
The Problem of Front-end Loading and Disorder in the Housing Market

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Abstract

The paper asks why indexation of debits is not typically observed in the UK housing market. Indexation ensures that real debits change only if the real rate of interest alters and eliminates the problem of front-end loading or the tilt. The typical British repayment mortgage and the index-linked alternative are just two special cases of a more general repayment schedule. A measure of front-end loading, which compares the real value of debt with the index-linked alternative over the term of the loan, is described. Neither of the two special cases need correspond to the ideal degree of front-end loading.

1. Introduction

FRONT-END loading becomes an issue when debt repayments are tied to *nominal interest* rates in a world of inflation. Because the nominal interest rate fixes the nominal debit, *real* debt repayments are higher at the beginning of the loan period and correspondingly lower at the end. This is sometimes known as the problem of the tilt. In the absence of inflation, repayments in real terms would remain constant. Inflation, therefore, has the unintended consequence of making borrowers pay off debt more quickly and forces them to under-consume at the beginning of the loan period. Mortgage repayments are the classic example of this phenomenon.² Furthermore, there is evidence that inflation-induced tilt in debt repayments has real distorting effects on the housing market. Because of the tilt issue, even fully anticipated inflation

can have real effects, contrary to the usual money neutrality proposition.³ The solution is well known; when there is inflation, debt repayments should be index-linked, thus making debits constant in real terms and equal to the non-inflation case. The *interesting* question to ask is, given that indexation of debits is apparently a better arrangement, why is it not typically observed in the housing market?

Recent times have witnessed falling house prices and the problem of the negative equity trap, followed by an equally volatile upward movement in house prices. The simple repayment mortgage has historically exhibited wild fluctuations in both the nominal and real rate of interest paid. These fluctuations have contributed to the undesirable disorder that has existed in the housing market. Describing these fluctuations helps cast light on the question why indexation is not observed. Indexation cannot, in itself, guarantee the elimination of such problems, but it can help contribute to a more orderly market.

The first part will show exactly what the front-end loading problem is and its severity will be shown for various inflation rates. This leads on to a discussion of the advantages of indexation and why, despite these advantages, it is not commonly observed. The latter part develops a practical measure of the degree of tilt embodied in repayment contracts that are not index-linked and the severe tilt of the typical British mortgage will be demonstrated using the measure. As the new century begins we now live in a time of moderate inflation and it might be argued that discussions about indexation are irrelevant. But, just as experi-

ence of the 1950s and 1960s convinced many that the phenomenon of mass unemployment would never re-emerge, the problems of inflation might yet come again to haunt us all.

2. Alternative payment schemes

The following terminology is used:

- T The number of repayments over which the loan is amortised. The first repayment occurs at time 1 with subsequent ones spaced evenly thereafter until time T .
- P_t The price level at time t .
- P_0Y_0 The nominal amount borrowed at time = 0.
- P_tD_t The nominal amount repaid at time t (the debit amount), $t=1, \dots, T$. Because of inflation, it will also be necessary to work in real terms. This will be done in terms of base year (time = 0 prices). Thus the first real debit is P_0D_1 and so on.
- ρ_r The real rate of interest.
- π_t The rate of inflation = $(P_t - P_{t-1})/P_{t-1}$.
- r_t The nominal rate of interest. Because the framework uses discrete time periods, the real interest rate and the inflation rate are related to the nominal rate of interest according to $1 + r_t = (1 + \rho_r)(1 + \pi_t)$.
- P_tY_t The nominal amount of the loan outstanding at time t (after P_tD_t has been paid).

Given this set-up, the outstanding value of the loan in nominal terms will evolve according to the first-order difference equation

$$P_tY_t = (1 + r_t)P_{t-1}Y_{t-1} - P_tD_t \quad (1)$$

The various repayment schemes are just special cases of the following general structure,

$$P_{t-1}Y_{t-1} = \sum_{i=1}^{T+1-t} \frac{P_iD_i(1+g_i)^{i-1}}{(1+r_t)^i} \quad t=1, \dots, T \quad (2)$$

$$g_i \geq -1$$

The nominal debit is planned to grow at rate g_t . The simple adjustable non-index-linked mortgage is just the special case that specifies $g_t = 0$ and indexation is just the special case which sets $g_t = \pi_t$. For example, for the simple non-index-linked scheme, the first nominal debit P_1D_1 is the solution to

$$P_0Y_0 = \frac{P_1D_1}{(1+r_1)} + \dots + \frac{P_1D_1}{(1+r_1)^T} \quad (3)$$

and P_2D_2 is solved from

$$P_1Y_1 = \frac{P_2D_2}{(1+r_2)} + \dots + \frac{P_2D_2}{(1+r_2)^{T-1}} \quad (4)$$

and so on. As long as the nominal interest does not change then the nominal debit amount will remain constant in successive periods, but if the interest rate changes then the debit amount is recalculated according to Equation 2 with $g_t = 0$.

One broad distinction to make is between the fixed (nominal) rate mortgage (FRM) and the adjustable (nominal) rate mortgage (ARM). Equation 2 makes clear that it covers both types, with the ARM type typical of Britain. Section 6 gives an example of varying debits. It is important to realise that ARMs do not in any way eliminate the front-end loading problem. The traditional American mortgage has been of the FRM variety ($r_t = r$ throughout the loan, hence nominal debits are not varied with market rates).⁴ This has led to severe distortions with some households locked into cheap mortgages negotiated at a time of low inflation. They are reluctant to move because to do so would mean the loss of a *de facto* loan subsidy. This type of distortion is a different issue from the problem of the tilt.

