House prices, arrears and possessions: A three equation model for the UK

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Abstract

The current slump in the UK housing market has coincided with record increases in mortgage arrears and possessions. Falling nominal house prices reduce the amount of unwithdrawn equity in housing and, under certain conditions, provide incentives for borrowers to accumulate arrears and for lenders to possess. However, possessions may themselves depress house prices. This paper attempts to analyse and quantify these interactions by estimating a three equation econometric model of UK mortgage arrears, possessions and house prices, in which expectations of future house prices are formed according to the rational expectations hypothesis. The model is simulated to examine the implications of interest rate changes and policies to reduce possessions.

Update: May 1993

This paper provides a more detailed, technical account of the analysis summarised in an article in the May 1992 Bank of England Quarterly Bulletin. It does not take account of developments in the housing market since then.

In the 1992 Autumn Statement, the Government announced a scheme to enable housing associations to buy 20,000 empty properties for social housing. Although this scheme is not discussed in the paper, it is similar to the policy change analysed in Simulation 1.

1. Introduction

The current slump in the UK housing market has coincided with record increases in mortgage arrears and possessions (see Charts 1 and 2). In the two years to 1991 UK house prices fell by 3% in nominal terms, while mortgage arrears (over six months) and possessions more than tripled and quintupled respectively (although the latter still represented less than 1% of the total number of outstanding mortgages in 1991).(1) These developments may be partly related to a common set of causes, most notably the large increase in nominal interest rates which occurred during 1988-89 and recent rises in unemployment. They may also in part be related to each other. The current downturn in the housing market has been unusual in that it has accompanied falls in both real and *nominal* house prices - the first time this has occurred for a sustained period since the 1950s. Falling nominal house prices reduce the amount of unwithdrawn equity in housing and, under certain conditions, provide incentives for borrowers to accumulate arrears and for lenders to possess. However, possessions may themselves depress house prices, since they reduce the effective demand for residential properties in the market. This has given rise to fears that the current level of possessions may be prolonging the downturn in the housing market and has even prompted speculation about the possibility of an unstable possessions-house price spiral.

As well as the undoubted social costs involved, there are therefore strong grounds for believing that mortgage arrears and possessions may have important second-round effects on the housing market, and by implication on the wider macroeconomy.(2) In order to examine these issues, this paper attempts to analyse and quantify the interactions between mortgage arrears, possessions and house prices, using a three equation econometric model, estimated using aggregate time series data for the United Kingdom. Arrears in

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(1) For a discussion of recent trends in UK corporate and household debt see Joyce and Lomax (1991).

(2) The linkages between the housing market and the rest of the economy have been the subject of a number of recent studies, eg Muellbauer and Murphy (1989) and Carruth and Henley (1990).

this model arise through the behaviour of borrowers and their determination can logically be treated separately from that of possessions. The latter are assumed to be related to the behaviour of lenders, who decide to possess conditional on the level of arrears and, amongst other things, expected house price movements. House prices themselves are derived from an intertemporal model of housing demand, where possessions enter directly through their impact on the demand for housing and indirectly through expected house prices, which are modelled according to the rational expectations hypothesis. By simulating the model we are able to examine the effect on house prices of an exogenous shock to possessions and therefore, indirectly, to evaluate the effects of policy measures to reduce possessions.

The paper is structured as follows. In Section 2 we begin by setting out the theoretical underpinnings of the model. Section 3 discusses the data and estimation results. Section 4 then describes several simulations using the model which illustrate the potential importance of reducing possessions. Conclusions are presented finally in Section 5.

