	1.029 (3.553)***	75
ZWE	3.135 (0.992)	-0.033 (-0.606)	0.696 (7.966)***	81
RWA	5.135 (0.626)	0.027 (0.463)	0.255 (0.406)	75
STP	12.799 (2.638)**	0.066 (0.475)	0.575 (3.846)***	44
SYC	-6.887 (-0.167)	-0.542 (-0.358)	-0.809 (-0.262)	77
SEN	-1.697 (-2.127)**	0.03 (2.037)**	0.929 (7.026)***	68
SLE	-4.447 (-0.677)	-0.206 (-2.422)**	0.651 (2.595)**	83
NAM	-3.568 (-3.66)***	0.011 (1.146)	0.972 (15.3)***	35
SWZ	-0.825 (-1.802)*	0.016 (4.095)***	0.951 (25.507)***	84
TZA	-3.732 (-0.637)	-0.135 (-1.376)	1.006 (2.765)***	64

TGO	-1.907 (-2.16)**	0.032 (2.013)**	0.96 (6.574)***	68
UGA	-0.607 (-0.139)	-0.028 (-0.375)	0.71 (5.969)***	78
BFA	-1.589 (-2.369)**	0.029 (2.285)**	0.914 (8.154)***	68
ZMB	5.421 (0.442)	0.033 (0.198)	0.61 (2.246)**	76
SLB	10.265 (0.471)	-0.344 (-0.81)	-1.246 (-0.367)	77
FJI	1.025 (1.8)*	-0.055 (-4.333)***	0.253 (2.745)***	83
VUT	3.237 (1.359)	-0.1 (-5.846)***	-0.07 (-0.192)	58
PNG	-0.326 (-0.353)	-0.038 (-3.545)***	0.752 (10.07)***	68
ARM	19.047 (3.368)***	-0.296 (-1.031)	0.166 (1.125)	22
BLR	17.177 (5.592)***	-1.013 (-2.674)**	0.297 (8.828)***	29
ALB	4.044 (1.144)	-0.121 (-1.041)	0.591 (3.745)***	31
GEO	7.791 (1.989)*	-0.546 (-3.11)**	0.248 (2.261)**	17
KGZ	21.745 (4.46)***	-0.535 (-2.567)**	0.289 (2.402)**	17
BGR	3.272 (2.96)***	-0.509 (-5.599)***	0.58 (17.858)***	37
MDA	-0.405 (-0.017)	0.59 (1.242)	0.851 (1.033)	19
RUS	6.416 (1.179)	-1.134 (-1.6)	0.371 (5.497)***	23
CHN	0.291 (0.255)	-0.059 (-2.14)**	0.858 (4.221)***	38
UKR	-13.541 (-1.441)	-0.221 (-0.255)	0.921 (6.897)***	29
CZE	1.406 (4.346)***	-0.077 (-8.238)***	0.525 (14.642)***	29
SVK	-161.137 (-0.317)	4.09 (0.385)	19.662 (0.345)	29
EST	1.889 (0.618)	-0.189 (-1.3)	0.528 (1.33)	24
LVA	4.914 (1.421)	-0.295 (-0.618)	0.314 (0.797)	27
HUN	-8.71 (-2.195)**	0.022 (0.435)	1.338 (7.121)***	61
LTU	1.828 (2.687)**	-0.125 (-1.389)	0.508 (8.458)***	25
MNG	20.011 (5.362)***	-0.564 (-1.222)	0.137 (9.469)***	27
HRV	1.903 (0.189)	-3.522 (-1.154)	0.36 (5.117)***	33
SVN	3.698 (2.608)**	-0.194 (-2.003)*	0.769 (7.298)***	31
MKD	1.519 (6.32)***	0.048 (2.557)**	1.109 (57.715)***	25
POL	6.151 (1.371)	-0.558 (-3.152)***	0.595 (2.82)***	42

Estimated using Pesaran Shin and Smith (1996) methodology
t-stats in brackets
*, **, *** represent significance at 10, 5 and 1 percent respectively
Source: IFS

Table 3.3.1 presents results from the long-run relationship linking deposit rates to a variable we call G-int. This is an unweighted average of the largest available subset of policy, treasury bill and money market rates. The long-run relationship is recovered from the equilibrium-correction terms in regressions of monthly changes in deposit rates (results are given in Appendix Table A3.3.1). We applied Pesaran-Shin-Smith estimation procedures to obtain these results. What do they tell us?

The long run effect of G-int on deposit rates is positive for all but ten countries, and significantly so for a large majority (97 out of 133). This is evident from the data in the third column of Table 3.3.1. The coefficient is significantly less than unity, however, for just over half the sample, including France, Germany, Japan, Spain, Argentina, Brazil, Mexico, the Czech Republic, Russia, Indonesia and Thailand. Among Commonwealth countries, Gambia, Ghana, Mozambique, New Zealand, Uganda and all the Caribbean islands except for Jamaica are in the minority where deposit rates move *significantly* less than one to one with G-int. Where these coefficients are significantly less than unitary, testifying perhaps to some form of imperfect competition among retail banks, the monetary policy transmission mechanism channel running from deposit interest rates to saving by households will be undeniably weakened. We included a time trend, to pick up possible long-run changes in the intensity of competition. It is noticeable that there are just six advanced countries (Belgium, Canada, Italy, Japan, the Netherlands and Norway) which do not display a significantly negative time trend in the constant term (which is defined at 1998). For those countries with G-int coefficients close to unity (Britain, Germany, Switzerland) and also for some others, this suggests a rise in banks' gross margins on deposits, and hints at a possible decline in the intensity of competition between them.

The short-term results on deposit interest rates are presented in Table A3.3.1 in the Appendix. They reveal that most countries have a well-determined coefficient on the "long run adjustment" variable (column 2). Adjustment is really rapid in Canada and Trinidad and Tobago (and also in several other countries, Argentina, Israel and Peru among them, that have witnessed big inflation swings). In these cases, more than half the discrepancy in deposit rates from their long run equilibrium relation to G-int is eliminated in a single month. Macedonia's large negative coefficient suggests instability, but it is unique in this respect, and not reliable given the short sample period. Elsewhere, the coefficient on long run adjustment is quite modest, suggesting half-lives of two or three months or even longer. In France, Germany, Italy and Japan, for example, discrepancies are very long lived indeed.

Table 3.3.2 Estimate of the long-run passthrough from policy interest rate (gintn) to lending rates.
Quaterly data. Sample period (1980Q1-2000Q4)

	Constant	Trend (98.1)	Policy rate (Gintn)	no.obs
USA	2.37 (4.798)***	0.022 (1.631)	1.19 (11.81)***	84
GBR	0.434 (2.411)**	-0.003 (-0.911)	0.98 (45.261)***	84
BEL	3.292 (14.96)***	0.05 (7.783)***	1.222 (26.857)***	63
DNK	6.236 (12.809)***	-0.083 (-5.295)***	0.429 (3.735)***	78
FRA	5.046 (23.452)***	-0.037 (-5.042)***	0.413 (8.337)***	84
DEU	4.12 (1.856)*	0.027 (1.988)*	1.418 (2.871)***	84
ITA	-2.268 (-0.561)	0.118 (1.415)	1.696 (2.993)***	71
LUX	4.368 (9.668)***	-0.063 (-2.083)**	0.264 (1.893)*	34
NLD	2.779 (13.756)***	-0.003 (-1.043)	1.128 (30.864)***	74
NOR	0.784 (0.903)	-0.027 (-1.667)*	1.066 (8.503)***	80
SWE	3.394 (12.802)***	-0.032 (-3.515)***	0.923 (15.052)***	83
CHE	3.358 (22.4)***	-0.005 (-1.581)	0.554 (11.753)***	78
CAN	1.125 (3.407)***	0.015 (2.406)**	1.078 (18.248)***	84
JPN	1.858 (14.956)***	0 (0.037)	0.856 (6.797)***	83

FIN	-0.236 (-0.156)	0.062 (2.041)**	1.349 (5.344)***	81
GRC	-3.561 (-0.236)	0.053 (0.202)	1.583 (1.374)	84
ISL	7.355 (4.537)***	-0.047 (-0.298)	0.668 (2.551)**	74
IRL	1.238 (3.001)***	-0.027 (-2.137)**	0.804 (9.977)***	84
MLT	9.45 (10.463)***	-0.012 (-1.719)*	-0.325 (-1.859)*	82
PRT	12.225 (1.144)	-0.507 (-0.826)	-0.829 (-0.364)	81
ESP	2.51 (1.999)**	-0.033 (-1.172)	0.775 (4.107)***	73
AUS	4.54 (4.021)***	0.008 (0.322)	0.847 (4.939)***	84
NZL	4.884 (9.615)***	0.01 (0.627)	0.805 (12.231)***	54
ZAF	4.134 (3.063)***	0.018 (2.195)**	1.006 (10.296)***	83
ARG	-14.666 (-1.017)	-0.025 (-0.21)	3.521 (1.835)*	29
BOL	17.523 (1.274)	0.297 (0.931)	1.357 (2.083)**	41
COL	18.87 (7.568)***	-0.034 (-0.957)	0.608 (6.985)***	58
CRI	37.261 (1.396)	0.146 (1.042)	-0.236 (-0.302)	74
DOM	3.463 (1.515)	-0.025 (-0.745)	1.357 (9.046)***	17
ECU	11.409 (0.594)	0.175 (0.724)	0.855 (2.231)**	78
SLV	32.147 (3.117)**	-0.393 (-2.319)*	-1.448 (-1.585)	13
GTM	15.497 (13.501)***	0.23 (2.889)**	0.285 (1.806)	14
HTI	21.024 (15.917)***	0.202 (3.064)**	0.117 (1.559)	13
MEX	3.042 (8.45)***	-0.119 (-10.891)***	1.016 (88.542)***	30
NIC	22.087 (9.459)***	-0.049 (-0.639)	-0.265 (-1.223)	20
PRY	3.712 (0.525)	0.08 (1.101)	1.444 (3.774)***	41
PER	-23.081 (-0.431)	10.183 (0.727)	2.577 (3.197)***	58
URY	47.61 (5.902)***	0.008 (0.025)	0.404 (3.449)***	76
VEN	11.936 (3.333)***	0.239 (2.973)***	0.781 (14.588)***	65
BHS	5.392 (17.733)***	-0.059 (-11.679)***	0.221 (3.687)***	84
ABW	16.396 (19.502)***	-0.004 (-0.802)	-0.634 (-6.75)***	54
BRB	6.464 (10.263)***	0.005 (0.527)	0.462 (5.399)***	77
DMA	-9.717 (-0.315)	0.01 (0.927)	3.14 (0.652)	70
GUY	8.458 (2.529)**	0.077 (1.87)*	0.813 (7.176)***	77
BLZ	252.372 (0.051)	-3.473 (-0.048)	-31.964 (-0.048)	60
JAM	0.407 (0.095)	-0.078 (-1.526)	1.215 (7.453)***	83
ANT	11.792 (4.148)***	0.027 (0.685)	0.131 (0.215)	73
LCA	80.034 (1.861)*	0.022 (0.622)	-9.926 (-1.623)	74
TTO	6.918 (2.288)**	-0.017 (-0.469)	0.786 (3.172)***	68
BHR	14.008 (14.307)***	0.078 (4.347)***	-0.328 (-1.884)*	58
CYP	8.646 (8.218)***	-0.009 (-2.599)**	-0.017 (-0.112)	68
ISR	35.137 (0.758)	3.266 (0.729)	2.068 (1.951)*	69
KWT	-0.599 (-0.097)	-0.01 (-0.967)	1.281 (1.437)	78
LBN	-20.255 (-1.612)	-0.221 (-2.375)**	2.216 (3.456)***	70
EGY	4.555 (1.004)	0.009 (0.197)	0.972 (2.158)**	79
BGD	9.995 (7.395)***	0.061 (3.304)***	0.711 (4.069)***	83
MMR	-69.351 (-0.557)	-0.888 (-0.452)	5.49 (0.698)	31
LKA	-7.054 (-1.958)*	-0.141 (-5.769)***	0.987 (4.945)***	82
HKG	2.463 (3.688)***	-0.001 (-0.157)	1.086 (9.477)***	33
IND	7.122 (8.161)***	-0.052 (-10.955)***	0.695 (7.403)***	83
IDN	12.687 (11.335)***	-0.093 (-3.265)***	0.455 (9.537)***	55
KOR	1.467 (0.299)	0.046 (0.594)	1.253 (1.344)	79
LAO	63.902 (5.859)***	0.599 (6.304)***	-1.116 (-3.162)***	30
MYS	2.555 (1.228)	-0.034 (-1.874)*	0.943 (2.502)**	83
NPL	4.144 (0.406)	-0.051 (-1.187)	1.001 (0.813)	64
PHL	3.7 (1.674)*	-0.077 (-3.455)***	0.927 (5.34)***	83