The second scheme, index-linking or the Price Level Adjusted Mortgage (PLAM), is one that specifies that $P_t D_t$ is linked to the rate of inflation. For example, $P_1 D_1$ is the solution to

$$P_0 Y_0 = \frac{P_1 D_1}{(1+r_1)} + \dots + \frac{P_1 D_1 (1+\pi_1)^{T-1}}{(1+r_1)^T} \quad (5)$$

This can be written equivalently in terms of the real debit $P_0 D_1$ as

$$P_0 Y_0 = \frac{P_0 D_1}{(1+\rho_1)} + \dots + \frac{P_0 D_1}{(1+\rho_1)^T} \quad (6)$$

and $P_0 D_2$ as

$$P_0 Y_1 = \frac{P_0 D_2}{(1+\rho_2)} + \dots + \frac{P_0 D_2}{(1+\rho_2)^{T-1}} \quad (7)$$

and so on. As long as the real interest rate does not change then the real debit amount will remain constant in successive periods, but if the real interest rate changes then the real debit amount is re-calculated according to eq.(2) with $g_t = \pi_t$. The symmetry between both schemes is self-evident.

With the index-linked instrument there are two choices. The first choice would be to set $\rho_t = \rho$ in all periods, thus the borrower is guaranteed a fixed real rate throughout the contract (equivalent to the FRM, but with indexation). The second type would offer no such guarantee and the 'reference' index-linked real debit would respond to variations in the reference real rate of interest, just as the simple ARM debit responds to nominal interest rate changes. The monetary authorities, for example, might wish to raise the real interest rate in response to inflationary pressures. Real debits in the second type of indexation would respond to any change in the reference real rate and make monetary policy correspondingly more effective. A further advantage is that, if financial intermediaries are competing for funds to lend and are obliged to borrow 'short', a matching index-linked saving scheme with a variable real rate would offer financial inter-

mediaries greater security when market real interest rates vary.

It is obvious that scheme one, where the debit amount is fixed in nominal terms for a given nominal interest rate, means that the loan is front-end loaded when there is inflation. As the price level rises, the real value of debits will decline as the loan gradually matures. Consequently, the real outstanding value of the loan must decline faster compared with the index-linked scheme. It should also be realised that the PLAM involves no guesswork about the rate of inflation and is surprisingly simple to operate. Once a mortgage is negotiated the borrower can be told the base period debit. If this is $\pounds x$ then the monthly debit is $\pounds x$ times the price index for that month. With a fixed real interest scheme, $\pounds x$ remains fixed throughout the mortgage, whereas, with a variable real rate, the base debit can be easily recalculated. Borrowers would thus be able to distinguish the inflation and real interest rate change components in their mortgage debits.

The index-linked and non-index-linked schemes alter the timings at which debt is paid off. It is actually incorrect to assume that this is all that happens, because it is impossible a priori to predict which will be the more expensive way to borrow money. Even if the real rate of interest is the same across both schemes in any particular period, real costs can differ across the life of the loan. This is because the real outstanding value of the loan differs across the schemes in any particular period. For example, if real rates turn out to be high at the end of the loan period, the non-indexed scheme has a smaller real amount outstanding to be charged at this high real rate compared with the indexed scheme. In this case, the non-indexed scheme will prove to be cheaper. Only in the case where the real rate of interest is the same across the schemes and does not vary through time, can it be asserted that costs (in real money units) will be the same.⁵ Costs can be compared by calculating the real debits for

both schemes. Then that constant real interest rate which has a present value equal to the original loan for these calculated real debits is a measure of the loan cost. The appendix gives an example of differing cost structures.

These are not the only alternative mortgage instruments. For example, there is the Graduated Payment Mortgage (GPM). This sets $g_t = a$, implying a constant growth in nominal payments throughout the life of the mortgage.⁶ Strictly speaking, this is not really an index-linked scheme and, unlike the PLAM, involves guesswork about the inflation rate. The idea is to set a somewhere near to the expected inflation rate over the life of the loan. To the extent that expectations are fulfilled, the problem of the tilt is eliminated. However, such schemes will at best be crude approximations. To the extent that a is a better guess than zero for the expected inflation rate, then the GPM should have less tilt than the simple ARM. However, if the idea is to eliminate the tilt, then there seems no advantage in the GPM over the PLAM.

As special cases of Equation 2, none of these schemes need give the ideal degree of front-end loading. Some people prefer to make early capital repayments on their mortgage and this would be a case where $g_t < 0$ is preferred.⁷ An intermediate case is partial indexation, where $g_t = \pi_t - a$. A more interesting case is over-indexation, where $g_t = \pi_t + a(1 + \pi_t)$. In this case real payments are allowed to grow at the fixed rate a , which necessarily means even lower debits at the front-end compared with the pure indexation case.⁸ The next section gives an example of this type of contract. With currently high real interest rates, in some ways lenders have gone some way to recognise the marketability of rising debit mortgages by offering products with various 'discounts' in the first few years of the loan. However, interest rate discounts or 'teaser' rate inducements in the initial years are a somewhat different mortgage product compared with the over-

indexation case just described.