Chart 1
The Growth Rate of Nominal and Real House Prices

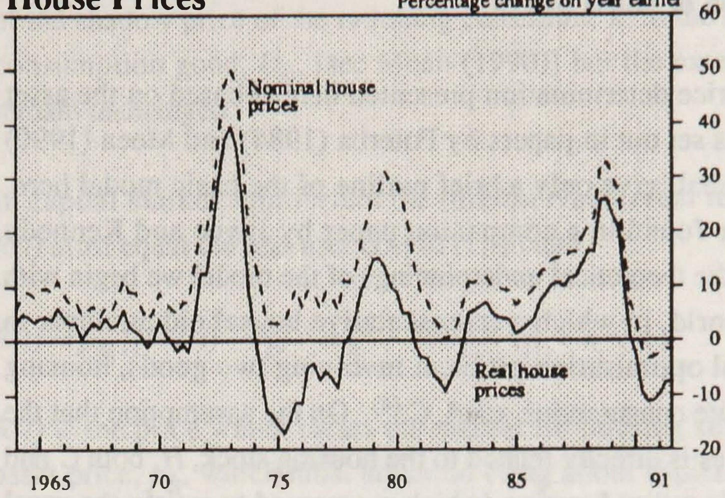
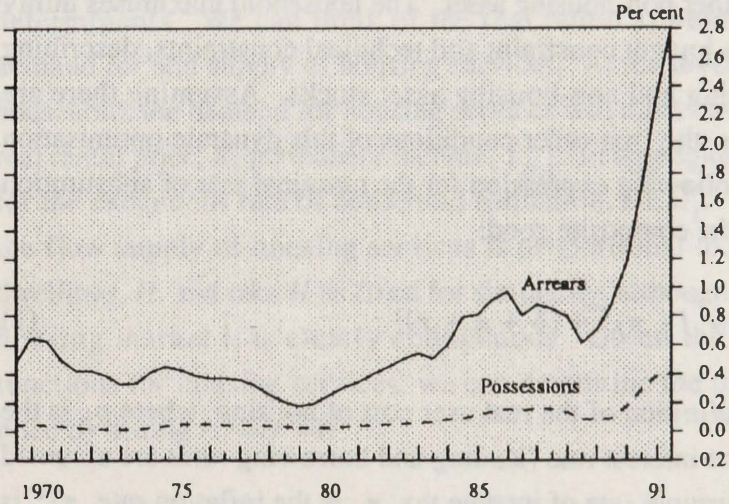


Chart 2
Mortgage Arrears and Possessions



——— Mortgages over 6 months in arrear as a percentage of the outstanding stock of mortgages

– – – – Possessions as a percentage of the outstanding stock of mortgages.

2. The Model

(a) The determination of house prices

The model of house price determination presented here is based on the asset market approach,[3] as set out in papers by Poterba (1984) and Meen (1990) amongst others. We shall give only a brief outline of the basic model here, [further details can be found in a companion paper by Joyce and Kennedy (1992)]. To illustrate the theoretical underpinnings of the model we begin with a highly simplified world, in which a representative household attempts to solve an intertemporal optimisation problem involving two goods, housing services and a composite consumption good, C.[4] On the assumption that the flow of housing services is directly related to the housing stock, H, both C and H enter the household's utility function (which is assumed to satisfy the usual conditions). There is assumed to be no rented sector housing. Apart from housing there is one other non-housing asset. The household maximises utility over time, subject to a budget constraint and technical constraints, describing the evolution of housing and non-housing asset stocks. Assuming there are perfect capital markets, the first-order conditions of this dynamic optimisation problem provide the following expression for the marginal rate of substitution between housing and the composite good:

$$U_h/U_c = p_h\,\{[i\,(1-t) - \pi_c] - \pi_h^e + (\delta + \kappa + \tau)\} \tag{1}$$

This is the standard definition of the real user cost of housing, where p_h is the real house price, i is the interest rate (lending and borrowing rates are assumed equal here), t is the marginal rate of income tax, π_c is the inflation rate, π_h^e is expected real capital gains on housing, δ is the real rate of depreciation including repairs and maintenance, κ represents property taxes, and τ

(3) Although the approach allows for housing's role as an asset, no explicit allowance is made for risk and uncertainty. Poterba (1984) notes that '[a] more complete model would recognize the importance of portfolio considerations in the home purchase decision'.

(4) This exposition is based on Meen (1990).

represents transactions costs. Allowing for credit market constraints complicates this expression, by adding an additional term measuring the ratio of the shadow price of the rationing constraint, λ, to the marginal utility of the consumption good, U_c, [see Meen (1990)] but the essentials of the analysis remain unchanged.

In capital market equilibrium the (unobservable) real rental price of housing $R(t)$ must equal the real user cost in (1) so that

$$R(t) = p_h \{[i(1-t) - \pi_c] - \pi_h^e + \lambda/U_c + (\delta + \kappa + \tau)\} \qquad (2)$$