SGP	2.571 (3.988)***	0.03 (1.725)*	1.129 (5.899)***	83
THA	5.448 (11.125)***	-0.018 (-2.295)**	0.721 (11.902)***	84
AGO	-40.794 (-3.049)***	-8.474 (-5.89)***	1.725 (9.174)***	22
BWA	-6.237 (-1.118)	-0.097 (-1.701)*	1.511 (3.674)***	81
BDI	8.786 (4.424)***	0.016 (1.238)	0.599 (2.976)***	69
CMR	25.217 (14.581)***	0.132 (7.853)***	-0.431 (-2.092)**	84
CAF	23.69 (6.776)***	0.165 (8.351)***	-0.228 (-0.588)	84
TCD	23.135 (4.622)***	0.188 (7.35)***	-0.113 (-0.205)	84
COG	23.307 (6.322)***	0.179 (8.854)***	-0.151 (-0.363)	84
ZAR	37.702 (1.068)	-2.813 (-0.348)	0.927 (2.019)*	23
GNQ	23.316 (15.099)***	0.156 (10.191)***	-0.206 (-1.169)	62
ETH	7.459 (23.105)***	0.111 (11.375)***	0.788 (12.2)***	57
GAB	24.775 (5.566)***	0.156 (5.673)***	-0.347 (-0.682)	84
GMB	11.172 (5.152)***	0.079 (4.206)***	1.082 (6.736)***	73
GNB	108.017 (1.526)	1.444 (1.028)	-1.673 (-1.028)	43
GIN	-15.052 (-4.899)***	-0.281 (-6.61)***	1.936 (13.238)***	39
KEN	8.731 (2.319)**	0.059 (1.279)	0.78 (5.135)***	83
LSO	6.865 (2.262)**	0.009 (0.492)	0.747 (3.531)***	81
MDG	22.448 (1.362)	0.227 (0.505)	0.722 (0.85)	15
MWI	8.252 (4.643)***	0.009 (0.413)	0.97 (13.92)***	81
MUS	14.904 (15.764)***	0.131 (12.627)***	0.562 (5.372)***	79
MAR	10.154 (2.194)**	0.081 (4.234)***	0.354 (0.561)	50
MOZ	16.62 (2.874)*	-0.8 (-1.211)	0.849 (4.011)**	10
NGA	-1.089 (-0.352)	0.009 (0.239)	1.424 (8.882)***	75
ZWE	-7.958 (-1.181)	-0.245 (-2.21)**	1.455 (6.365)***	82
STP	22.237 (11.846)***	0.638 (11.58)***	0.705 (12.09)***	44
SYC	12.407 (7.772)***	-0.229 (-2.158)**	-0.322 (-1.045)	45
SLE	8.133 (1.883)*	-0.049 (-0.737)	0.857 (6.359)***	83
NAM	5.206 (7.015)***	-0.01 (-1.174)	0.893 (18.023)***	35
SWZ	6.101 (9.726)***	0.046 (8.765)***	0.983 (19.488)***	84
TZA	11.413 (1.742)*	-0.055 (-0.492)	0.852 (2.644)**	71
UGA	13.197 (8.162)***	0.051 (1.794)*	0.608 (15.143)***	68
ZMB	8.378 (3.031)***	0.071 (1.739)*	0.988 (18.206)***	79
FJI	7.208 (3.655)***	0.012 (0.236)	1.065 (1.544)	73
VUT	-0.123 (-0.018)	-0.173 (-4.709)***	1.555 (1.577)	58
PNG	9.151 (2.451)**	0.009 (0.198)	0.374 (1.537)	68
ARM	50.351 (12.377)***	-2.054 (-13.87)***	-0.032 (-0.281)	22
AZE	-1.539 (-0.155)	-0.45 (-0.807)	1.053 (47.803)**	8
BLR	29.825 (5.969)***	-0.255 (-0.372)	0.572 (11.563)***	30
ALB	14.269 (4.827)***	0.17 (1.398)	0.485 (4.194)***	24
GEO	50.162 (22.538)***	-1.752 (-12.489)***	-0.104 (-1.543)	17
KGZ	51.713 (6.194)***	0.181 (0.51)	0.213 (1.099)	17
BGR	8.88 (13.909)***	0.002 (0.029)	0.97 (43.332)***	37
MDA	21.937 (4.727)***	0.261 (1.536)	0.365 (2.533)**	19
RUS	-25.38 (-1.172)	1.285 (0.665)	1.743 (8.298)***	23
CHN	2.956 (5.866)***	0.001 (0.138)	0.803 (11.072)***	38
UKR	18.68 (2.623)**	-0.672 (-1.016)	0.951 (9.465)***	29
CZE	5.77 (20.126)***	-0.174 (-22.177)***	0.588 (21.05)***	29
SVK	46.854 (0.939)	-0.44 (-0.369)	-3.296 (-0.573)	29
EST	0.221 (0.016)	-0.146 (-0.225)	1.393 (1.056)	24
LVA	11.117 (3.102)***	-0.212 (-0.41)	0.773 (2.468)**	27
HUN	-0.93 (-0.302)	-0.264 (-5.039)***	1.048 (6.741)***	46

LTU	7.024 (17.994)***	0.116 (3.519)***	0.668 (23.026)***	25
MNG	32.308 (7.51)***	-0.305 (-0.633)	0.508 (15.772)***	27
HRV	4.858 (6.099)***	-0.324 (-1.165)	1.172 (143.69)***	33
SVN	8.581 (7.339)***	-0.294 (-2.76)**	0.908 (11.189)***	31
MKD	-6.569 (-5.766)***	0.175 (1.554)	2.986 (35.235)***	25
POL	-100.569 (-1.507)	-1.569 (-1.617)	5.27 (1.968)*	69

Estimated using Pesaran Shin and Smith (1996) methodology
t-stats in brackets
*, **, *** represent significance at 10, 5 and 1 percent respectively
Source: IFS

As for *loan* rates, G-int has a significantly positive coefficient for all but 34 of the 123 countries for which data were available (and most of these 34 are at least correctly signed). Table 3.3.2 refers. The G-int coefficient only exceeds unity significantly in seven countries, Belgium, the Netherlands and Nigeria among them. Loan rates were predictably above G-int at almost all times and in almost all countries. Bulgaria and Uruguay are alone in displaying a significantly positive time trend for the constant (again defined for 1998). Elsewhere it is often significantly negative. This suggests that competition in lending between retail financial institutions could have been increasing.

The rather modest coefficients on G-int in some countries, such as Barbados, Denmark, France, India, Indonesia, Luxembourg and Switzerland, hints at the possibility of deliberate long run loan rate smoothing by banks. A possible explanation for this is fear that higher interest rates on loans have adverse incentive and selection effects, as powerfully argued by Stiglitz and Weiss (1981, 1983). In these economies, the monetary policy transmission channel that runs from loan rates to private sector investment and consumption spending will be correspondingly weaker than where G-int coefficients are higher.

The short run loan results, in Appendix in Table A3.3.2, testify, in the main, to well-identified and significant coefficients, of the expected negative sign, on the long run adjustment variable (the second column). Only a handful of these coefficients is either perverse or unstable. Adjustment is notably rapid in Ireland, and rather fast in Canada, France, Sweden and the UK. It is much slower in China, Germany, India and the United States, and very sluggish, among others, in Egypt and Greece.

3.4 INTEREST RATES AND CONSUMPTION

The main purpose of this section is to study how interest rates affect consumption. The section starts with an analysis of the reasons for expecting such effects to be present. It concludes by scrutinising evidence, both from econometric investigations conducted specially for this Report and from the findings of other studies, on how large and how dependable these effects are in practice. This is a controversial and unsettled subject. The debate between Bernanke and Gertler (1995) and Taylor (1995) reveals the width of the range of opinions and findings on the key issue of how much impact interest rates have on consumers' spending. Countries differ greatly in this respect, we find.

Interest rewards postponed consumption. A higher interest rate makes future consumption more attractive, relative to present consumption: future consumption has become cheaper. The higher interest is, the likelier it is that consumption displays a positive time trend, starting low and climbing later. The relevant interest rate here is a *real* one. Impatience is a psychological trait that makes people value consumption more heavily, the earlier it is enjoyed. Impatience encourages people to advance pleasure. Higher impatience makes it likelier that consumption is initially high, falling later. The degree of impatience is the rate of time preference, the rate at which future utility from consumption is discounted. Impatience and interest are forces in opposition. When interest exceeds impatience, consumption will grows over time. If impatience exceeds interest, consumption will start high but recede. In the simplest economy, where population and technology are unchanging, everyone has an infinite time horizon, preferences are similar, and information and capital markets are perfect, the real interest rate will eventually converge on the rate of impatience.

If population and technology keep advancing, real interest should exceed the rate of impatience in the long run. The gap between the two will tend to $n + ax$, where n is the population growth rate, x is the rate of technological progress (taken here to denote the rate of advance in the efficiency of labour) and a is a parameter, called the coefficient of relative risk aversion, that reflects the extent to which consumers are prepared to substitute between consumption at different dates. If a is high, this suggests that consumers are fussy about the timing of consumption, enjoying consumption in broadly similar amounts in all periods, substituting little between consumption at different periods. A high value of a tends to keep consumption up in bad times and down in good times[1].

It is the role of the real rate of interest on the time path of consumption spending that is of particular interest here. Suppose there is a given rate of impatience, β. Preferences over consumption are

[1] If savings and capital income are not exempt from income tax, it is the *after-tax* real rate of interest that equals the rate of impatience in the long run (plus $n + ax$ if technology or population is growing). When all nominal interest payments are subject to tax, inflation and income tax rate interact. They reduce an economy's long-run stock of capital, and potential output. Inflation can exert adverse effects on long-run output for other reasons, too. For example, if real money holdings save their owners' time that would otherwise be wasted on making transactions, sustained inflation tends to lower the supply of labour, and eventually output, capital and consumption have to fall in step, too.

such that the parameter a is a constant. We shall assume that capital markets are perfect, and that there are no costs of adjusting consumption at once. The one-period real rate of interest is $\boldsymbol{r_t}$ at date t. If individuals are to choose their consumption spending plans optimally, to do as well as they can for themselves, and are perfectly informed, facing perfect capital markets with no taxation, the following relationship[i] will hold:

$$c^{P}_{t+1,t} = c_t + [r_t - \beta]/a \qquad (3.4.1)$$

Here, $c^{P}_{t+1,t}$ is the log of consumption spending planned at date t for the next date, $t+1$, and $\boldsymbol{c_t}$ is the log of consumption at date t. One period earlier, consumers will also have laid plans about $\boldsymbol{c_t}$ and $\boldsymbol{c_{t+1}}$ (and chosen $\boldsymbol{c_{t-1}}$ as well). Back then, those plans will have implied $c^{P}_{t+1,t-1} = c^{P}_{t,t-1} + [E_{t-1}r_t - \beta]/a$ and $c^{P}_{t,t-1} = c_{t-1} + [r_{t-1} - \beta]/a$. Here, $\boldsymbol{c^{P}_{t,t-1}}$ is the log of consumption planned at t-1 for date t, and $\boldsymbol{c^{P}_{t+1,t-1}}$ is the log of consumption planned at t-1 for the following date, t+1. Linking (3.4.1) with those previous plans gives a relationship between $\boldsymbol{c_t}$ and c_{t-1}, actual consumption levels (in logs) for these two dates:

$$c_t = c_{t-1} - (r_t - E_{t-1}r_t)/a + (r_{t-1} - \beta)/a + [c^{P}_{t+1,t} - c^{P}_{t+1,t-1}] \qquad (3.4.2)$$

There are many insights to be gained from equation (3.4.2). One is the fact that consumption will largely tend to repeat itself. When the other terms vanish, $\boldsymbol{c_t}$ will equal c_{t-1}. A second feature, evident from the second term on the right hand side, is that present consumption c_t will respond adversely to an unexpected rise in the real rate of interest at date *t*. The term $\boldsymbol{r_t - E_{t-1}r_t}$ is the difference between $\boldsymbol{r_t}$ and what it had been expected to be, one period earlier. When consumers are fussy, a is high, and only really large real interest rate surprises affect consumption much. Parameter a exerts a similar effect on the third term. This expression tells us that a higher real interest rate in the previous period has a positive influence on consumption now. This is because consumption grows over time when real interest exceeds impatience. To repeat, the *previous* period's real interest rate exerts a positive impact on present consumption, while an unexpected jump in the *current* real interest rate has the opposite effect. The fourth term, in square brackets, is the revision made, between *t*-1 and *t*, in the planned value of consumption spending at the next date, *t*+1. This could be positive or negative, mainly reflecting things like revised expectations of future income.

If monetary policy tightens between *t* and *t*-1 unexpectedly, it will exert two principal effects. First, a higher nominal interest rate at t, increasing by more than any rise in expected inflation at least, will raise r_t above what it was predicted to be one period earlier, $E_{t-1,}r_t$. As (3.4.2) shows, consumption at date t must be squeezed by this, although not by much if *a* is large. There is a second possible effect, too. The fourth term on the right hand side of equation (3.4.2) might be negative. An unexpected real interest rate jump now may make consumers gloomier about their real income prospects in the following period, than they were before. Some workers – for example, those employed in the construction and capital goods sectors – may suddenly fear for their jobs, if policy rates rise unexpectedly. Thus far, we have identified two main channels running from a monetary policy change upon consumption spending. First, an *unanticipated* rise in the real interest rate will lower consumption now. Second, it may make households more pessimistic about their future income, lowering present consumption relative to previous plans for it. An *anticipated* monetary policy change, though it has no effect on $c_t - c_{t-1}$, will already have reduced the level of consumption when it first came to be expected, thereby tending to lower current consumption, too.

To all these effects we must now add another. In practice, capital markets display numerous imperfections. One of these is illustrated by the adage, "you can always get a loan if you can prove you do not need it". Potential borrowers are usually subject to constraints on what they can borrow. Collateral may be needed. An unexpected rise in interest rates will cut the value of collateral. Borrowing limits tighten. A fall in consumption spending by such borrowers must ensue. Financial institutions may predict a rise in defaults on existing loans, and become more selective in granting new credit. Credit will be harder to obtain; credit gets dearer and scarcer. Borrowers may be forced to curtail their outlays. Even if not required to cut spending by their lenders, they may think they should. Any expectation that credit will tighten later on, though it may encourage greater pre-emptive borrowing arrangements now, will tend to lower current consumption. When policy rates drop, (3.4.2) shows that consumption rises. If the rate cut is unanticipated, the second term on the right hand side is positive. That raises c_t relative to c_{t-1}. Real income prospects later on may improve, making the fourth term on the right hand side of (3.4.2) go positive. Had the rate cut been predicted back at date t-1, neither of these effects operates, but, instead, c_{t-1} will already have received a stimulus – and so c_t should recover, too. In addition, collateral requirements are eased, and the value of collateral offered increases as well; a credit expansion should follow, with favourable impact on borrowers' consumption.

All effects operating via equation (3.4.2) should work symmetrically in both directions – higher interest should deter consumption, and lower interest encourage it. But credit effects could be asymmetric. Higher interest can starve new (or renegotiating) borrowers of credit. Lower collateral values may force spending cuts. But cheaper interest is only permissive: being allowed to borrow more need not mean that you will borrow more. That may be why Peetmans and Smets (2002) find that, in eight Euroland countries, interest rate changes have quantitatively different effects in booms and recessions. Equation (3.4.2) also confirms the results obtained about interest rates in the long run. In a long-run steady state, devoid of shocks, $\boldsymbol{r}_t$ and $\boldsymbol{r}_{t-1}$ will both settle down at the value of β (assuming no trend in population or technology). So the third term on the right hand side of (3.4.2) vanishes. With no shocks, so will the other terms, too. Consumption will be steady.