Given the many permutations of Equation 2, the logical conclusion might be to argue for letting the debtor decide the value of g_t in any particular any month, subject to a minimum payment consistent with financial prudence. After all individuals, not financial institutions, are best equipped to determine how to schedule debt repayments for long-term loans. The ideal schedule is bound to be highly idiosyncratic, reflecting the path of actual future disposable income and so on for specific individuals. Such flexible schemes are very common in other contexts. Borrowers using credit cards are typically given a high degree of leeway about scheduling their monthly debit amount. The disadvantage seems to be that this flexibility is associated with very high borrowing costs.

3. Illustrating front-end loading

Table 1 gives some illustrative numbers for a 25 year loan of 10,000, based on 300 monthly repayments and an annual real interest rate of 2 per cent and various inflation rates. It shows the initial nominal payment P_1D_1 and the initial real payment P_0D_1 under various choices.⁹ With no inflation, it can be seen that the PLAM and the ARM are the same. With higher inflation rates and correspondingly higher nominal interest rates, P_1D_1 rises rapidly under the simple ARM. With the PLAM, the initial payment rises a little because of the first period indexation. The real debit amount remains constant in every case and is exactly the same as the ARM when there is no inflation. In other words, indexation automatically restores the debt repayment schedule to that which prevailed under the first scheme when there is no inflation.

Indexation eliminates the inflation induced tilt in debt repayments and this is its chief advantage. Borrowers, particularly in the housing market, are most stretched at the beginning of the loan period. At the end, when

Table 1: Repayment examples
(Loan = 10,000, $\rho = .02$, T = 300)

Inflation rate	Non-index-linked mortgage (first debit)		Index-linked mortgage (first debit)		Index-linked plus 2 per cent real growth (first debit)	
	Nominal debit P_1D_1	Real debit P_0D_1	Nominal debit P_1D_1	Real debit P_0D_1	Nominal debit P_1D_1	Real debit P_0D_1
0	42.30	42.30	42.30	42.30	33.39	33.39
.05	69.91	69.62	42.47	42.30	33.52	33.39
.10	102.13	101.33	42.63	42.30	33.65	33.39
.15	136.38	134.80	42.79	42.30	33.78	33.39
.20	170.96	168.38	42.94	42.30	33.96	33.39
.30	238.13	232.98	43.23	42.30	34.13	33.39

they have a higher salary and fewer family commitments, the burden of a mortgage lessens. There must be many borrowers, who, with hindsight, would have preferred to have paid less at the beginning of the loan and more at the end.

One response to the higher burden of increased nominal repayments might be to increase the length of the loan, rather than to index. This would serve to reduce nominal payments. But this is only a viable option with very low rates of inflation. Even with 5 per cent inflation, an interest only contract (i.e. the repayment period is extended to infinity) would reduce the real payment to 57.09, far in excess of the index-linked real debit of 42.30. This point has also been noted by Miles (1994).

It is not self-evident that indexation is synonymous with the *ideal* degree of front-end loading. The final two columns show the nominal and real first period debits where *real* debits are allowed to grow at an annual rate 2 per cent above the rate of inflation - i.e. the loan repayments are now over-indexed. This results in roughly a 20 per cent reduction in the initial payment, a very significant reduction in the degree of front-end loading. Such a repayment schedule would be easily sustainable for the typical long-term borrower. With index-link-

ing the burden of repayment would ease, because incomes typically rise faster than the underlying inflation rate. Assuming a growth of 2 per cent in real earnings is actually rather modest, because the real earnings of a typical borrower would be expected to rise somewhat faster than the underlying average growth in real earnings. With over-indexation, it is possible that the real value of the outstanding debt could increase initially. Scott *et al.* (1993) argue that the default risk for this type of instrument would be too large to be practical.

4. Some advantages of indexation

The great (and probably only) virtue of the American style FRM is its simplicity. Borrowers find the idea that 'I pay an unchanging x dollars per month for a fixed number of years', easy to understand. Indeed, such instruments worked well in an era of low inflation. The problem with simple debit systems is that they can turn out to be surprisingly expensive to either the borrower or the lender, depending on who guessed wrong about the rate of inflation. The British ARM is more complex, and avoids the most glaring problems of the FRM, but does not avoid the problem of the tilt. The PLAM is a further small step in complexity, but avoids the problem of the tilt. So the trade-off seems to be

simplicity versus the novelty of instruments that cope better with variable and unpredictable inflation. People are inherently conservative and are reluctant to change to new arrangements, more especially if, in the past, familiar arrangements have worked reasonably well. The truth, as Section 2 shows, is that the PLAM is actually very simple. Novelty should not be confused with complexity.

A financial intermediary, such as a building society, should be able to match its assets (money lent) with its liabilities (money borrowed from the public). Many of the problems of American Savings and Loans Associations (S&Ls) arose because they lent long at guaranteed low fixed rates when inflation was low and borrowed short. Disaster ensued as the newly deregulated institutions attempted to trade their way out of insolvency as the inflation rate accelerated. So the \$100 billion eventual bill to the American taxpayer is not the best advertisement for simple to understand debit schemes.¹⁰ It is financially prudent that financial intermediaries borrow on the same terms as they lend. Thus savers could be similarly guaranteed an index-linked rate of return with a specified (but possibly varying) real rate of return, instead of the present guessing game as faced by borrowers. Such schemes would make the operations of such intermediaries *transparent*. The spread in real rates - the difference between the lending and borrowing real rate - would be a direct measure of the efficiency of the financial institution. Borrowers and lenders, who deal with building societies, typically seek *certainty*, not a gamble on an uncertain inflation rate. Given the advantages, it is surprising that indexation of debt is not observed more often. Section 6 explains this reluctance.