$R(t)$ is the price which clears the market for housing services so it is the real asset price, p_h, which must adjust to bring about capital market equilibrium. Equation (2) can therefore be rearranged to give an expression for real house prices. However, since R is unobservable we need to substitute in for its determinants. We can think of the real rental as being determined by the demand for and supply of housing services. At the level of the ith individual household, the demand for housing services will most obviously depend on the real rental price, R, permanent income, $Y_{p,i}$. In aggregate, we must also allow for the exogenous rate of household formation, DEM_i. We shall assume that the flow supply of housing services is proportional to the existing stock of dwellings, H, and take H as fixed for simplicity, although in a full model of the housing market it is clearly endogenous. Given the demand and supply functions for housing services, we can determine the market clearing rental price by setting $H^d = H^s = H$:

$$R = g(Y_p, H, DEM) \qquad (3)$$

If we now substitute out for R in (2) we get an expression for the real house price in terms of the determinants of the real rental price, permanent income, demographic factors and the housing stock, as well as the real user cost of housing:

$$p_h = f_1(Y_p, DEM, H, (1-t)i - \pi_c, \pi_h^e, \lambda/U_c, \delta, \kappa, \tau) \qquad (4)$$

This equation may be augmented in a variety of ways before it is estimated. For example, in order to measure permanent income the model may need to include measures of financial wealth, W, possibly disaggregated into liquid and illiquid components [see Kearl and Mishkin (1977)], and unemployment. In addition, the phenomenon of 'tilting' or front-end loading suggests that the 'nominal' user cost may be more important than the real user cost (ie nominal user cost net of expected capital gains) in explaining house prices, suggesting that capital gains effects may need to be estimated separately.(5)

Here we shall also want to augment the model by the inclusion of an effect from the flow into possession, $POSS$.(6) Possessions will affect house prices in this model primarily through their impact on housing demand. It might at first not be clear why this should be the case, since the model already includes several measures of demand. However, in principle, possessions will have an additional impact on prices, since possessed households are effectively constrained to have a zero demand for home-ownership, at least in the short-run. Unless possessed dwellings are transferred to the rented sector, there is no direct impact on the stock supply of housing, ignoring the possible impact on depreciation (though there may be a temporary reduction in supply whilst lender's hold possessed properties before putting them on the market). Thus possessions will lead to a corresponding reduction in the excess demand for housing/an increase in the excess supply, putting downward pressure on house prices. If the increase in the flow of possessions persists in the long run then house prices are likely to be permanently reduced by what can be thought of as a stock adjustment effect, although to the extent that the consequent expansion in demand raises the relative costs of renting to home-owning there may be an offsetting increase in demand from those previously renting. Of

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(5) This follows from the fact that when inflation rises, nominal and real repayments typically rise over the early years of the loan, even if the present discounted value of real interest payments remains constant. This may give rise to a problem for some borrowers whose cash flow is constrained (perhaps because nominal incomes do not rise as inflation occurs).

(6) The absence of time series data on sales of possessions makes this inevitable, though, to the extent that unsold possessions are held by lenders for speculative reasons, they will also influence house prices by effecting expectations.

course, the model described above does not explicitly include a rented sector. This simplifies the exposition somewhat but means that households whose property has been possessed must be assumed to merge with other households.

Since house prices in this model are determined by the demand and supply for the stock of housing (rather than the flow), and possessions are assumed to affect house prices by reducing the stock demand for housing, the magnitude of the possessions effect needs to be judged in relation to the stock of dwellings. We therefore include possessions in the model expressed as a ratio of the stock of dwellings, so that the estimated model becomes

$$p_h = f_1\,(Y_p,\, W,\, DEM,\, H,\, (1 - t)i,\, \pi_c,\, \pi_h^e,\, \lambda/U_c,\, \delta,\, \kappa,\, \tau,\, POSS/H) \qquad (5)$$

(b) The determination of arrears

Our theoretical model of arrears owes its origins to earlier work by Brookes *et al* (1991), which applied Wadhwani's (1986) analysis of corporate bankruptcies to the analysis of mortgage default.(7) Rather than repeating their exposition, we shall only outline the salient features of the analysis here. Consider first a world without inflation. Let us assume a household buys a house by taking out a 100% mortgage equal to an amount, M, and paying a rate of interest, r. The household has no savings. We also assume that if at some point in the future there is some accumulated equity in the property (ie the market price of the property exceeds the value of the mortgage) the household can raise additional finance by remortgaging. Given these assumptions, a household i will face difficulties meeting debt-service repayments where

$$Y_i - CL_i - rM_i + (W_i - M_i) < 0 \qquad (6)$$

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(7) Since we are modelling movements in aggregate arrears data we can avoid the difficult issues involved in explaining differences across individuals in the propensity to default. For a recent study on the link between self control and general indebtedness see Cameron and Golby (1991).