Does evidence confirm these ideas, drawn from the hypotheses underlying our discussion – namely that consumers optimize over an infinite horizon, and face perfect capital markets? Our empirical analysis of quarterly changes in the real value of consumption per head related these to:

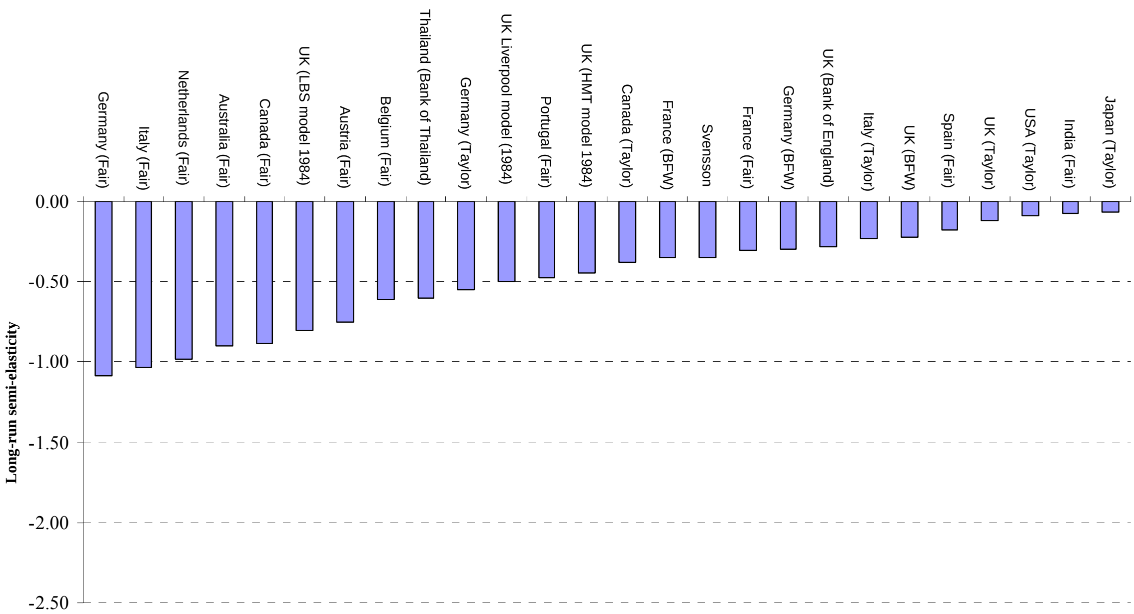
(i) a constant, reflecting any trend;
(ii) the previous quarter's change in consumption;
(iii) changes in central bank nominal interest rates, in the current quarter and the previous quarter;
(iv) the level of real central bank interest rates, a quarter ago;
(v) the proportionate change in the real value of the stock market price index;
(vi) the real value of consumption per head a year ago; and
(vii) the level of real income per head a year ago.

Regressions were run on 25 countries (the largest number for which data were available) on IFS data. The period under study ran from the start of 1980 to the end of 2000. Full results are presented in the Appendix. The main points are as follows. Our key interest rate terms (iii) and (iv) performed rather unsatisfactorily in the main, with insignificant coefficients and even perverse signs in several cases. Above all, there were big differences in countries' experiences. There is a negative effect, statistically significant, of (iii) in the US, the UK, Sweden, Japan, New Zealand, Mexico, and Peru. Sometimes, as in Sweden and New Zealand, it is current interest rate changes that display the predicted effect. In other cases, higher interest rates depress consumption only with a lag. There could be reverse causation – policy rates may rise if consumption grows fast in the current quarter.

The predicted positive effect of the lagged real interest rate, (iv), was well displayed in the US, the UK, France, Japan and the Philippines, in each of which it was significant. Elsewhere, the results for this term were disappointing and mostly uninformative. Only Germany, the Netherlands and the US generated significant, correctly signed coefficients on share prices (the sixth term). The coefficients on the last two regressors (lagged consumption and income) are well determined and of appropriate sign and relative magnitude for several (mostly European) countries, but not all.

The main inference, then, is that the speed, size and predictability of interest rate effects on consumption vary widely across countries. In some, there appears no dependable evidence about them at all. But s this a surprise? Central banks change interest rates for a reason. Usually it is to counter the effects of a shock; or to alter aggregate spending if it seems to be too strong or sluggish; or to stabilise future inflation at a target level, declared or tacit. The impact of policy rate changes may be buried by the shocks or deviation that prompted them. Shocks calling for policy rate rises are likely to be linked to rapid consumption growth, witnessed or foreseen, a positive relationship. But interest rate increases are designed to lower consumption growth, among other objectives. It is a consoling thought that if interest rates were moved with the objective of stabilising consumption growth, and if perfect stabilisation were achieved, econometric results would imply that interest rates had no effect. (This is the first paradox of the transmission mechanism, mentioned in 3.1 above).

Figure 3.4.1 Long-run semi-elasticities in consumption equations



Cross-country diversity in the impact of interest rates upon consumption is not a new finding. Figure 3.4.1 displays estimates of the semi-elasticities of real interest rates (annualised) on real quarterly consumption or real quarterly GDP for different countries, obtained from various other sources[2]. It is interesting how the diversity of these results is matched by the diversity of our own results, even if details differ.

There are strong reasons for expecting consumers' spending on durables to be interest-sensitive. The data we have examined draw no distinction between durables and non-durables spending. It may well be that the evidence we have found, that interest rate increases do reduce total consumer spending significantly in several countries, either at once or with a brief lag, is primarily driven by their effects on durables expenditure. Furthermore, the simplest two-period models (from which our analysis has generalised) suggest that although *savers'* non-durable spending could in principle rise or fall in response to interest rate changes, *borrowers'* spending should drop when interest rates go up. It should also be emphasised that a sizeable minority of consumers appears to be credit-rationed. This suggests that a relaxation of monetary policy, which increases the supply of credit, should stimulate aggregate consumer spending even when interest rates facing consumers are sticky, or actually rise as credit restrictions are liberalised.

This section gives mixed evidence on the effect of interest rate effects upon consumption. It shows that choice by rational long-lived consumers should predict a negative effect of a nominal interest rate increase on the growth of consumption, but a positive effect from previous real interest rate levels. So *high* (real) interest rates in the recent past should make consumption grow faster, while *rising* (nominal or real) interest rates should have the opposite effect. Cross-country evidence gives highly diverse results from different countries. Our hypothesis receives no support from some countries' experience. But data for Britain, Japan and the United States in particular, and from several other countries to a reduced extent, provide an encouraging degree of support for it.

3.5 INTEREST RATES AND INVESTMENT

When studying the impact that monetary policy exerts on investment and construction, it is helpful to begin with a number of relevant observations.

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[2] [Bank of England (2000), Bank of Thailand (2001), Britton, Fisher and Whitley (1997), Easton (1986), Fair (1984), Giovannini (1985), McCallum and Nelson (1998), Svensson (1999) and Taylor (1993b)]

First, new capital goods and buildings are supplied. We should not simply focus on the demand side. Producers typically need a higher selling price, or the prospect of it, to induce them to raise output. So the output of the machine-producing and construction sectors should increase with the relative price of those products, actual or expected. These sectors' output is of two kinds: there is output to replace these assets as they wear out, replacement investment; and there is net investment, the rise in the stock. So writing q as the relative price of the physical investment product, in terms of consumption goods, δ as the rate of depreciation, and S as the stock of the asset in question, supply will be given by an equation of the form

$$\delta S + \overset{*}{S} = f(q) \qquad (3.5.1)$$

Here, δS is replacement investment, and $\dot{S}$ is net investment. So the left hand side of (3.5.1) is the total output of capital goods. The positive link between this expression for the total output of the sector on the one side, and its relative price q on the other, means that $f'(q)$ is positive. If the stock is to be steady, a bigger stock will imply more replacement investment, and so a higher price. If q is higher than needed to keep a given stock steady, the stock will climb (and decline if less).

Second, an asset becomes more attractive to buy if it is expected to rise in value. Company executives are often besieged by request to buy the latest computers by their IT experts. An executive anxious to resist such pressures can react with the following argument. "I agree that these latest computers are better than what we have at present. But why do we need to replace our existing stock now? In a few months' time, new ones will be cheaper — and possibly superseded by still better ones at the cutting edge. So should we not wait?" The negative trend in q for computers, which fall in price on a quality-adjusted basis by some 40% per year on average, *restrains* demand for them, and increases the cost of renting them. A computer-leasing agency must cover its costs to survive. A big component of those costs is the anticipated rate of value-depreciation. Rentals must be high: a year's rental might be 60% of the purchase price. Assets expected to appreciate in price, such as houses in sought-after areas with strict zoning regulations, antiques, and shares in companies with excellent profit growth forecasts, are correspondingly attractive and expensive.

A third point is that those engaged in the sale or purchase of large or valuable assets have strong incentives to be well informed. A corollary of good, up to date information is that systematic forecasting errors should be few and far between; it is simplest to assume there are none. The future is unknowable; random events may exert big effects on asset markets. Economists are unhappy constructing models of a market where there is a difference between the model proposed and the perceptions of participants in that market as to how it works. If there is a good model, should it not fit in with the perceptions of those involved in the market? So rational expectations are likely to form part of that model.

The fourth point is that the value of any asset is inextricably linked to the real rate of interest, *R*. This link is the key point of contact with monetary policy, and the analysis of the transmission mechanism. Complications like tax and capital market imperfections aside, the demand for the stock of an asset like housing will be negatively related to the "rental cost of capital", $q(R+\delta-E\dot{q}/q)$. Here, $E\dot{q}/q$ is the anticipated growth rate for q. For computers it is negative – explaining why rental rates are high; for housing, it could be positive, at least it will be in a growing economy.

If expectations are rational (point three), and with no unanticipated disturbances or trends in supply or demand, *q* and *S* should evolve together towards a long run equilibrium where both are steady. There will be just one path, the "saddle path", to that equilibrium, and rational expectations and foresight should place the market on it. If *S* is climbing to long run equilibrium, *q* should be declining (and climbing if *S* is slipping). Suppose we start in long run equilibrium, say in the housing market, then perturb it with an unexpected permanent rise in *R*. In the new long run equilibrium, not attained for many years maybe, *S* and *q* will be lower than before. *S* only changes very slowly. The approach to long run equilibrium sees *S* slipping, and *q climbing,* along the saddle path. So the monetary policy change that raised *R* will mean that, on impact, house prices must drop sharply. They overshoot. They fall not just by the anticipated long run fall, but by more, to make room for their gradual recovery in the adjustment phase.

In practice, though, monetary policy affects real interest rates only temporarily. Suppose the central bank raise the (nominal) policy rate now, unexpectedly, by 100 basis points. Two years later, they are expected to bring them down again to their old level. The real interest rate rises straightaway by 100 basis points, then climbs a little (as inflation recedes), and is then expected to drop back after two years to something close to its previous level. We may now identify three phases for the housing market. Phase 1 is the immediate drop in house prices, when the policy surprise occurs, and before *S* has had any time to react. Phase 2 lasts for two years, and ends with the policy rate reversal. Phase 3 starts then, and concludes – eventually – when the initial long run equilibrium is restored.

Working backwards, phase 3 is quite straightforward – here, *S* will be rising, and *q* slipping slightly, along the saddle path. Phase 2 should see *q* climbing a bit, and *S* dropping (at least initially). In the very brief phase 1, *q* takes a bit of a tumble, to create room for the amount by which phase 2's rise in house prices exceeds phase 3's slight decline. Phase 2, incidentally, sees the building trades in recession, with some knock-on effects on spending elsewhere in the economy, which are amplified by the drop in consumers' housing wealth that occurred in phase 1. In a closed economy at least, what happened to house prices and residential construction would be qualitatively similar to the effects on machine prices and equipment investment, for example. And because *q* is not just the price of a new machine, but also the market value of a little company whose sole asset was one new machine, the analysis just described could be extended easily to share prices. If monetary policy affects share prices, it will affect consumer spending (see Poterba (2000) for an analysis of the empirics of this link for the United States), and also corporate investment, too. The collateral that a bank is likely to request in return for a loan falls in value if *q* drops; banks respond by tightening credit and raising loan rates, triggering the "financial accelerator" effects described by Bernanke and Gertler (1995).

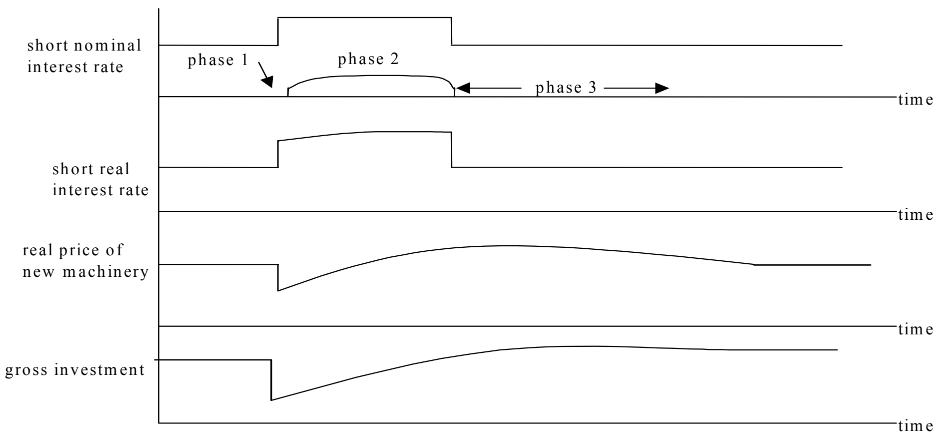


Figure 3.5.1: The time paths of key variables in response to a correctly perceived temporary rise in interest rates

Figure 3.5.1 depicts the time-paths of nominal and real short-term interest rates, asset prices and gross investment during the three phases. It is noteworthy that there is no jump or crash in q, except at Phase 1. This is because we have assumed that the date – two years on - at which the monetary authorities are expected to reverse the initial rise in nominal interest rates has been correctly predicted. If it had not been, what would have happened? If the interest rate rise is reversed unexpectedly early – in less than the two years we assumed – Phase 2 would be truncated, and q would jump upwards, by at least a little, as soon as the decision to reverse was announced. If Phase 2 lasted longer than expected, q would slip at the end of the two years, and keep slipping until lower interest rates were introduced.

Equities are internationally traded. Many big companies are quoted on stock exchanges in different countries. Even for those with a single quotation, profits often come at least as much from overseas subsidiaries and affiliates as from operations at home. And, crucially, stock market price movements are closely correlated across countries. Put simply, US stock market prices drive world equity prices. To the extent monetary policy affects share prices, US monetary policy that matters most, outside the US almost as much as inside it. Furthermore, machinery is usually traded internationally, too, so our analysis of the q and S should perhaps best be thought of as a global story, not a national one.