A problem with the property market in the 1990s was the issue of negative equity. This occurs when the value of the property, which is the co-lateral for the loan, is exceeded by the outstanding value of the loan. The problem of

negative equity is rather different from the problem that borrowers are unable or unwilling to meet their repayment obligations.¹¹ Those with negative equity are tempted to 'throw in the keys' and walk away from the debt, even though they are able to meet their current obligations and despite the threat of restrictions on borrowing at any time in the future. There is some suggestive evidence that this is so. For example, compare 1992 with 1983. In 1992, the proportion of those in arrears (6 months or more) was 3.55 per cent, compared with 0.54 per cent in 1983. In 1992, 1.34 per cent of houses were repossessed, compared with 0.12 per cent in 1983. Yet unemployment rates and interest rates were virtually the same in these two years. The major difference was negative equity, given that 1992 was the peak year for the great house price crash. The standard house price fell 5.6 per cent. Negative equity peaked at 1.6 million (16 per cent of mortgages) at around £7,000 per household.¹² However, there may be reverse causation here, because those in arrears were unwilling or unable to sell, unlike more buoyant times.

These alternative lending schemes cannot avoid the possibility of negative equity. Lending and borrowing carry an inherent risk, and no-one can guarantee that the house price index will roughly follow or do better than the index of average prices. What can be said is that indexed schemes can contribute to an orderly market, not subject to violent fluctuations, compared with nominal payment schemes.¹³ Section 6 will illustrate these destabilising fluctuations. An orderly market for loans makes stability in house prices more likely. Debt reneging would be less likely with index-linking. As the loan matures, the probability of negative equity diminishes. Those on an indexed scheme pay more towards the end of the loan period compared with those on the simple repayment mortgage, but would have a lower incentive to dissemble. Those at the beginning are better protected from inflation

with indexed schemes, as Table 1 shows. They are correspondingly less likely to have difficulty in paying.

5. A digression on retirement annuities

Many of the issues that arise from a non-indexed mortgage market apply equally well to the recent problems that have affected retirement annuities, namely apparently low historic rates of return. The two issues are in fact Siamese twins; a standard non-indexed annuity is rather similar to an American style FRM with all its associated problems. Whereas an FRM charges a fixed monthly nominal debit (irrespective of market rates) in exchange for a house loan, a standard annuity purchases a fixed monthly payment (irrespective of future movements in interest rates) in exchange for a lump sum.

Just as the American S&Ls made the mistake of fixing nominal debits at a time of low inflation (implying problems when inflation

stock. When inflation was high and expected to remain so, nominal returns on long dated stock were high. One such company, Equitable Life, made the mistake of guaranteeing a high nominal return, based on these observed returns. When both inflation and expected long-term inflation fell, nominal returns correspondingly dropped. Equitable Life's attempts to have the guarantee set aside has been (as of January 2001) rejected by the courts leading to a similar black hole in its finances as with the American S&Ls - though mercifully not on the same scale.

Obviously, falling real rates of interest (partially the consequence of a shortage of long-dated government stock which back annuities) and longer life expectancy compound the problems of falling annuity rates, but this should not detract from the central issue of failing to recognize that price inflation and a refusal to think in real rather than nominal returns are the heart of the issue. Indexation is just about the

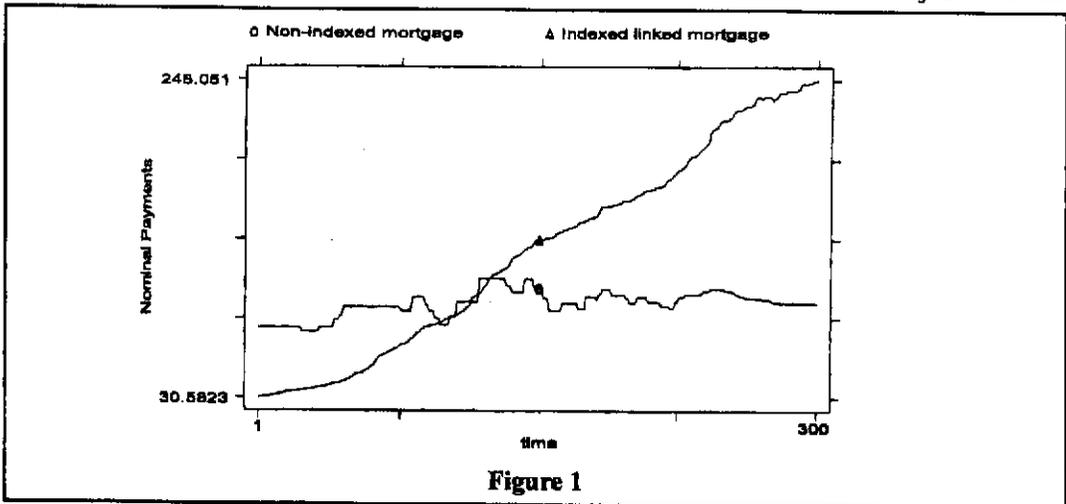


Figure 1

became surprisingly high), some British annuity providers made the mistake of guaranteeing future nominal returns at a time of high inflation (implying problems when inflation became surprisingly low). Companies selling annuities are obliged to underpin their obligations by purchasing long-dated government

only credible guarantee that should be given with annuity returns.