where Y_i is income, CL_i denotes priority living expenses, and W_i is the market value of the property (ie so that $W_i - M_i$ is the amount of unwithdrawn equity - the inverse of capital gearing). This suggests that in aggregate the probability of arrears *(ARR)* will be a function of the left-hand side variables in the above expression augmented by factors likely to produce income shocks. A recent survey of arrears cases by Ford and Wilcox (1992) found that 40% of arrears case were due to a drop in income whilst 37% were associated with unemployment. Other factors, such as administrative problems (20%) and relationship difficulties (13%) (the survey allowed for multiple responses), were less important and are clearly more difficult to measure at an aggregate level (though Brookes *et al* used the divorce rate to measure the latter). This suggests that unemployment *(UR)* and aggregate income are the best macro measures of income shocks, so that

$$prob(ARR) = f_2\,(Y, UR, CL, r, W - M) \qquad \textbf{(7)}$$

If we now allow for the impact of inflation, Brookes *et al* show that, due to the non-indexation of mortgage contracts, the debt service ratio (debt service relative to income) facing borrowers will rise when inflation rises, increasing the likelihood of arrears, although this will be offset to the extent that house prices also rise and the additional unwithdrawn equity can be removed. This suggests expanding (7) either with inflation or, as we do here, using the debt service ratio *(DSR)* instead of interest rates to pick up the inflation effect. Using a measure of real income we shall ignore the difficulty of explicitly measuring CL, so our model for determining the probability of arrears becomes:

$$prob(ARR) = f_2\,(Y/P_c, W - M, DSR, UR) \qquad \textbf{(8)}$$

where P_c is a consumer price index.

(c) The determination of possessions

We shall model the determination of possessions from the perspective of the lending institution, although in practice the decision to possess is not the lenders alone. Once the lender has decided to possess it is necessary to obtain a court order, which may be refused if the court believes that the borrower is making a genuine effort to pay. Moreover, it needs to be borne in mind that nearly one half of recent possessions have been 'voluntary', in the sense that the borrower has voluntarily handed over the keys to the lender. However, such decisions seem hard to rationalise in terms of any economic calculus, unless they reflect the borrower simply attempting to pre-empt the lenders decision. It is conceivable that this occurs because some borrowers wrongly believe that this will absolve them from any losses after the property is resold.

Ignoring for the moment any second-round effects (which we shall return to below) or the difficulties of obtaining a court order, the risk-neutral profit-maximising lender will decide to possess a property only if the following inequality holds

$$P_t - c_t > MAX_i\{\rho_{t+i} . E_t(P_{t+i} - c_{t+i}) + \Sigma^i_{n=1} \rho_{t+n} . E_t(DEBT_{t+n})\} \qquad (9)$$

where P = resale value of the property
c = cost of possession and resale
ρ = discount factor
$DEBT$ = borrower's debt payments
E = the expectations operator at time t

Thus the lender will possess if the current resale value of the property exceeds the maximum discounted expected future resale value plus the discounted expected debt payments by the borrower before resale. The lender's decision to possess therefore depends in large part on his estimate of the probability of the borrower resuming repayments (this will also influence the likelihood of obtaining a court order) and his expectation regarding future house price movements. The former may be determined by a number of factors, such as the value and length of arrears, the permanence of the income shock that caused arrears, the tax and benefit system, the interest rate, and the credibility of the lender's possession threat. Expected future house price movements are important because if there is unwithdrawn equity in the property (ie if the market value of the property exceeds the mortgage advance) then the borrower will be able to either sell the property (assuming the market is sufficiently liquid), or take out a second loan on the collateral in the property, in order to resolve the arrears problem. In these circumstances it is unlikely that a lender would seek to possess the property since any profits in so doing would be transferred to the former occupant and possession is itself costly. For the same reason, if the equity in the property were likely to increase, through expected house price inflation, then the lender will have less incentive to possess now.

However, in aggregate, the possession decision for the lender is somewhat more complicated than equation (9) implies. This follows for two basic reasons. First, if possessions affect house prices, in the manner postulated in Section 2(a) above, then this may discourage possession. Second, a lender who lends to more than one borrower must consider the effect of each individual possession on these other loans, since each individual possession may affect the credibility of the lender's threat to possess other properties. Thus a particularly lax possessions policy may lead to other borrowers going into arrears. It is probably the interaction between these two effects that explains why mortgage lenders have recently been holding on to a stock of unsold possessed properties. This policy may be optimal if the credibility effect implies early possession, whilst the price effect implies delaying sale until the housing market picks up. To the extent that flows (as well as stocks) matter in house price determination, then the sale of possessed dwellings in a more liquid market may have a smaller depressing influence on aggregate prices.