Real estate prices are very different. International trade in titles to buildings and land is still very modest. Dwellings are mostly non-traded assets. So monetary policy decisions in a small open economy should have much bigger effects on house prices and construction, than on share prices and machinery investment. It is noteworthy that most econometric studies of plant and machinery investment (such as Bean (1981)) find interest rates to have at best limited effect on investment. Other variables, such as changes in sales (or changes in real GDP at the aggregate level) appear considerably more powerful. This is not say that monetary policy exerts *no* direct impact on corporate investment. A rival tradition, associated with Jorgenson and his co-authors, suggests the opposite. Rather, the impact of interest rates on investment is unclear, controversial, and usually subordinate to other factors.

Establishing the exact empirical relationship between interest rates and investment is challenging. First, policy rates change *for a reason*. Inflation has just climbed unexpectedly, perhaps, or the latest central bank forecasts have just detected a probable rise in inflation in the near future that was not previously predicted. Or some shock has appeared that threatens higher inflation in the near future. Econometricians find it really hard to separate the investment effect of the higher interest rates from the investment consequences of the phenomena that led the central bank to introduce them. Second, the time profiles of interest rates and investment are highly complex, pointing to spells of rising as well as falling investment during the period when interest rates are held above their long run values. Third, there are lags, a factor our analysis has ignored in the interest of simplicity: capital projects simply cannot be switched on and off like a tap. Fourth, from the standpoint of equities at least, share price and interest rate movements in the United States may dominate the impact of domestic monetary policy.

In the case of housing, however, monetary conditions play a very powerful role. Easy money during competition and credit control (mid-1971 to 1973) and DM-shadowing period (1986-7) were swiftly followed by a near-doubling of UK house prices. The spell of high interest rates before and after ERM entry in November 1990 saw house prices in South East England fall by some 40% in real terms, peak-to-trough. Hendry's (1984) econometric model of UK house prices, probably the most sophisticated to date, testifies to the potency of credit and monetary variables in causing large, sharp house price changes.

In conclusion, a tightening of monetary policy should cut asset values, and, at least temporarily, reduce investment. But these effects should be stronger, and more easily discerned, in real estate prices and construction activity, than equity prices and non-construction investment. Yet monetary factors are only one of several influences affecting all these variables. Furthermore, since interest rates are normally changed for a reason – to try to offset their inflation effects of some shock – it is hard in practice to disentangle the consequences of interest rate changes from those of the shock that precipitated them. This applies to investment no less than to consumption.

3.6: CONCLUDING NOTE

This chapter has examined how and why policy interest rates changed, and then turned to key initial aspects of the transmission mechanism for policy rates – their impact on other interest rates, other asset prices, and the major components of aggregate demand, consumption and investment. The next stages of the transmission mechanism concerns how a change in the level of aggregate demand translates into changes in output and prices, and labour markets. These questions, together with the special features of the open economy, money supply – interest rate links, statistical features of inflation, and evidence on interest rates and disinflation, are examined in chapter 4.

4 HOW POLICY RATES AFFECT OUTPUT, PRICES AND LABOUR; OPEN ECONOMY ISSUES; AND INFLATION AND DISINFLATION

This chapter extends the analysis of chapter 3 to output and prices (4.1), labour (4.2) and exchange rates (4.3). Section 4.4 looks at interest rates under money targets, while 4.5 explores inflation dynamics, and 4.6 at how these are affected by interest rates in practice.

4.1. INTEREST RATES, OUTPUT AND PRICES

Changes in monetary conditions will lead to a change in nominal aggregate demand – that is, the total demand for goods at a given level of prices. But will a change in nominal aggregate demand lead to a change in output and employment? Or will it cause prices to change? Shall we see changes in both aggregate output and the price level, and, if so, what determines the exact mix of price and output responses? Will the pattern of responses change over time? These are the main questions in this section.

Answering these questions involves exploring four separate issues. One is the extent to which the prices of goods are sticky. The second issue concerns the response of goods prices to the extent that they are flexible. The third is the reaction of costs, chief among them the cost of labour. The fourth and final issue is the role of overseas trade and the exchange rate in the open economy.

If we start with a closed economy, where the time-path of money wage rates is given, at least initially, and there is no stickiness in the prices of goods, we focus on the second issue. Goods prices are fully flexible, but money wage rates, for the time being at least, are not. The prices of good will presumably be set, jointly with their levels of production, at points of equilibrium where demand and supply are in balance. Aggregate nominal demand has changed in response to a monetary policy initiative, such as a change in the policy rates set by the central bank. Determining the reaction of prices and outputs involves analysing the shape of the "aggregate supply curve". If aggregate supply is highly elastic, output will change, but prices will hardly change at all; if highly inelastic, the opposite. The ratio of the change in aggregate output to the change in the aggregate price level will be given by the elasticity of aggregate supply. Call this $\boldsymbol{E_s}$.

Under perfectly competitive conditions, where labour is the only variable factors of production and the money wage rate is given, $\boldsymbol{E_s}$ will be given by the formula

$$E_s = \left[\text{elasticity of substitution between labour and other factors}\right]\left[\frac{\text{wages}}{\text{other costs}}\right] \qquad (4.1.1)$$

In an economy with many sectors, $\boldsymbol{E_s}$ in the aggregate will be determined by the average values of the terms in brackets for each sector, weighted by each sector's share in total output. The ratio of wages to other costs in the economy as a whole will equal the ratio of labour's share in income to one minus that share. Employee compensation amounts to about two-thirds of national income in most advanced economies, and a little less, on average, in most developing countries. So the wages/other costs ratio is approximately 2. Estimates of the elasticity of substitution between labour and other factors of production vary somewhat; in the United States, many cluster around unity, while in Europe many are a little lower. If this elasticity can be assumed to be approximately 1, this means that our formula predicts a value for $\boldsymbol{E_s}$ of 2. A cut in policy rates that raises nominal aggregate demand by $\boldsymbol{x}$% will, on that basis, be expected to raise output levels twice as much as it increases prices. Equation (4.1.1) gives us a useful way of decomposing the likely output and price responses to a change in monetary policy.

There are several important qualifications, however. One concerns the extent to which the change in monetary conditions had been *predicted* beforehand. Equation (4.1.1) describes the case where the policy change comes as a surprise. Had it been predicted far ahead, before the money wage rates currently ruling were determined or negotiated, nominal labour costs would reflect those predictions. It is quite possible that prior wage increases will have matched the anticipated increase in prices that the policy change would bring about. Then $\boldsymbol{E_s}$ would be zero. All else equal, perfectly competitive firms will only take on extra labour, and produce more output, if real wage rates drop. And if the time-path of money wage rates matches that of prices, real wage rates stay the same, so neither employment nor output will respond.

It is not just a question of whether the monetary policy initiative is a surprise or not that matters. If it has been predicted, how far ahead it was predicted matters, too, and by whom. Suppose all market observers, including employers and labour representatives, expect relaxation in monetary policy a month before it happens, and money wage rates we set annually, let us say, with almost 2% of rates of pay being reset each week. Money wage rates would have been set in about 88% of the economy's industries before the policy change was predicted. In the week after the policy change, equation (3.6.1) will apply to between 85% and 88% of the economy, and, in the remainder, it will be price, not output, that responds. For the latter group, $\boldsymbol{E}_s$ will be (approximately) zero. Five months later on, a zero value of $\boldsymbol{E}_s$ should apply to half the economy; and a full year after the expectations were formed, money wage rates and prices should have responded in full, leaving us with an overall average value of zero for $\boldsymbol{E}_s$.

So the frequency of nominal wage resetting affects the pattern of output and price responses to a monetary policy change. But whose expectations and predictions change matters too. The financial press frequently speculates on whether the authorities will raise or cut policy rates. This may not filter through to employers. They may also ignore it. Even if employers follow this discussion closely, employees and their representatives at the bargaining table may not. If an employers says, "We must go for a moderate pay increase this year because everyone is predicting monetary policy to tighten", employees may retort "They would say that, wouldn't they?"

A second qualification for (4.1.1) relates to the assumptions on which it is based, and, in particular, to the notion that labour is a fully variable factor of production and that all other factors are fixed. There are costs of hiring and firing. Adjustment costs for labour are rarely negligible, especially for skilled and specialised labour. New recruits have to be trained. Dismissals may disturb productivity and morale. There may be lengthy and expensive legal processes to go through. There may also be reluctance to release labour in response to any policy change expected to have only temporary effects: any labour now released may well have to be rehired later on. If labour and other factors really are fixed, the ratio of wages to other costs no longer matters: $\boldsymbol{E}_s$ will be zero, because that term there in equation (4.1.1) relates only to the ratio of payments to a freely variable factor to other costs.

If skilled labour were fixed and unskilled labour freely variable, up and down, the formula in (4.1.1) would replace "labour" by "unskilled labour" and "wages" by "total unskilled pay". This would bring down the value of E_s. If capital is the only variable factor of production, and nominal capital costs were given, $\boldsymbol{E}_s$ would change again: we would replace "labour" and "wages" by "capital" and "capital costs" respectively. With capital costs about 1/3 of value added on most definitions in most economies, and with the elasticity of substitution taken to be unitary, our new formula would cut $\boldsymbol{E}_s$ to about one half, much lower than implied by (4.1.1).

A third qualification for equation (4.1.1) arises when we probe further the initial assumption that money wage rates are (temporarily) given. If labour markets are in equilibrium, all else equal, it is only a *fall* in real wage rates that makes employers increase employment and output. All else equal, for given utility, it is only a *rise* in real wage rates that prompts workers to offer more labour. If a relaxation in monetary conditions is to raise output in such conditions, it can only work by persuading firms that real wage rates have dropped and employees that they have risen. At least one group's beliefs must be false. In the long run, in full equilibrium, a change in monetary conditions can exert no significant effect on any variable – output, employment real wage rates or relative prices. Any output response to altered monetary conditions can only be brief, based on the unsatisfactory foundation of inconsistent expectations and perceptions. In most contemporary economies, up-to-date and dependable information about key price indices is freely available. These arguments suggest that the long run value of E_s, in response to changes in monetary conditions, really should be zero; and even for a short period, of a year or less perhaps, any confidence in a robustly positive value of E_s is undermined by serious doubts. Further, a history of monetary turbulence in the past may well make output less sensitive to monetary policy changes in the future.

In some economies money wage rates are indexed to prices. This is particularly evident in countries with a record of rapid and/or unpredictable inflation. For many decades Italy applied its *scala mobile* to rates of pay for most categories of workers. Indexation has also been widespread in, for example, Israel and Brazil. Allowing for this possibility causes (4.1.1) to change to

$$E_s = [\text{elasticity of substitution}][\frac{\text{wages}}{\text{other costs}}]\ [\text{1- elasticity of money wage rates to prices}] \quad (4.1.2)$$

Full indexation makes the new third term vanish. E_s is zero. Even partial indexation of money wage rates will reduce E_s. There is clearly a link between money wage indexation and a high frequency of wage renegotiations. They are both methods of insulating real wages from the force of shocks, particularly monetary shocks. Risk-aversion will strengthen their appeal, and perhaps for employers (and their creditors) as well as for employees. Both tend to reduce the elasticity of aggregate supply in response to monetary policy changes. They tend to increase the variance of prices, and lower variance in output and employment.

The main inferences to draw for the effects of monetary policy at this point are as follows:

1. The output and employment effects of monetary policy changes will be smaller and briefer in countries with a record of rapid and/or unpredictable inflation. Here there will be a greater

tendency for frequent revisions to nominal pay, and for implicit or formal indexation of pay to prices;

2. monetary policy changes should have smaller output and employment effects, and larger effects upon prices, in economies where the monetary authorities' behaviour is more transparent and predictable;
3. monetary policy will exert weaker effects on output and employment in economies where firms are subject to restrictions, or substantial costs, in hiring and firing, since these will transform labour from a freely variable factor into a largely fixed one;
4. when policy rates have been revised in the past only by small amounts, and/or relatively rarely, any given policy change is likely to have larger output effects, and smaller (initial) price effects.

So far firms have been assumed to revise goods prices immediately in response to shocks. Money wage rates are temporarily or partially fixed. This brings us to the first issue of whether goods prices are rigid or flexible, and to the question of what happens when competition is less than perfect. Under perfect competition, firms are price-takers. Under imperfect competition, a firm will not see its market vanish if it raises its product selling prices unilaterally. Imperfectly competitive firms are price-setters, usually taken to adjust prices to maximise expected profits - sometimes in concert with other firms, sometimes on their own, taking rival firms' output levels (or prices) as given. What difficulties does such a firm encounter if it alters its price? One problem is gauging rivals' reactions, unless they are acting together, and even then there is the possibility of someone breaking ranks to undercut, particularly in oligopolistic tendering. A price revision sends a message to the firms' customers; and it also sends a message to its rivals. Another difficulty is the fact that many people believe "You get what you pay for". A price cut might be taken as indicating lower quality. Department stores often sell "seconds" in sales. Frequent price revisions might also erode firms' goodwill and reputation, and reduce the value of information gained from past searching by consumers. Price discrimination can have this effect, too.

Then there are the actual costs of changing prices. A firm sets, and resets, its prices in terms of a unit of account, money. It is not relative prices that are set. The real costs of altering nominal prices are called menu costs. The faster the rate of inflation, the more frequently prices will have to be revised. The bearing this has for the transmission mechanism for monetary policy is that the temporary real effects of policy changes are largest when the trend of inflation is zero. The greater the rate of inflation, the more quickly firms reprice in reaction to it, and the smaller the transitory gain to output and employment following a monetary policy relaxation. For output, monetary policy changes are most powerful when policy is at its most conservative. There is a close pharmacological parallel: a drug works best if used little. In a country with rapid inflation, output changes in the wake of an alteration in nominal interest rates will be brief and small.

After addressing the first three issues identified in the second paragraph of this section, we now look at the fourth - the question of how the open economy differs from the closed one, from the standpoint of the responsiveness of prices and output to monetary policy changes. The open economy differs from the closed economy in several ways. Many firms sell their goods abroad, and not just at home; and imports become a potential source of supply. Two kinds of industrial sector are distinguished: industries supplying traded goods whether abroad or at home, and those producing non-traded goods for the domestic market only. The analysis above will hold, with minor modifications below, for the non-traded firms. But for the traded goods sector, it is wholly recast.