6. Why is indexation not observed?

Consider a £10,000 loan taken out in January 1970, to be repaid in 300 monthly instalments commencing in February 1971. The non-

indexed line in Figure 1 traces out the monthly repayments (in nominal terms) for a simple repayment mortgage as the nominal interest rate varies, with the loan fully amortised in January 1995.¹⁴ This gave a low payment of £75.48 and a high of £112.24. The calculations exclude any tax benefits.

Even in the absence of the substantial tax benefits, this loan would have represented excellent value for the borrower, especially in the beginning period. Overall this borrower paid a negative real rate of interest of 0.714 per cent on an annualized basis for this loan. For example, in the mid 1970s the annual inflation rate was 26.9 per cent, yet the corresponding nominal interest rate was just 11.0 per cent.

Shown on Figure 1 is an 'equivalent' index-linked mortgage. This is constructed with the same (negative!) real rate of interest as the non-indexed mortgage, assumed constant throughout.¹⁵ It demonstrates the front-end loading of the simple repayment mortgage. The initial payment is £30.58, compared with £78.42 for the repayment mortgage. This rises steadily with the price index, finally exceeding the repayment mortgage after 9.5 years.

No financial intermediary would ever construct an index-linked mortgage on such favourable terms for borrowers. With hindsight, savers would not have been prepared to invest on such manifestly unfair terms. This reinforces the discussion that indexation, based on a 'reasonable' real rate of interest, can contribute to an orderly housing market. Indexation creates fairness to both borrowers and lenders. Part of the reluctance for indexation might actually be based on the folk memory amongst borrowers that ARMs have been extremely cheap. In fact, for borrowers to have paid an *ex post* realized annual real rate of 2 per cent would have required nominal repayments to have been 24.4 per cent higher in every period over the life of this hypothetical loan. Once again, this excludes any tax bene-

fits.

In fact, the story is really one of two halves. If a loan taken out over 150 periods in the second part of the period is considered, then the annualized real rate of interest is 6.55 per cent. In the first half of the period, the annualized real rate was *negative* 2.15 per cent. It is hardly a co-incidence that the second period was associated with a severe downturn in house prices and negative equity. Indexation, by specifying the real rate in advance, would help avoid this real rate roller-coaster which history shows has been a feature of the current system. Real rates of interest need not be so variable under index-linked schemes. Such an arrangement would contribute to an orderly market.

It is also no coincidence that the first half, with negative real rates, was a time of high inflation and the second half was a time of relatively low inflation. In the first half, prices rose 4.57 fold, and by 1.78 in the second half. Britton (1991, p.174) emphasises the important lesson that nominal interest rates are not very responsive to the inflation rate and start to lag behind the inflation rate when inflation is high.¹⁶ In a high inflation economy, borrowers might feel that indexation is a bad deal for them. Only when borrowers become convinced that the era of cheap money is gone for good will there be a receptive mood for indexation, which has been shown to have a number of subsidiary benefits. In other words, the resistance to indexation might be based on the feeling that the reference real rate will be pitched too high to make it worthwhile to swap out of the risky roller coaster of the present system, which historically has worked to the borrower's advantage.

7. Does indexation cause inflation?

It is sometimes claimed that because indexation takes away the pain of inflation, this would tend to make inflation more likely. Indexation isolates people from the consequences of inflation, thus they become indif-

ferent to its presence. The opposite is probably nearer the truth. It is non-indexed debt instruments that make inflation a more likely eventuality. It is observed in Table 1 that a rise in nominal interest rates leads to large rises in debits for the non-indexed mortgage. Interest rate policy, therefore, was highly political because the so-termed 'mortgage lobby' was be the first to plead hardship in response to interest rate rises. And it has been seen that such pleas, because of front-end loading, had some justification. The new arrangements whereby the Bank of England has operational independence in setting the reference repo interest rate is supposed to prevent this, but this has never really been tested with a severe inflation.

Against this is the view that front-end loading makes interest rate policy more effective. Because debits respond more to interest rate changes in the non-index-linked case, a smaller interest rate change is required to achieve any given objective. However, the transmission mechanism, whereby interest rate rises dampen inflationary pressures, does not exclu-

matic stabiliser. Debits automatically rise with the price index, whereas a policy change is required in the non-indexation case.

Key reference interest rates are now determined by the Bank of England. Because of the fear of the mortgage lobby backlash, politicians were reluctant to raise rates, until inflationary pressures more or less dictated it - indeed this is the prime argument for independence of monetary policy. Thus interest rate policy reacted to events rather than acting as a leading instrument of control. To restore the credibility of monetary policy, real rates were periodically jacked up to alarmingly high real levels. Section 6 demonstrated this. Despite high nominal rates, compared with other countries, real rates were on average surprisingly low, especially in the early period. This did little to contribute to a credible anti-inflation policy.