The above discussion suggests the following general model of the probability of possession:

$$prob\ (R) = f_3\ (\rho,\ ARR,\ ARR12/ARR6,\ W - M,\ \Delta P_h^{\ e}) \qquad \textbf{(10)}$$

where the ratio of *ARR6* (arrears between 6 and 12 months) to *ARR12* (arrears of more than 12 months) is included as a measure of the seriousness of a given stock of arrears.

3. Empirical Implementation

(a) The data

Before turning to the estimation results, it is necessary to briefly describe the construction of the arrears and possessions data since this has influenced our approach to modelling equations (8) and (10). Unfortunately, the available UK data on arrears and possessions (published by the Council for Mortgage Lenders) are not produced quarterly and are only available on a bi-annual basis and then only back to 1982, with data before that date available only annually back to 1969. We rejected the idea of interpolating quarterly data [as in Brookes *et al* (1991)], since our initial results suggested this led to equations with implausible dynamic structures. As a compromise we used the available bi-annual data back to 1982 and then interpolated additional bi-annual data from the annual data prior to that date. In the case of the house price equation, rather than discarding the available information in the quarterly data, we interpolated a quarterly series for possessions which was then used as an explanatory variable. This process leads to an efficient use of the data, but prevents the equations being estimated simultaneously.

(b) Estimation results

(i) Methodology

The empirical analysis reported in the paper was based on a two-stage estimation approach, using the Johansen (1988) maximum likelihood approach in the first stage to identify a cointegrating vector and in the second stage including the residuals from this vector (lagged one period) in a dynamic equation.

As was mentioned in the previous section, the difficulties of combining quarterly and bi-annual data meant that we could not adopt a systems method for estimating the three equation model. Instead, we used instrumental variable estimation wherever endogenous variables were included as regressors in the individual equations.

(ii) House prices

Section 2(a) suggests that a long-run relationship may exist between house prices, income, wealth, demographic factors, the real user cost and the stock of dwellings. We also argued that it was possible that the ratio of possessions to the housing stock would also have a long-run impact. Unit root tests on measures of all these variables showed that, with one exception, all the variables were integrated of order one and could therefore be included in a cointegrating vector (details are contained in Appendix C). The one exception was the real user cost measure - nominal user cost less expected capital gains - which appeared to be stationary and was therefore included in the second stage dynamics.

In order to estimate a long-run relationship using the Johansen methodology we set up a second order VAR, which included the real user cost measure as an additional I(0) variable. Our preferred long-run equation is shown in Table 1(a). The equation implies that real house prices are a function of RPDI, the stock of owner-occupied dwellings, a demographic term [the proportion of the population aged 25-29 - see Milne (1991)], and total real financial wealth. All the variables have correctly signed coefficients with plausible magnitudes (though the inclusion of a wealth term in the equation means that a simple income elasticity of demand for housing cannot be inferred from this model). Both the long-run cointegration test based on the maximal eigenvalue and the test based on the trace of the stochastic matrix suggested that this set of variables formed a unique cointegrating vector. Since the possesions variable was not necassary to form a cointergrating vector, we concluded that there was no long-run effects of possessions on house prices

Table 1(a): Cointegrating Vector, Johansen Estimate, 1970 Q1-1990 Q3

$$ln\ RHP = 2.87\ ln\ RPDI + 0.15\ ln\ RFW - 2.13\ ln\ KOHS + 17.84\ P2529$$

Maximum lag in VAR = 2; other included I(0) variables:
$(USERC - \Delta\ ln\ PAHM_{t+1})$

Where	*RHP*	=	Real house prices, *PAHM/PC*
	PAHM	=	Department of Environment mix-adjusted UK house price series
	PC	=	Consumers expenditure price deflator
	RPDI	=	Real personal disposable income
	RFW	=	Real gross financial wealth, *FW/PC*
	FW	=	Gross financial wealth
	KOHS	=	Stock of owner-occupied dwellings
	P2529	=	Demographic variable, proportion of population aged 25-29
	USERC	=	Nominal user cost - see Appendix A for definition

In the second stage of the estimation, the preferred cointegrating vector reported in Table 1(a) was incorporated into a dynamic equation. Because of the presence of future expected house prices in the real user cost term, this equation could not be consistently estimated using OLS. The inclusion of a forward house price term leads to endogeneity bias and the presence of a first-order moving average error process. The equation was therefore estimated using the Hayashi-Sims (1983) method, which is a form of instrumental variable estimation that also corrects for moving average errors. Since lagged house prices appeared to be poor instruments (probably because they are separately included in the dynamic equation), changes in producer prices and the exchange rate were used. These may be interpreted as leading indicators of nominal income.