Competition from imports makes for a close link between domestic-currency import prices, and the local prices charged by home firms offering close substitutes. So long as a monetary policy change leads to no change in the exchange rate, domestic import prices will be largely given. Home firms supplying import-substitutes will not be led to alter their selling prices in response to a monetary policy change. Nor should they vary output or employment. If the monetary policy change raises aggregate demand, the variable that responds most is the volume of imports. Similar conclusions apply to exports. For a given exchange rate, monetary policy changes at home have little direct effect on prices. Competition abroad should ensure that, especially for smaller economies and for goods where close foreign substitutes are numerous. But the supply of exports is liable to change. Monetary expansion at home raises home demand for exportables, leaving less to export.

Monetary relaxation will therefore worsen a country's trade balance, at a given exchange rate. Some exports are redirected to the more buoyant home market, and imports meet increased demand for importable products. To these developments we must add subsequent effects on wage rates, and also the effect of home consumers' reaction to rising non-traded goods prices -substitution into traded goods. The worsening of the trade balance will transmit expansionary pressures into overseas economies, and significantly so if the monetary relaxation occurs in a very large economy such as the United States. But for the domestic open economy, this leakage in additional spending power abroad will betoken a much smaller set of inflationary pressures at home than would be expected in a closed one.

These repercussions follow if exchange rate is given. Monetary relaxation at home will make it hard to hold the exchange rate, barring parallel developments abroad. A cut in home policy rates, from previous equality with foreign rates let us assume, opens a gap that prompts exports of financial capital. Domestic residents will be tempted to transfer funds to foreign centres, if free to do so. Foreigners will also respond this way, and they will find it more attractive to borrow from the country that has lowered its policy rates. International capital movements are sensitive to interest rate gaps (at least to gaps corrected for risk premia). Their magnitude can dwarf official reserves.

If monetary relaxation at home leads to a fall in the exchange rate, a free-float fall or a crisis-induced devaluation under fixed but adjustable rates, there will be immediate impacts on domestic-currency prices of traded goods. These should rise. But pass through here may not be one for one. There is widespread recent evidence that many exchange rate deprecations in the 1990s have had surprisingly limited general short-run effects on prices. Yet the direction of the effect is unambiguous. The prices of traded goods are bid up in home currency, and, if they rise relative to nominal labour costs at least, this will stimulate additional production and employment in traded sectors. The split between higher prices and higher output will be determined by the elasticity of supply - which will depend upon the factors identified in equation (3.6.1) above, and its subsequent variants. Under a freely floating exchange rate regime, when passthrough is large, the open economy will react to a change in monetary conditions at home in ways similar to the closed one. Non-traded goods prices will climb in direct response to higher nominal aggregate demand; home-currency traded goods prices will respond similarly, through the exchange rate mechanism.

These effects arise when the exchange rate floats, or monetary policy changes force the authorities to lower its peg. If the exchange rate is fixed, and the authorities can hold it, quite a different set of results ensues. Monetary expansion at home erodes foreign exchange reserves, as a result of the balance of payments effects noted earlier. If sterilisation is impractical or incomplete, monetary conditions at home will now steadily tighten. The previous nominal interest rate cut will have to be reversed, and domestic monetary aggregates will slide back towards their original value. Such developments would accord with the Hume's price-specie-flow mechanism.

4.2 INTEREST RATES AND LABOUR MARKETS

The interest rate is sometimes called the price of capital. It is certainly a key element in the cost of capital. Under the simplest conditions, where competition is perfect, the buying price of a new capital asset is q and expected to remain constant in real terms, and there is no depreciation or taxation, the rate at which a machine can be leased will be rq per period. Here r is the real rate of interest. Allowing for depreciation at the rate of δ, and an anticipated trend in q of α, the leasing rate will be $q_t(r+\delta-\alpha)$. A higher real interest rate makes capital dearer. Competitive firms will lease capital (or buy it) up to the point where its marginal return balances the explicit (or imputed) cost of leasing it. At this point the rate of profit and the cost of capital will equate. Labour, too, is engaged up to the level where the wage rate balances the value of its marginal product.

The higher the cost of capital, the lower the wage a firm can afford to pay to labour, when the price of its product and the level of technology are given. A rise in the cost of capital lowers the demand for labour when all else is equal. When the monetary authorities increase the nominal interest rate, at a given rate of inflation, they increase the cost of capital. So firms' demand for labour must fall. A drop in labour demand will lower the real wage if labour supply is given and the labour market is in continuous equilibrium. If the real wage is fixed, and there are many different reasons for thinking that it should adjust only slowly to a shock of this kind, it will be the level of employment that responds. It can only fall.

Monetary tightening that involves higher nominal interest rates should therefore lead to a weakening in labour demand, and, all too likely, at least a temporary increase in the level of unemployment. As unemployment rises, the pace of increase in money wage rates should slacken. Pay increases may also fall because employers and employees tend to lower their expectations of future inflation, in response to the monetary authorities' restrictive actions. The first of these two effects may well work faster than the second. But both may be quite gradual, given the pattern of wage settlements.

There are reasons for suspecting that there are more links between the demand and the rate of interest. Consider a firm that produces a product that will be sold after the bulk of the work has been done. Examples abound: films; ships; buildings; pharmaceuticals; food. To simplify, imagine the following time sequence. At date 1, the firm commits itself to lease capital for date 2. At date 2, a year later, it engages labour at a wage rate *W* to work with the leased capital. It is then that production occurs. The product is available for sale, at a price *P*, a year after that, at date 3. Let technology be Cobb-Douglas, with a labour weight of *b*. The firm borrows from a bank at a rate r_1 for the first year, and at r_2 for the second year. Banks' loan rates move one for one with the central bank's policy rate, let us suppose.

At date 1, *W, P* and r_2 are unknown. Suppose the firm has point expectations of them at that date, of E_1W, E_1P and E_1r_2. A year later, *W* and r_2 become known, and the new prediction of *P* is E_2P. At date 1, it plans the profit maximising level of labour, E_1N call it. That will depend on E_1W, E_1P and E_1r_2.

If r_2 and E_1r_2 turn out equal, all well and good. But now imagine that the central bank's policy rate is raised unexpectedly by 100 basis points. This may well mean that *P* is now predicted at date 2 to be less than previously anticipated: a macroeconomic squeeze should lower the demand for the product, and if the good is traded internationally, any exchange rate appreciation could amplify this. Possibly, *W* might turn out unexpectedly low, but money wage stickiness would prevent that.

The unanticipated tightening of monetary policy should result in lower employment at date 2. Under our assumptions, the unplanned job cuts will be given by the approximation

$$\frac{E_1N - N}{E_1N} \approx \frac{1}{1-b}\left[\frac{E_1P - E_2P}{E_1P} + (r_2 - E_1r_2) - \frac{W - E_1W}{E_1W}\right] \qquad (4.2.1)$$

Here, *N* is labour actually engaged at date 2. In words, this equation says that cuts in labour, relative to plans, will be some three times larger than the sum of: (a) the interest rate surprise change and (b) the fall in the final sale price, relative to the wage rate, that this induces. (The parameter *b* will presumably be about two-thirds, its economy wide average). So, in our example, a rise in the expected product real wage of 0.1%, together with the 100 basis point jump in the interest rate, would entail a cut in labour demand of 0.33%.

There is another way in which monetary policy can affect the demand for labour in this framework. Suppose the supply of credit is unexpectedly tightened mid-way through the project, at date 2. We previously assumed that the firm could borrow as much as it wished at this point, at a rate of interest R_2. This may not be true. If it is forced to borrow less than anticipated at this stage, the level of employment the firm can afford is cut back. Less will be produced for sale at date 3 as a result. Even worse, if all credit is subject to roll-over period by period, a very tight credit squeeze might lead to the project's cancellation, and the firm's bankruptcy.

We saw in section 3.4 of chapter 3 that consumption should grow slowest when interest rates are low and rising. For workers able to choose their hours of work, similar findings should hold, except that, for labour supply, they run in the opposite direction. We should expect labour supply to increase most when real interest rates have been low, and are now raised (in both nominal and real terms).

Not all unemployment represents an imbalance between the demand and supply of labour. Some jobs terminate, and some workers quit, and it takes time for employers and employees to match. Turnover in the job market establishes an equilibrium level of unemployment, often called the natural rate, which may depend upon the level and duration of benefit and other factors. If unemployment exceeds the natural rate, the supply of labour exceeds the demand for labour. So if we begin at a point of labour market equilibrium, and interest rates now rise, unemployment should increase as a result of the labour demand and supply responses just discussed. On top of these comes the indirect labour demand effect operating through aggregate demand, which will be powerful and negative in this case.

With unemployment above its natural level, downward pressure is then transmitted on the pace of money wage increases. The size of this response may be smaller when inflation is low: there is evidence from Canada (Crawford, 2001) and the UK (Nickell and Quintini, 2000) that money wage changes are only very rarely negative.

A reduced rate of increase in money wages implies a fall, relative to trend, in firms' unit labour costs. To the extent that labour is a variable factor of production, marginal cost drops relative to trend. Profit-maximising firms' product prices will always reflect marginal cost. In perfect competition, the two are equal. In imperfect competition, price is marked up above marginal cost, the size of the mark up inversely proportional, in simple cases at least, to the elasticity of demand for the firm's product. So slower money wage in the rate of inflation, all else equal. Taylor (2000) offers evidence, however, that the size of this affect has become somewhat weaker at low rates of inflation. This gives rise to a third paradox of monetary policy: when monetary decisions succeed in reducing inflation, monetary decisions may subsequently have a diminished impact. There is some recent evidence which accords perfectly with this: Boivin and Giannoni (2001) find that exogenous interest rate fluctuations in the United States have been exerting diminished effects, and that changes in the systematic elements of monetary policy are an important factor in this.

4.3 INTEREST RATES AND EXCHANGE RATES

Actual holding period returns on different assets very widely. *Expected* holding period returns vary too. Some assets are thought safer than others, some more convenient, some with more favourable tax status, or greater liquidity. Setting aside any difference in such features, two otherwise identical assets should display the same anticipated rate of return. And if those trading in the markets for them are assumed to make no systematic forecasting errors, the actual returns on these assets should not differ systematically.

These arguments will apply not just to a pair of assets traded in the same country or denominated in the same currency. They should be no less true of cross-country comparisons as well. The only provisos are that the countries should have abjured any controls on international capital movements or restrictions on currency convertibility. This suggests that assets with very similar characteristics (such as three month default-free treasury bills, issued in two different national currencies) should have similar holding period yields. Suppose this instrument, issued by country *i*'s treasury in its own currency, gives an annualised yield over three months of x_i, given that $(1+x_i)^{1/4}$ equals the ratio of price at redemption to price at issue. If everyone were convinced that there was no chance whatever of any rise or fall in the value of country *j*'s currency in term of *i*'s, then a similar treasury bill issued by *j*'s government in *j*'s currency should also bear an annualised return of x_i. More generally, if x_j is the annualised rate of return on this second bill, expressed in j's currency, we should observe the following approximation:

$$x_j \sim x_i + Ez_{ji} + p_{ij} \qquad (4.3.1)$$

Here, Ez_{ji} is the anticipated rate of appreciation of *i*'s currency in terms of *j*'s, over the three month period, expressed at an annual rate, and p_{ij} a risk premium attaching to this prediction.

When p_{ij} is assumed negligible, approximation (4.3.1) is known as the *uncovered interest parity condition* (UIP). It states that any difference in interest rates between similar assets expressed in different currencies should reflect one-for-one expectations of exchange rate changes over that period. UIP is a condition of portfolio equilibrium, at least if all risks can be ignored. If it failed to hold, agents could increase expected portfolio returns by shifting funds out of one currency into another. In an efficient market, this should not be possible.

Traditionally, the analysis of the transmission mechanism of monetary policy in an open economy has relied on two pillars. One of these is UIP. The other is a condition for arbitrage in traded goods rather than assets. This is the commodity arbitrage condition (CAC) which states that internationally traded goods should broadly cost the same at home as abroad.

Let us suppose that the central bank raises its policy rate, and that its currency is freely floating against other countries. Assume for the moment that the two conditions given above (UIP and CAC) both hold perfectly. How does the exchange rate respond? This depends on how the domestic yield curve moves in relation to a weighted average of foreign yield curves; and on the extent to which the change in nominal rates alters real rates (i.e. what has happened to inflation expectations at home and abroad). In the short run, with given inflation, we assume that a change in nominal rates is equivalent to a change in real rates. Continuing the example above suppose that home and foreign central banks' rates were previously equal and expected to remain equal, and that they are now expected to be equal after m months, at the end of a period where they are 100 y basis points apart.

What these assumptions mean is that the market is expecting exchange rates to stay unchanged from m months onwards. Until then, however, the home currency will be expected to slide. Meantime, the monthly rate of decline, according to the UIP condition, is approximately $y/12$ per cent. So if $y = 2$ and $m = 6$, a slide of 1/6 of one per cent per month can be anticipated for 6 months, implying a total decline of one per cent. If y had been 3 and $m = 12$, the slide would expected to last a year and amount to 3% in all (1/4% per month over 12 months). Our assumptions about home and foreign interest rates before the policy change, and now expected from m months' time onwards, imply that the market should be predicting that the exchange rate, at the end of m months, should return to what it had been before the policy change.