The Conservative era showed less reluctance to a high interest rate policy to control inflation. However, in the absence of widespread indexation of government debt, policy credibility had to be bought (at enormous cost) with

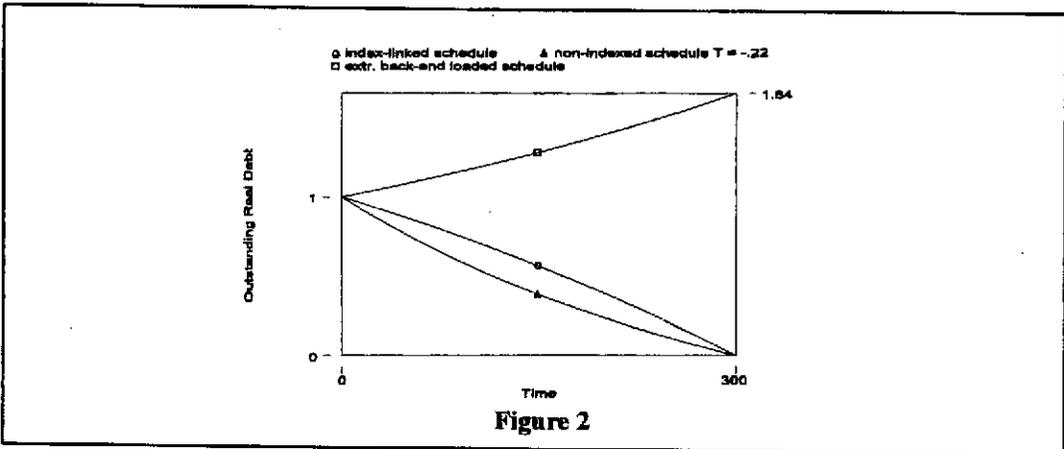


Figure 2

sively operate through mortgage debits, so the idea that the appropriate interest rate response is reduced in the non-indexed case has correspondingly limited validity. Remember also that index-linked debits have an in-built auto-

unusually high real rates. Eventually, the Conservatives paid a heavy price for its determination to face down the mortgage lobby in pursuit of its anti-inflation strategy and ERM membership, which also necessitated high real

rates of interest. House prices fell by 10.6 per cent between 1989 and 1995 and even more in the London and the South East. With hindsight, index-linked mortgages would have made this era much less painful and the proactive interest rate policy more attractive. Indexation also offers the possibility that real rates of interest will be more stable, because there is no need for unusually high real rates to ensure credibility.¹⁷

8. A measure of front-end loading

Figure 2 helps to develop a practical measure of the degree of tilt. It shows the outstanding real value of debt for a loan of 1 unit at an annual real rate of interest of 2 per cent

outstanding real value would then just follow the axes of the graph. All possible repayment schedules are just lines drawn in the space bounded by the two axes and this upper bound.

The front-end loading index (denoted *T* for 'tilt') compares the non-index-linked ARM with the index-linked PLAM. Consider the area between these two schedules. The bigger this area then the greater the degree of front-end loading. *T* will be defined as negative of the ratio of this area to the area below the index-linked schedule. *T* will lie between -1 and 0. Clearly, the PLAM will have a *T*-value of 0 and the extreme front-ended schedule, which has the least tilt, would have a *T*-value of -1. Lower values of *T* indicate a smaller

Table 2: Sensitivity of the *T*-index

non-index-linked mortgage	<i>T</i>	non-index-linked mortgage	<i>T</i>	graduated payment mortgage 5% annual growth in debits	<i>T</i>
$\rho = 0\pi = .01$	-.04	$\rho = .02\pi = .01$	-.05	$\rho = .02 \pi = .01$.16
$\rho = 0\pi = .05$	-.20	$\rho = .02\pi = .05$	-.22	$\rho = .02 \pi = .05$	0
$\rho = 0\pi = .1$	-.36	$\rho = .02\pi = .1$	-.40	$\rho = .02 \pi = .1$	-.21

repayable over 300 (monthly) periods with an underlying annualized inflation rate of 5 per cent. The example assumes a constant inflation and real interest rate over the whole of the loan period. The lowest line shows the outstanding real debt for the ARM and the line above this shows the outstanding real debt for the PLAM. Real debt declines fastest for the ARM; it is front-end loaded and the distorting tilt caused by inflation is directly visible.

Shown on the graph is a third upward sloping line, denoted as the extreme back-end loaded schedule. Suppose that the borrower paid nothing in repayments and amortised the loan with one large payment in the last period. This loan has the maximum degree of tilt. The outstanding real value of the loan = $P_0Y_0(1+\rho)^t$ would evolve as shown, with a maximum value of 1.64. The least tilt case would be where the debt is immediately paid off, and the

degree of tilt.

T has a neat practical interpretation. In Figure 2, the area between the schedules measures the timewise cumulated value of the difference between the outstanding non-index-linked real debt and the outstanding index-linked real debt. *T* expresses this difference as a proportion of the total timewise cumulated value of index-linked real debt. *T* for Figure 2 is -0.22. This roughly says that real debt in the non-indexed case is 22 per cent below the indexed case, averaged over the life of the loan.

The *T* indicator can be used to compare any loan with the baseline index-linked schedule, and is readily generalised to the case of back-ended loans, which would evolve above the index-linked schedule in figure 2. Such loans would have a positive *T* value. Changing the denominator to the area below the back-ended

loan would mean that the extreme back-ended loan would have a T value of 1. In general, therefore, T lies between -1 and +1, with lower values implying more front-end loading and 0 the mid-point case of the index-linked schedule whose tilt is independent of the rate of inflation. Increases in loan length, *ceteris paribus*, decrease the degree of tilt.