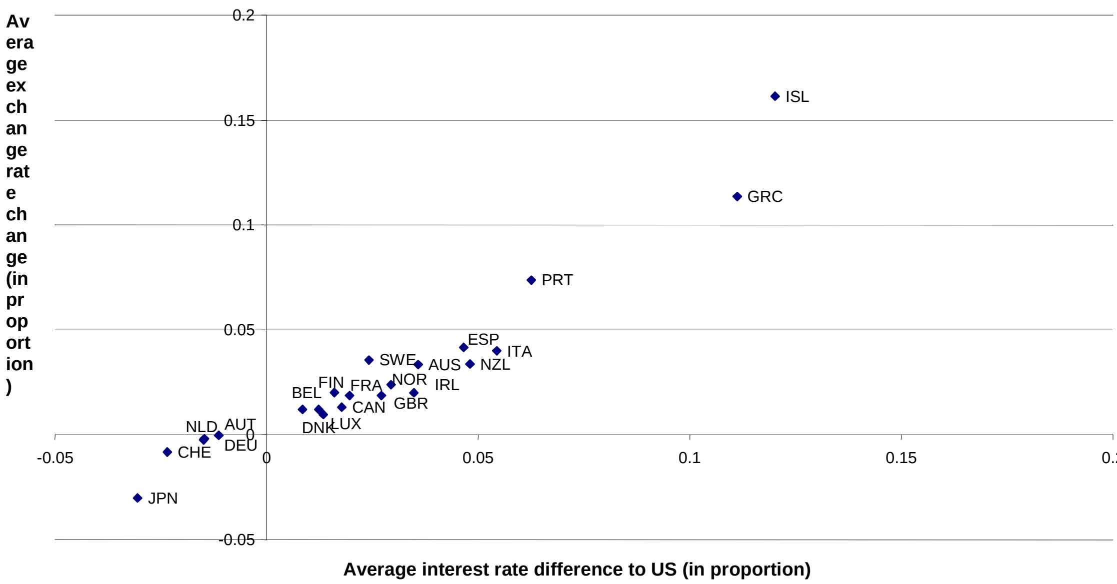
Putting these items of information together, we may deduce that the spot exchange rate has to appreciate now. It must do this, to create room for the subsequent depreciation now anticipated. With $y = 2$ and $m = 6$ (a 200% bp interest rate rise, to last 6 months), the spot exchange rate has to jump by 1%, because that is the foreseen decline over the next half-year. With $y = 3$ and $m = 12$ (a 300% bp interest rate rise, to last a year), the spot exchange rate must now jump by 3%. To see what this means for inflation, we now invoke the CAC and ask to what proportion of domestic expenditure it applies. Suppose this is 40%. Then, in the case of the 200% bp six month hike, we would predict an impact effect (doubtless phased over time) of a 0.4% reduction in the price index for domestic expenditure. With the 300 bp twelve-month rise, the price index impact effect would treble to 1.2%. These are only the impact effects, however. The exchange rate is not expected to stay up. Quite the contrary: it is only jumping now, in order to create room for the anticipated decline predicted by the UIP condition. Consequently all the price index effects will be reversed. The appreciation of the exchange rate puts a purely temporary dent in the price index, because the subsequent depreciation will cancel it later on.

The conclusion to be drawn from the traditional theory then, and the examples we have considered, is this. So long as the CAC and UIP conditions hold, we may use an estimate of the proportion of traded goods in total spending to predict the impact of interest rate changes on inflation quite precisely. Inflation should drop initially, then slowly climb for a while in compensation, and, after that, end up unaffected. The size of these exchange rate effects on inflation will vanish if all central banks alter interest rates in unison. When not, they will be very small if the home interest rate rise is expected to be reversed soon afterwards, and correspondingly larger if this is not so. And if the market has *anticipated* the interest rate rise, the exchange rate will have risen already, with a slide predicted (by the UIP condition) to begin after the forecast like takes place. So the key inference is – provided UIP and CAC hold – that the open economy transmission mechanism for monetary policy makes for a faster set of repercussions from unilateral interest rate changes on inflation, when the exchange rate is freely floating, than when it is fixed.

Do UIP and CAC hold, however? On UIP, the verdict is mixed. The prediction that the actual change in an exchange rate between two currencies is approximately equal to the relevant policy rate differential fares very badly over short periods. Over a time-span of one, three, six or even twelve months, the UIP conditions turns out to be a very poor predictor of exchange rate evolution, at least between the currencies of advanced countries. A random walk usually performs much better. Lengthen the time span to a decade or more, however, and the picture changes completely. The average interest-differential becomes a highly significant and correctly signed regressor for actual exchange rate changes over longer periods.

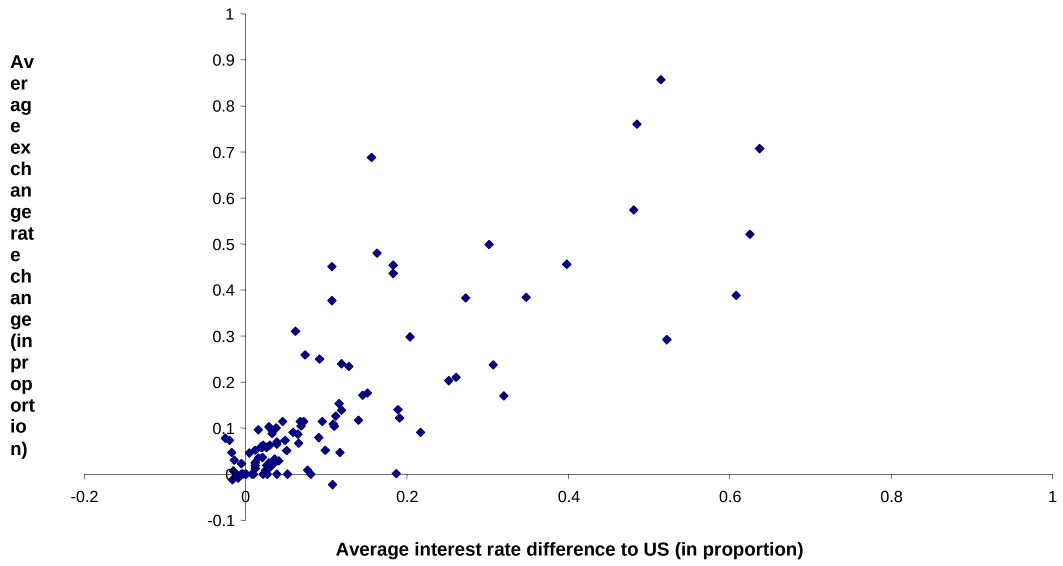
We took the set of (other) OECD countries' exchange rates against the US dollar over the period 1981-1998, and regressed their annual average rate of change against that country's nominal interest differential against the U.S., imposing commonality on the interest rate differential coefficient. This resulted in a resounding confirmation of UIP. The coefficient on the interest differential is 1.039. This is insignificantly different from unity. The constant term, 0.0013, is insignificantly different from zero. Figure 4.3.1 illustrates the close relationship between these two variables. Appendix Table A.4.3.1 gives the econometric results.

Figure 4.3.1 Average exchange rate changes versus average interest rate difference for 22 OECD countries (1990 1998)



We conducted a similar regression for all non-OECD countries, over the same period (or subperiods necessitated by data limitations), where the results are almost equally encouraging. Figure 4.3.2 presents the scatter plot of observations, and Appendix Table A.4.3.2 gives the regression results. The coefficient on the interest differential is 1.001, and insignificantly different from unity. The constant term is significant, and positive. This cannot be interpreted as a risk premium, unless the US dollar is deemed riskier than the average non-OECD currency. A reasonable interpretation of the positive constant is that it captures the effect of financial repression in some economies.

Figure 4.3.2 Average exchange rate changes versus average interest rate difference (1980-1999, depending on data availability)



Appendix Table A.4.3.3 shows how very different things are in the short run. Separate annual time series regressions were run for the each of the advanced countries' exchange rates against the U.S. dollar, upon a constant and the previous year's average interest differential. Results were poor: the coefficients are rarely significant or close to unity, and usually incorrectly signed. What these results tell us, therefore, is that although UIP performs very poorly in the short run, it works (almost) exactly as predicted in the long run, at least for the *generality* of OECD and non-OECD countries, as two large groups. What is most in doubt is when the drift in the exchange rate predicted, under UIP, by the interest differential actually happens. Eventually it will, but we can have no confidence at all about timing.

How can we reconcile the long-run evidence with the short-run evidence? For a start, relatively few currencies are floating freely. Some have fixed parities, with periodic discrete changes. Many others are managed. For those that float freely, two kinds of exchange rate movement are observed - jumps and drifts. Drift, or trend movements, are at least to some degree foreseeable. Jumps are not. Jumps result from news, some of it – but not all – news about interest rate decisions. UIP can defended, as Meredith (2002) emphasises, as a statement about drift. The longer the time span, the broader the canvas, the more the trends predominate over the jumps, which should have a broad tendency to cancel out over time and across currencies. We shall return to this point below.

Quite similar findings emerge about CAC. The pass through from the exchange rate to prices has been notably smaller in the 1990s than in the previous two decades. This has been true for the UK's depreciation in late 1992, and of its appreciation in the late 1990s. The same phenomenon, of surprisingly low pass through, has been evident in Australia, Chile, the Czech Republic, Indonesia, Italy, New Zealand, Spain and Thailand. Larraine (2001) presents an interesting discussion of several of these cases. The first clear evidence of it came in the United States in the mid-1980s, and prompted the hysteresis theories of Baldwin (1988) and Dixit (1989).

There is some long-term tendency for deviations in purchasing power parity (or infringements of CAC) to decay over time. As Taylor (2001) writes, "the present consensus is that these price differences have a half-life of five years at best, and infinity at worst". Taylor goes on to argue that this consensus may lead to a downward bias in the speed of convergence, because prices are observed discretely and linear methods are employed. Nonetheless, deviations do not vanish overnight. What causes them?

The CAC may be undermined by several factors. Indirect tax differences, retailers' markups, tariffs and international transport costs all drive wedges between consumer prices in different countries for a given traded good, expressed in a common currency. Binding import quotas can be particularly insidious, because any tariff-equivalent is amplified by the effects of imperfect competition among home producers of substitutes. Imperfect competition can also create discrepancies when cross-border arbitrage is costly, and particularly so when degrees of competition, or product demand elasticities, differ. On top of these come the effects of sunk costs faced by importers, which, as Dixit (1989) shows, may make them reluctant to quit or alter local currency prices in the wake of adverse exchange rate changes viewed as temporary.

How may we explain the empirical short-run failure of UIP? A simple model may help to illustrate. Consider a country that permits free international movement of capital between itself and the rest of the world, and for which the responsiveness of capital flows is perfect. In the rest of the world, there is no inflation, and the nominal interest rate is given at $r*$. The home country's central bank sets its policy rate, *n*, by the rule

$$n = r* + \sigma[p - p_0 - \theta] \qquad (4.3.2)$$

where $p_o + \theta$ is an implicit price level target. (The variables $\boldsymbol{p}$ and p_0 represent the actual and target values of the logarithm of the domestic price level, and $\boldsymbol{\sigma}$ is positive). Aggregate demand, y in logarithms, responds to the level of external competitiveness (in logs), *c,* and to the domestic short term real interest rate:

$$y = \alpha_1 c - \alpha_2 (n - \pi) \tag{4.3.3}$$

Here, α_1 and α_2 are both positive: an overvalued real exchange rate, implying $c < 0$, worsens the trade balance and reduces aggregate demand, while a high real interest rate lowers if by squeezing domestic investment and consumption. Inflation at home responds to the output gap

$$\dot{p} = \gamma (y - \bar{y}) \tag{4.3.4}$$

where $\bar{\boldsymbol{y}}$ is normal potential output, again in logs. The real exchange rate, c, is related to the nominal home currency price of foreign exchange, s, and the logarithms of the home and foreign price levels by

$$c = s + p^* - p \tag{4.3.5}$$

So there is real undervaluation of the home currency when *c* is positive. Lastly, UIP is assumed to hold, so that

$$\boldsymbol{E\dot{s} = n - r^*}$$

Figure 4.3.1 illustrates the dynamics of the exchange rate and domestic prices. The vertical axis depicts –c, so the currency is overvalued above and undervalued below long equilibrium at the origin. The horizontal axis variable is the gap between home prices and their target value. If domestic inflation is zero, domestic aggregate demand must equal normal potential output. The locus for zero inflation, $\dot{p} = 0$, slopes down, because if prices are above target, the interest rate rule prescribes a higher real interest rate, and the deflationary consequences of this must be offset by the stimulus to demand from currency undervaluation. There is positive inflation below the $\dot{p} = 0$ locus (the economy is overheating here) and negative inflation above. If external competitiveness is to be constant, the nominal exchange rate must drift down to offset any domestic inflation. If $\beta\gamma < 1$, the $\dot{c} = 0$ locus, which slopes down, is steeper than the $\dot{p} = 0$ locus. Competitiveness will be drifting downwards above and upwards below the $\dot{c} = 0$ locus. Fig 4.3.1illustrates.

To the right of the $\dot{c} = 0$ locus and above the $\dot{p} = 0$ locus, currency overvaluation, and the price gap $p - p_0 - \theta$ will both be declining: hence the arrows in this region which point south and west. Below the $\dot{p} = 0$ locus and to the left of the $\dot{c} = 0$ locus, the currency will be becoming less undervalued (so c will be falling), and domestic prices will be climbing. So that explains the arrows in this region, which point north and east. A unique upward-sloping saddle path SS points towards long run equilibrium at the origin, E. The broken, downward-sloping line labelled UU depicts the system's unstable eigenvector. Had it been the case that $\beta\gamma > 1$, the $\dot{c} = 0$ locus would have been flatter than the $\dot{p} = 0$ locus, and the system would have been globally unstable.

The horizontal variable, the domestic price level, is sluggish, while, under free floating, the nominal (and real) exchange rate can jump instantaneously. With fully rational expectations, the exchange rate must jump to the unique saddle path taking the system eventually to *E*. If the domestic authorities were suddenly to reduce θ, the nominal interest rate would jump. Starting at an old long-run equilibrium at E_0, foreign exchange market participants – once they had understood what had happened – would drive the exchange rate up to point *F*, in response to the higher domestic nominal interest rate the central bank had set. We should then observe a drift downwards towards the new long run equilibrium at *E:* domestic prices would be falling, and the exchange rate would slip back, faster initially then later on because n would be lowered gradually towards it long run equilibrium value of r*.

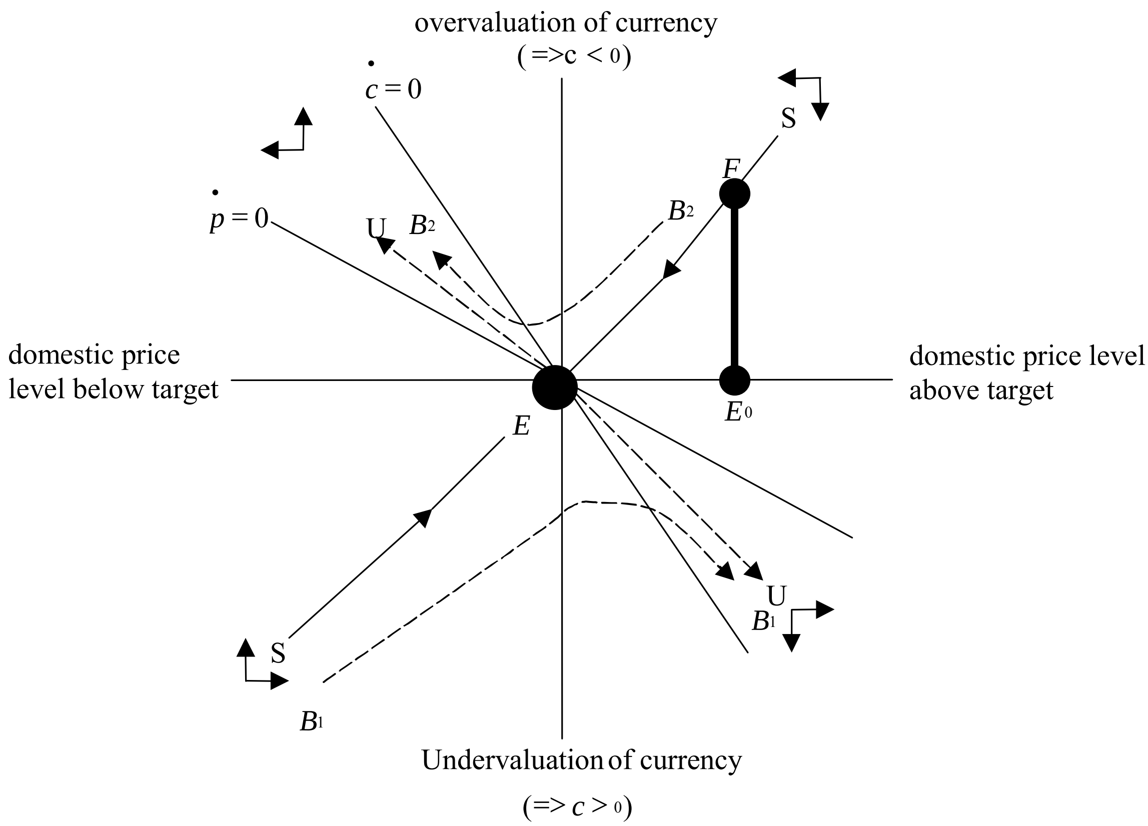


Figure 4.3.1: The Dynamics of Domestic Prices and the Real Exchange Rate

In any given period where the authorities revise θ (or any other parameter in the system changes), we should witness both jumps and slides in the exchange rate. Actual exchange rate movements would display a complex written pattern of sudden movements and subsequent reversals. It is hardly surprising if UIP is found to fail in conditions such as these. Shocks (to θ, or other variables) contaminate the actual data for exchange rate changes and interest differentials so much that the UIP mechanism, even if operates perfectly, cannot readily be discerned. Meredith (2002) offers important reflections on this point.

The model depicted in Figure 4.3.1 can easily be adapted to admit inflation trends at home and abroad, and to changes in foreign nominal interest rates. If there is a persistent gap between rates of inflation in two countries, this should be matched, approximately one-to-one, in the average short-run nominal interest differential between them – and in the nominal exchange rate trend, as well. This should become increasingly apparent as the length of period under study increases. For this reason, longer run tests of UIP should be more successful. We can therefore reconcile the two sets of results presented in Tables 4.3.1 and 4.3.2. Further reasons can be advanced to explain short-term discrepancies between actual exchange rate changes and relevant cross-country nominal interest differentials. One is that there could be bubbles. A bubble path is an unsustainable route that eventually diverges from long-run equilibrium by ever-increasing amounts. Two examples are exhibited in Figure 4.3.1 by the dashed paths labelled B_1, and B_2. If either is present, the unstable eigenvector UU rotates clockwise slightly. Bubbles are very hard to reconcile with economic rationality. The thinking behind Fig 4.3.1, and the saddle path SS, is that market participants try first to calculate the long-run equilibrium for the system as a whole. Then they work out, for any given current value of p, the logarithm of the domestic price level, what the current exchange rate should be in order, eventually, to attain it. This is one way of formalising the thought processes of those market participants known as "fundamentalists".

Fundamentalists focus above all on the long run, and then on how history could evolve to reach it. They are opposed, in popular parlance, by "chartists" whose gaze is fixed, instead, upon what may happen in the near future. Chartists predict short-term price movements on the basis of recent past movements, and what data drawn from a less recent past seem to suggest about the profile of gradual and sharp price movements. Chartists look closely at the balance of portfolio flows in and out of particular assets. At certain times they may hold extrapolative expectations, believing that what has recently been rising should continue to go up, at least for a while. They look closely at what assets seem to be in fashion. Chartist behaviour can indeed generate bubbles. At any point in time, two things can happen to a bubble. It can burst, or it can survive. If it survives, it must grow. Further movement in the wrong direction is needed when it does not burst, in order to provide the capital gain that must be offered to compensate for the possibility of loss if and when it bursts.

McCallum (1994) attributes the empirical failure of UIP, in short-run tests, to the combination of bubbles and the tendency of central banks to lean against them. A central bank facing a bubble path B_1 may start to raise interest rates cautiously after undervaluation begins increasing (the ECB and the Euro in late 2000 is a possible example). A central bank that believes the foreign exchange market is driving it along path B_2 may try to lower its interest rate as the overvaluation begins to grow (the USA in late 1984 and January 1985 is another possible instance). Either of the two things how happens: the bubble path may continue, after a slight dislodgement towards the horizontal axis;

alternatively, the bubble is punctured. Bubble-punctures, as in the case of the US dollar in January 1985, lead to a large crash (which might be all the way towards the saddle path SS, or even further). They will reveal a combination of interest rate changes in one direction, and exchange rate jumps in the same direction. A few incidents of bubble puncturing will generate huge disturbances to the relationship between exchange rate changes and interest differentials.

Whether the authorities *should* attempt to puncture perceived bubbles is a fascinating question, recently addressed by Cecchetti et al (2000) in the context of equity prices. Bubbles are hard to identify. The sharp movements associated with punctures are very costly: output and financial stability are imperilled. But the case for "wait and see" is undermined by the fact that postponing the burst of a correctly perceived bubble may involve still greater costs later (a point stressed by Kent and Lowe (1997)). This is because a bubble should grow if it does not burst. Had the stock market bubble in the later 1920s in the United States been pricked earlier than it was, the resulting crash in equity prices, and perhaps the Great Depression that followed it, would have been less severe. Similar inferences may be drawn for the property and equity booms in Japan in the late 1980s, which form the basis of the powerful credit and land-price cycles model of Kiyotaki and Moore (1997) and its application to the 1997 Asian crisis by Miller et al (2000). The most prominent example of a foreign exchange rate bubble is the sharp rise in the US dollar during 1984. The case for leaning against a bubble in the foreign exchange market is stronger when the bubble is of the type described in Allen and Gale (2000) than a mechanical bubble inserted (for example) into the UIP equation. This is because, in contrast to the former, the latter will tend to grow faster, when squashed as opposed to pricked, leading to (foreseeable) difficulties later on if it does not burst in the meantime.

In the very long run, on average across countries, UIP does indeed hold. So too does CAC, wrinkles aside. But short term departures are so widespread that we can, alas, have very little confidence indeed about precisely how much exchange rate appreciation a given domestic nominal interest rate change will induce, let alone when. Nor can we have any clear idea about how quickly, and when, the exchange rate will tend to drift back. The impact of exchange rate changes upon domestic inflation is, unfortunately, open to similar uncertainties. Lastly, we should expect the inflation response to exchange rate changes to vary country by country. It should be fastest and largest where inflation is rapid, and exports and imports are large in relation to national income.

4.4 INTEREST RATES UNDER MONEY TARGETING

In most economies with well developed domestic financial markets, interest rates are key policy instruments. In some, they are deployed to keep inflation close to a pre-announced track. In others, where monetary aggregates are subject to targets, nominal interest rates may still be the month-by-month instrument of choice, revised and reset to keep the demand for monetary aggregates and their supply in balance, in the context of their pre-announced time paths. But there are transmission mechanism questions to address, in the latter case at least, relating to the supply of money.

As in countries with less developed financial systems, the evolution of the monetary base is unquestionably sensitive to budget deficits and (under fixed exchange rates) to balance of payments surpluses. The monetary base will tend to rise automatically in response to either. But it can be blocked. The monetary base can be insulated from the government's budgetary position if deficits are matched in full by sales of bonds to the domestic non-bank public. External payments surpluses need have no impact upon the monetary base if sterilised by bond sales on the same basis. For a variety of reasons, full blockage may be hard to achieve, but partial blockage should not prove an insurmountable challenge.

Open market operations are the principal weapon at the central bank's disposal for affecting both the monetary base and the pyramid of inside money built upon it. Open market purchases will involve raising the market price of bonds. Market interest rates at the maturity of bonds purchased will fall directly, and adjacent maturities should display similar changes very quickly. Commercial banks will experience a rise in cash reserves, presumably surplus to requirements; money market interest rates and Treasury Bill rates should slip somewhat, and there may be some consequential easing in deposit and loan rates set by the retail banks. From this point, the transmission mechanism will display the sequence of changes in aggregate nominal demand, prices and wages similar to that studied above. The key difference between the transmission mechanism relating to a change in (some definition of) the supply of money, and the transmission mechanism for a change in interest rates, is that the former introduces a prior stage. This prior stage is the set of effects stemming directly from the money supply change. In the case of open market operations, these direct effects take the primary form of alterations in the prices and yields of the bonds that the authorities have bought and sold. Various other interest rates move in response.

When the money supply change emanates from budget deficits or payments surpluses that are less than fully offset by bond sales to the domestic non-bank public, the initial consequences differ somewhat. The larger the proportion of the budget deficit or payments surpluses covered by bond sales, the likelier it is that bond prices fall rather than rise (unless larger bond sales and the associated lower monetary growth cause inflation expectations to be lower). Pressure on interest rates will be upward if this is so. When the proportion is small, so that substantial monetisation occurs, short interest rates are likely to fall, transmitting muted downward pressure on other interest rates.

This is one reason for uncertainty about the pattern of interest rate changes consequent upon a rise in the money supply. There are others. The benefits that holders derive from balances stem from real holdings, not nominal holdings. So if the money supply increase is matched by inflation, real money is unchanged, and there is no "excess supply of money" to exert effects in other markets. Even when real money holdings do increase, the direction of interest rate changes is not necessarily downward. Real money demand might have risen in response to higher wealth or income, greater uncertainty, financial innovation, changes in intermediation patterns, transactions technology or the character of structure or degree of competition in the provision of financial services. In such cases there may again be "no excess supply of money".

Furthermore, when money is initially in excess supply, there could be reasons for increases rather than reductions in nominal interest rates. One such is the traditional, if somewhat suspect, idea of real balance effects. These postulate a direct link between real money holdings and consumption. An unanticipated increase in the real level of currency or bank deposits, surplus to needs, could lead directly to higher consumption spending on the part of agents experiencing it. Additional outlays on consumer durables (like money, an asset) are particularly likely; and for households restricted by credit limits from spending what they would like, higher spending may well follow. Extra general consumption spending by a fringe of hitherto unsatisfied borrowers, or on durables by recipients of what are treated as windfall gains, will tend to raise equilibrium interest rates all else equal, and not to lower them. There is also the possibility that market observers raise their expectations of future growth of nominal money. That should lead them to predict faster inflation, and hence higher equilibrium nominal rates of interest. This should show up in some rise in at least long term nominal interest rates now. Finally, there is the point that untoward or unexpected rises in nominal or real monetary aggregates may prompt the authorities to increase official interest rates, and that even if they do not do so immediately, the market may expect them to do so later on.

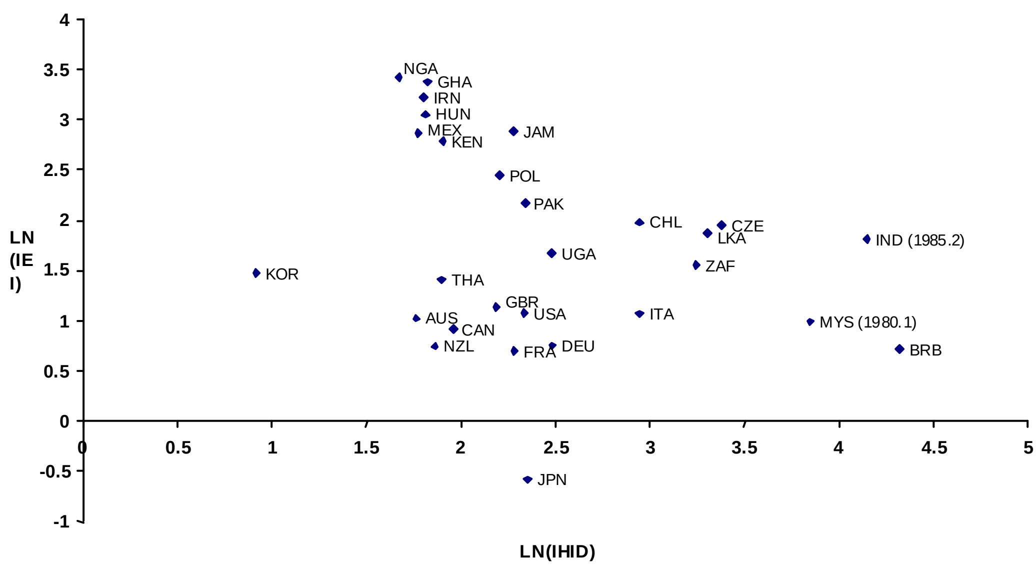
All this leads to the conclusion that it is perilous to draw influences about how interest rates should respond to a rise in the supply of money. They could fall; they could also rise. So the initial stage in the transmission mechanism for a change in the supply of money – its impact on interest rates – is far from certain, even in direction, let alone magnitude or timing. These considerations also reinforce the case for concentrating on the official rate of interest as the key instrument of monetary policy.

4.5. INFLATION DYNAMICS - SOME FACTS

Table A4.5.1 in the Appendix reports evidence about inflation for 135 countries. It explores the link between the change in inflation from one year to the next on one side, and an earlier level of inflation, one or two years previously, on the other. If monetary policy stabilises the rate of inflation, we would expect the coefficient on earlier inflation to be negative. In all the countries reported, it is indeed negative, and often significantly so, especially for advanced countries. Data relate to the period from 1981 to 2000, sampled at quarterly frequencies, and in some cases restricted to a more recent span of years. The constant terms are invariably positive, though often not significantly. The ratio of the estimated constant to the estimated coefficient on the lagged level of inflation gives a figure for the *equilibrium* rate of inflation. This is an equilibrium in a purely statistical sense: it is the average level of inflation that would have emerged for the country and period under inquiry, had it been constant throughout the period. In some cases the change in inflation between years 2 and 3 captures the influence of the level of inflation in year 1; in others it is the influence of inflation in year 0 that is given. The choice between the two was made on the basis of relative statistical significance.