Table 2 shows how sensitive the T -index is to various parameter values, which are assumed constant over the life of the loan. T is independent of the initial loan amount. The first case shows that T decreases fairly rapidly in response to inflation for the ARM. The second case is for the same inflation rates, but this time for a real interest rate of 2 per cent. *Ceteris paribus*, T decreases with a higher real interest rate, but this is much less severe than the inflation effect. Finally, the third case shows how a GPM moderates the degree of tilt. With zero inflation, the loan is back-loaded; with 5 per cent inflation the GPM has guessed correctly and T is 0. With inflation rates higher than the graduated payment increment, the loan is front-end loaded, but to a lesser degree.

Kearl (1978, 1979) has also attempted to construct a tilt measure ($= K$). His measure is based on the Macauley bond duration model and is defined as the elasticity of the present value of nominal debits with respect to the discount rate. Thus:

$$K = \frac{\sum_{t=1}^{T_0} t d^t P_t D_t}{\sum_{t=1}^{T_0} d^t P_t D_t} \quad (8)$$

where $d = 1/(1+r)$. This measure has some merit, in that for a given ρ and T_0 , K is invariant to the inflation rate for the index-linked bond. Lower values of K indicate lesser tilt. Its disadvantage is that the absolute value has no easy interpretation and it is not clear how the measure would cope with the case of varying interest rates. The tilt measure can easily accommodate actual cases as opposed to hypo-

thetical constant interest rate cases.

The data of Figure 1 have a value of -0.39 and show that actual loans were highly front-end loaded, which is unsurprising given the high inflation at the time. It helps explain observed patterns. In the 1970s and 1980s, the housing stock turned over quite rapidly, roughly 13 per cent per annum. This figure slowed considerably in the 1990s. Loans would rarely run their full course, with a life of 6 to 7 years being typical.¹⁹ High initial debits restricted the amount individuals could borrow. The severe tilt quickly eroded debt levels, and borrowers traded up by moving to more expensive property with a new mortgage. The view that house prices would for ever spiral upwards added fuel to this game of musical chairs.

The fact that front-end loading might alter the amount borrowed leads to a macroeconomic consideration. This says that an old rule is a good rule, even if it would not be the one that would be chosen if the option of redesigning the system from the outset was available. Suppose it was agreed that a move toward less front-end loaded contracts was desirable. As a result, suppose that people now wish to borrow a larger amount. With particular assets in fixed supply - in the short run at least - the effect might simply be to drive up the price of the asset which loans are used to purchase. The housing market is a good example where this might happen. So the benefits of PLAMs may be more than offset by additional housing costs.

9.A possible objection

One objection is to argue that, with perfect capital markets, it does not matter what the repayment rule is because borrowers can always adjust to place themselves on a repayment schedule that gives them the optimal level of front-end loading. Figure 2 illustrates this. Suppose that the indexed contract is the repayment schedule which gives the optimal intertemporal consumption plan. The borrower is, however, obliged to follow the non-

indexed path. The borrower can return to the optimal path by borrowing an additional amount represented by the gap between the actual and desired real value of outstanding debt, and this can be repeated at all points throughout the life of the loan - the Bank of England refers to this as 'mortgage equity withdrawal.' As long as capital markets are perfect, the repayment rule is irrelevant. 'Trading up' with a new higher mortgage, as previously described, is partly a reflection of this type of adjustment.

Undoubtedly, some people avoid the borrowing constraint in this way. But there are objections. First of all, many borrowers feel constrained to follow the announced rule, even though they might prefer something else. They lack the sophistication to adjust. People feel that the announced rule is how they ought to behave and are reluctant to deviate from it, even though not to do so involves sacrifice. Financial intermediaries are sometimes reluctant to lend to existing borrowers where they see that new loans are to pay off existing debt. Finally, there is the issue of transaction costs - it is expensive to continually negotiate new loans and these are often on unfavourable terms for the borrower compared with the original loan. Trading up also involves high transaction costs. The degree of front-end loading should reflect as near as possible borrowers' preferences, rather than relying on the dubious perfect capital market idea as an apparent solution to the problem.

10. Concluding comments

Indexation of debt is becoming more common. The proportion of the British National Debt

held in the form of index-linked instruments has increased to around 18.8 per cent of the total in 1999 from nothing around twenty years ago. Around £8 billion of National Savings is currently index-linked, so the claim that the public lacks the financial sophistication to understand inflation-adjusted debt is no longer tenable. But there is still a long way to go for indexation to be the norm, rather than the exception.

There is no one reason why mortgage products are not index-linked. The first reason is inherent conservatism, sticking with what is familiar, especially if it has seemed to work adequately in the past. Coupled with this conservatism, is the mistaken belief that indexation can in itself generate inflation. Secondly, some believe that index-linked mortgage products are more complex than the traditional mortgage and, therefore, would prove to be less acceptable. Section 2 attempted to show that this is not really so. Thirdly, non-indexation has generated churning in the housing market. High initial payments mean people borrow less initially, but then quickly trade up as real debt rapidly erodes because of the tilt. Transaction costs from churning operate to the advantage of financial institutions concerned with the housing market. Finally, the traditional mortgage has historically worked to the borrower's advantage, but with Bank of England independence this is less likely to be true in the future. A good dose of unpleasantly high inflation, but without the accompanying negative real rates of interest of previous experience, might be the necessary incentive to hasten a desirable change.