The equilibrium rate of inflation for a country is not the same thing as the average rate of inflation over the given period. It is better treated as the core rate of inflation which monetary policy succeeded in restoring, after disturbances. It covers both the 1980s and the 1990s for most countries. In certain cases a narrower span, later in the period, had to be chosen, because of data limitations, the need to obtain correct signs for the coefficients, or the creation of new states within formerly communist countries. Furthermore, the aims of monetary policy were not necessarily stable over these decades. So the equilibrium inflation estimates do not tell us about the countries' monetary policy objectives now, at the start of the new millennium, but rather what they appear to have been, on average, over the 1980s and 1990s as a whole. In the developed world, the English-speaking Caribbean (Jamaica aside), Chile, and a group of mostly smaller Asian economies, statistical equilibrium inflation rates are close to 2% or 3% per year. In Japan and Singapore, they are around 1%; in Korea, Portugal and Trinidad and Tobago, nearer to 6 or 7%. In Latin America, most statistical equilibrium inflation rates lie in one of two ranges. The lower one, from 9 to 46%, embraces the majority, but in Argentina, Bolivia, Brazil and Peru, they are close to 500-600%, with Nicaragua heading the list at over 2000%. Africa is diverse, varying from 2% or less in Niger and Tunisia to over 1400% in Angola.

Figure 4.5.1 Inflation equilibrium vs Half Life (Sub group) 90-00



Equilibrium inflation rates implied by our regressions make an interesting contrast with the results for the average speed with which implied inflation disequilibria were corrected. We calculated implicit half-lives for inflation disequilibria (IHID) for all sampled countries, and regressed implied equilibrium inflation (IEI) rates upon them, and upon real GDP per head. The results were interesting. Richer countries tended to have lower inflation and/or more short-lived inflation disequilibria than poorer ones. There proved to be a reasonably robust negative association between the level of inflation and how quickly inflation discrepancies were removed (see the scatter plot in Figure 4.5.1). The faster the rate of inflation, then, the more quickly inflation adjusted back to its econometrically determined equilibrium value. This fits with the idea that the transmission mechanism for monetary policy works faster at high rates of inflation. This said, a word of caution is appropriate. These results tell us nothing about what *caused* inflation. Hendry's (2000) study of British inflation from 1875 to 1991 shows that the causation of inflation is a very complex issue, in practice as much as in theory. In the next section, we shall try to throw light on just one influence on changing inflation: interest rate policy.

4.6 INTEREST RATES AND DISINFLATION

Bringing down the rate of inflation is not an easy task. When inflation is very rapid, the challenge is to set up a new framework for monetary policy that people can trust. A credible counter-inflation strategy is the key. When this is in place, disinflation can be very rapid. When inflation has recently been very high, firms and workers have learnt, painfully, to reprice goods, services and labour frequently, and many contracts will have become indexed or denominated in foreign currency. The crucial thing is to lower inflation expectations. Once this is achieved, disinflation can proceed swiftly and almost costlessly. This has long been known: Sargent (1982) provides compelling evidence of this. A sharp reduction in inflation expectations can be brought about by currency reform (as in Germany in November 1923), the adoption of a currency board (as in Argentina, Bosnia, Bulgaria, Estonia and Lithuania in the 1990s), or when a new legal framework for the central bank is imposed (Peru, 1994). Not all reforms have lasting or even initial success. But many do.

Reducing the rate of inflation poses different difficulties when it is proceeding at a modest rate. Paradoxically, the lower the rate of inflation, the harder it appears to reduce it further. The intervals of time between pay settlements or price revisions are long. Expectations of inflation are sticky, and often appear to need a substantial drop in output, relative to trend, to knock them down. Granting operational independence to the central bank, and the adoption of a regime of inflation targeting, may bring substantial benefits, particularly, perhaps, when these changes are combined. The alternative of tying the domestic currency to another, with a superior record of inflation containment, has often proved valuable, too[ii].

Short of radical measures of this kind - or after they or something similar have been done - the task of trimming an inflation regarded as excessive is usually done most appropriately by raising official nominal interest rates temporarily. The sequence of events already described should ensue. Interest rates will edge upwards on mortgages, loans, advances, deposits and government bills and bonds. The prices of real estate and equities should recede. Through a variety of mechanisms, private sector spending on consumption (particularly on durables), and investment should start to decline or at least rise at reduced rates. Exchange rates, if free to float, are liable to appreciate, and the trade balance will tend to worsen as and when this happens. The reduction in aggregate demand will translate into a weakening in the demand for labour, reducing the rate of pay increases. Goods and services prices should rise more slowly as a result. Meanwhile, product market developments should lead directly to some trimming of price rises, particularly in traded goods sectors if the exchange rate has appreciated.

But merely raising policy rates may not be enough. For one thing, inflation expectations may have risen already. Raising policy rates by the amount of any rise in the rate of expected inflation will merely keep them steady in real terms, contributing no net disinflationary impulse. Raising them by less than any rise in inflation expectations will actually exert a counter-disinflationary effect. The critical point is that policy rates will only start to generate disinflation if they are held above a *neutral* value that matches the sum of relevant real rates, expected inflation and any risk premium. Bringing them up to this neutral level will only succeed in preventing further inflationary impacts. To achieve disinflation, policy rates must exceed their neutral value.

These ideas are illustrated in a simplified form in Fig. 4.6.1. In the lower left quadrant, this year's central bank nominal interest rate, "Bank Rate", is measured downwards from the origin O. This year's expectations of next year's inflation are measured leftwards. Two lines appear in this quadrant. Both slope up. The line FF gives the Fisher condition that an equilibrium value of the nominal interest rate rises one for one with expected inflation. Its intercept on the vertical axis captures the real (one year) rate of interest. The steeper line, RR, depicts the central bank's interest rate rule. The FF and RR lines cross at a presumed ideal rate of inflation, i^*. If Bank Rate were set at the Fisher level, which we can identify with Wicksell's natural rate of interest, there will be no systematic tendency for inflation to rise or fall. (The relation between the Taylor rule and the Wicksellian natural rate of interest is quite a complex one, see Woodford (2000) for a powerful dissection).

The upper left quadrant describes the relation between current expectations of next year's inflation, and what it will turn out to be. These two numbers should differ only by unanticipated shocks, indicated by the tramlines. In the upper right quadrant, the horizontal axis measures, rightwards, the rate of inflation now expected for the year after next. The line TT shows the effects of setting Bank Rate according to the rule RR.

The diagram abstracts from other relevant variables, such as the output gap. If inflation next year is now expected to be i^{**}, the rule should set Bank Rate at r^{**}. The difference between r^{**} and i^{**} is the interest rate gap. In the diagram, this year's gap is assumed to lower inflation between next year and the year after that, by the distance y. The linearity embedded in the diagram implies that y will be proportional to the gap. It is important that the rule line RR should be steeper than FF – if it were flatter, inflation would diverge from its ideal value. (Clearly there will also be a problem if RR is steeper than FF, in circumstances when expected inflation is below its ideal value – this is the challenge posed by the zero bound to Bank Rate). In what follows in this section, we shall attempt to quantify the size of the sensitivity of *y* to the interest rate gap for a large group of countries.

To gain a quantitative impression of how inflation responds to the gap between actual official rates, and their neutral levels, the following procedure was adopted. First, a "world" real short-term interest rate series was constructed. This involved averaging up to three relevant short-term interest rates within 20 advanced countries, then subtracting the annual rate of change of that country's GDP deflator, and weighting the ensuing estimated real rates by the country's share of total GDP in 1998. The world real rate series was then smoothed by a 3-year moving average. The average difference between each country's actual nominal interest series, and the sum of its GDP-deflator inflation rate and the world real rate series, was then obtained. This gives a measure of the average implicit risk premium on short-term nominal assets denominated in the country's currency, and was calculated for the period 1980-2000 (see Appendix table A3.11.1). The *neutral* rate of country *i* in year *t* was then defined as this average country-*i* risk premium, plus the three-year moving average world short real interest centred at year *t*, plus a three-year moving average of the rate of inflation in country *i* centred at date *t*.

When relevant policy rates exceeded their neutral value, the difference should be expected to lower inflation subsequently. When the gap is negative, the opposite could be predicted. The evidence from regressions of inflation changes on previous values of the "interest rate gap" is somewhat mixed. Statistically significant and correctly-signed coefficients are obtained for the United States and for Japan, and for a few other countries as well. But in the main, results for individual countries are not significant. There is also some disparity in the timing of effects, with the change in inflation between years t+2 and t+1 sometimes being more responsive to the interest gap in year t, and sometimes to the gap a year earlier. Pooling groups of countries and imposing a common coefficient on the gap that individual country regressions revealed to be more promising resulted, however, in some statistically significant results.

As a broad rule of thumb, an interest rate gap of 1% - so that the central bank rate is 1% on average above its neutral value for one year – reduces inflation by about 0.36% either two or three years later. This was the average finding for a group of industrial countries.

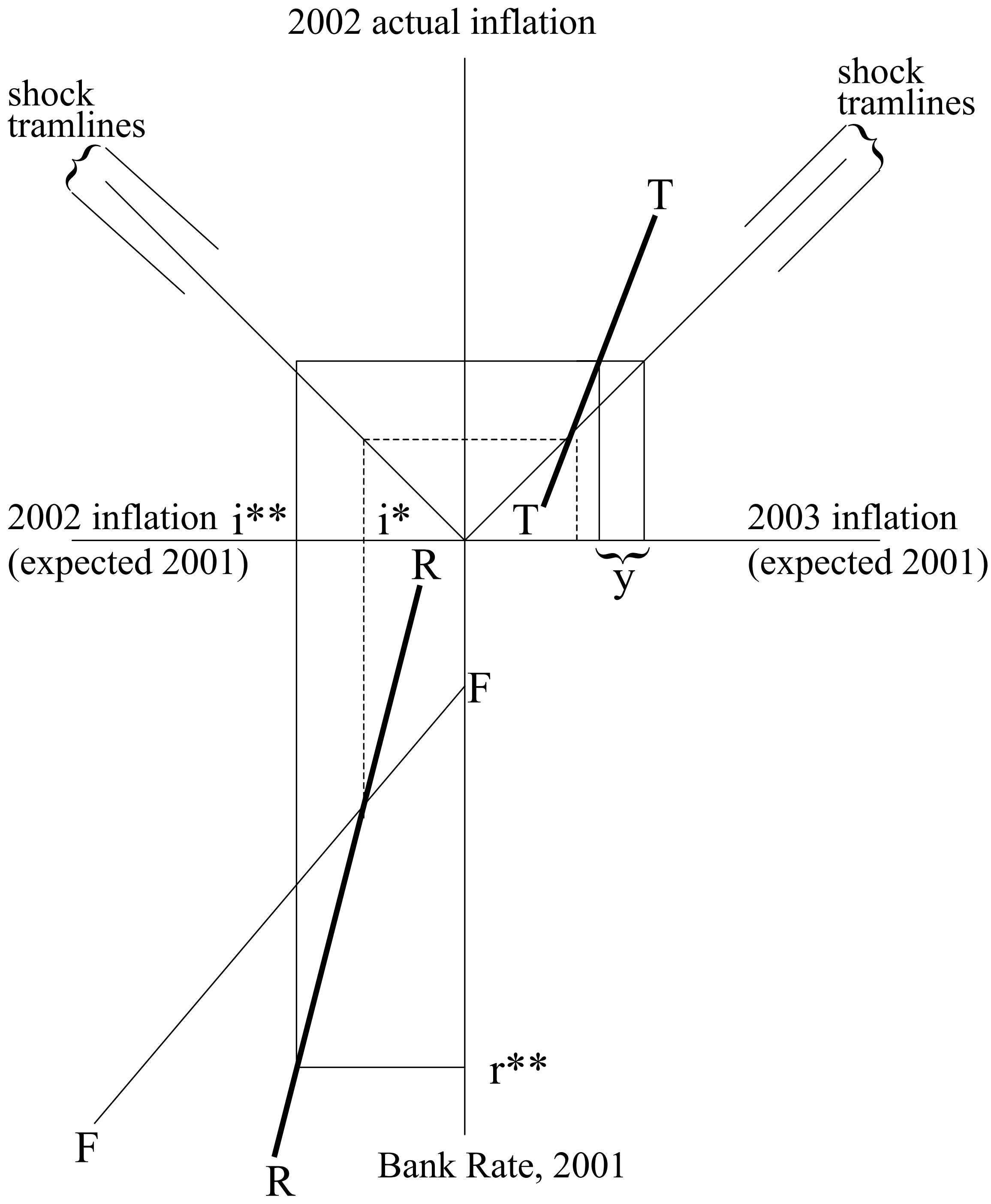


Figure 4.6.1. Interest Rates and Disinflation

In the United States, the coefficient on the interest rate gap in year t was smaller (0.212), and for Japan, 0.427. Israel's (0.765) and Australia's (0.517) were higher, and Singapore's rather lower (0.343). Of these five countries, the gap coefficient was significant in all except the United States.

The poor significance and low coefficient for the United States might testify to its large role in determining world real rates.

For some countries, confining the sample period to the decade 1990-2000 produced better results. For Canada, for example, it produced a statistically significant coefficient on the interest rate gap of 0.762, almost as high as Israel's for the full twenty years. There were, somewhat disturbingly however, quite a few countries for which the interest rate gap coefficient was wrongly signed. For Madagascar, it was large and significant, as well as perverse. The likely reason for this and similar anomalies for some other developing countries is the fact that the risk premium is in practice not stationary. When a debt or foreign exchange crisis afflicts a country, for example, the risk premium is liable to rise suddenly, and a quickening of the rate of inflation may well ensue too. Official interest rates will of course go up in circumstances such as these, but probably not by enough to match the risk premium, and if this is so, the stance of monetary policy will not be disinflationary.

These regressions attempt to pinpoint the amount of disinflation that a country can achieve on its own, by holding interest rates above the value implied by the sum of world real rates, domestic inflation and the country's own long run risk premium. It does not take account of the disinflation resulting from abnormally high world real rates resulting from similar actions undertaken by other central banks, which will form another part of the story. Disinflation proceeds from two channels. The domestic channel involves holding domestic policy rates above their neutral value at current values of world real interest rates. There is also a foreign channel of disinflation, if other central banks around the world are acting similarly. It is only the first of these channels upon which our results throw light.

[i] These and subsequent equations are derived from the line of reasoning suggested in the treatment of consumption in Bank of England (1999), Chapter 6.
[ii] See 'Monetary Policy Frameworks in a Global Context', edited by Sterne & Mahadeva (2000)