Appendix

Table 3 compares a non-indexed scheme and an indexed scheme for a 1000 loan amortised over ten periods with a constant 20 per cent inflation rate, but varying real rates of interest as shown. The key point to demonstrate (apart from the front-end loading) is that the index-linked scheme turns out to be more expensive than the non-index-linked scheme. The latter has an average real rate of 3.9 per cent compared with 3.3 for the non-indexed scheme, despite each having the same real rate charged in every period. As the loan evolves, the non-indexed scheme has a smaller real amount outstanding to be charged at the higher real rates of interest. This accounts for the higher average real cost of the index-linked scheme, despite the fact that interest rates are the same for both schemes in every period. If the interest rate structure was reversed, with high real rates at the beginning, then the index-linked scheme would prove to be cheaper.

Table 3: Differing costs under varying real interest rates

Debit no.	Real int. rate	non-index-linked mortgage				index-linked mortgage			
		Nom. debit	Real debit	Nom. amount outstanding	Real amount outstanding	Nom. debit	Real debit	Nom. amount outstanding	Real amount outstanding
1	.01	248.3	206.9	963.7	803.1	126.7	105.6	1085.3	904.4
2	.02	257.7	178.9	921.9	640.2	159.6	110.8	1168.9	811.7
3	.03	266.5	154.2	873.0	505.2	199.8	115.6	1244.9	720.4
4	.04	274.8	132.5	814.7	392.9	248.9	120.0	1304.7	629.2
5	.05	282.4	113.5	744.1	299.1	308.5	124.0	1335.5	536.7
6	.06	289.3	96.9	657.3	220.1	380.4	127.4	1318.3	441.5
7	.07	295.3	82.4	548.6	153.1	467.0	130.3	1225.7	342.1
8	.08	300.4	69.9	410.6	95.5	570.7	132.7	1017.7	236.7
9	.09	304.4	59.0	232.0	45.1	694.3	134.6	636.9	123.4
10	.10	307.2	46.1	0	0	840.8	135.8	0	0
Total		2826.2	1143.8			3996.6	1236.8		

Average real interest rate = .033

Average real interest rate = .039

Endnotes

1. Dept of Economics Manchester, Metropolitan University, Cavendish St., Manchester M15 6BG, United Kingdom. E-mail d.leslie@mmu.ac.uk. My thanks to George Zis and Derek Aldcroft for useful comments. All remaining errors are my own.

2. This is just one among many issues that lead to distortions in the housing market. See Hills (1991).

3. Lessard and Modigliani (1975) is an early example advocating indexation. For the interaction with the real economy, see Kearl (1978, 1979) and Hendershott and Hu (1983).

4. There are currently around 3,000 separate deals on mortgage finance on offer in Britain, so the position is far from simple. According to Miles (1994) around 50 per cent of new mortgages now have a guaranteed fixed nominal payment for some part of the loan, but this usually lasts for a short time.

5. Goodman and Wassmer (1992) argue that variable payment mortgages offer greater utility to borrowers and they should be prepared to pay more for this type.

6. According to Alm and Follain (1984), this type is instrument is commonly used by the Federal Housing Administration in the USA in conjunction with a fixed nominal interest rate. This gives a guaranteed growing nominal debit.

7. Some mortgage lenders allow for early capital repayments according to consumer volition without any early redemption penalty. The US literature calls such products an adjustable payment mortgage (APM), a rather different product from the ARM described here. The APM could be associated with a fixed nominal interest rate.

8. Other complex alternatives are possible with hybrids of these basic classes. For example, Scott *et al.* (1993) have advocated a mixed loan consisting of a PLAM element and the remainder as an FRM.

9. This covers familiar ground; see for example Whitley (1975). The monthly interest rate is calculated as $(1 + r_a)^{1/12} - 1$, where r_a is the annual rate, similarly for the monthly inflation rate.

10. See Krugman (1994) for a concise summary.

11. See Webb and Wilcox (1992).

12. Figures supplied by the Council of Mortgage Lenders, the Halifax and Woolwich. Follain (1992) also draws attention to the fact that default is most sensitive to negative equity than other factors.

13. An effective way of eliminating house price bubbles might be to index on house prices. Such a product would be too big a risk for a building society. No one would lend with real rates linked to house prices.

14. Interest rates are taken from *Financial Statistics*, and assumed to be the Building Societies Association recommended rate up to November 1984. After this, the cartel to fix rates fell away and the building society average rate is assumed.

15. Note there is nothing in principle to prevent an indexed loan at a negative real rate of interest. Indexation is based on the monthly RPI.

16. As an accounting identity the equation $1+r_t=(1+\rho_t)(1+\pi_t)$, which refers to realized rates, must be true. The Fisher equation refers to the expected real rate and the anticipated inflation rate. Fisher has written that, 'When prices are rising the rate of interest tends to be high but not so high as to be to compensate for the rise; and when prices are falling, the rate of interest tends to be low, but not so low as it should be to compensate for the fall ... the erratic behaviour of the real interest rate is evidently a trick played on the money market by the "money illusion" when contracts are made in unstable money' (quote from Trevithick and Mulvey, 1975).

17. This is part of a more general case that can be made for the indexation of all contracts, such as wage bargains. See Jackman and Klappholz (1975). Leslie (1993), Chapter (1), has a discussion of this period and the credibility argument.

18. A zero coupon 'deep discount' bond is an example of such an instrument. See Hills (1984). This structure would be derived from the general model, eq.(2), by letting $g_t \rightarrow \infty$. The other extreme of paying the debt immediately sets $g_t = -1$.

19. Figures supplied by the Halifax Bank. See Brueckner and Follain (1989) for an analysis of mortgage type on housing demand.

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