Our preferred dynamic equation is shown below in Table 1(b). The equation combines the lagged residuals from the long-run vector in Table 1(a) with seasonal dummies and terms in RPDI, net liquid assets (which appear instead of total wealth because of the importance of liquid assets for short term decisions), the loan to value ratio for first-time buyers (a measure of mortgage rationing), real user cost and possessions. On the whole the equation appears to fit the data reasonably well and estimation over a sub-sample, excluding the post-1985 period, suggests that the model is stable. Recursive estimation shows that the parameter on the possessions term is stable, although it is not statistically significant if the period after 1988 is excluded.

The real user cost term was initially disaggregated into its two main components (what can be thought of as an adjusted interest rate - see Appendix A for details - and expected capital gains) in order to examine the tilting problem raised in Section 2(a) above. However, the restriction that the coefficients on the nominal user cost and the forward inflation terms were equal and opposite was easily accepted by the data and this was therefore imposed in the final equation. As might have been expected, a very small coefficient on the lagged cointegrating vector term indicates that house prices adjust only very slowly towards equilibrium following an exogenous shock. This strong autoregressive component in house price behaviour can be interpreted as the effect of high adjustment costs on individual's actual demand for housing, though it may also be consistent with the view that a significant proportion of individuals use an adaptive expectations scheme when assessing potential capital gains on housing.

Table 1(b): IV MA(1) Estimate of the House Price Equation, 1970 Q2-1990 Q3

$$
\begin{aligned}
\Delta ln\ RHP = \ & -0.82 \ + 0.89\,(\Delta 4\ ln\ RPDI/4) \ + 0.43\ \Delta\ ln\ RNLA \\
& \ \ (8.4) \qquad (4.0) \qquad\qquad\qquad\qquad (4.7) \\
& + 0.26\ \Delta\ ln\ RNLA_{t-2} \ - 0.20\ \Delta\,(POSS/KOHS)_{t-1} \\
& \ \ (2.9) \qquad\qquad\qquad\quad (4.1) \\
& - 0.0051\,(USERC - 100\ \Delta\ ln\ PAHM_{t+1}) \ - 0.065\ Z_{t-1} \\
& \ \ (8.5) \qquad\qquad\qquad\qquad\qquad\qquad\qquad (7.5) \\
& + 0.18\ ZLVF_{t-3} \ - 0.01\ Q1 \ + 0.025\ Q3 \\
& \ \ (4.3) \qquad\qquad\ \ (2.2) \qquad (5.4)
\end{aligned}
$$

$$
\begin{aligned}
U = E \ & - 0.23\ E_{t-1} \\
& \ \ (1.8)
\end{aligned}
$$

$R^2 = 0.82$; SE = 0.016; DW = 1.97;

Instrumented variables: $\Delta\ ln\ PAHM_{t+1}$ and $\Delta\ ln\ RNLA$

Additional instruments: $Q2$, $\Delta\, EER_{t-1}$, $\Delta\, ln\, RNLA_{t-1}$ and $\Delta\, ln\, PPOX_{t-1}$.
The absolute value of asymptotic t-ratios are given in parentheses.

Where	Z_{t-1}	=	the lagged residuals from the cointegrating regression reported in Table 1(a)
	$RNLA$	=	real net liquid assets, NLA/PC
	NLA	=	net liquid assets
	EER	=	effective exchange rate
	$PPOX$	=	producer prices

(ii) Arrears

The arrears equation was estimated in log-linear form with the dependent variable defined as the logarithm of the ratio of arrears of more than six months to the number of outstanding mortgages. This functional form allows for the fact that this variable is bounded by zero. Unit root tests suggested that measures of all the variables specified in equation (8) were I(1). The Johansen estimate of our preferred long-run arrears vector is reported in Table 2(a) below. The equation appeared to represent a unique cointegrating vector according to the test based on the maximal eigenvalue of the stochastic matrix, although the test based on the trace suggested the possibility of two vectors. However, the second vector was impossible to interpret in terms of an arrears equation and we therefore rejected it. The preferred equation implies that the probability of arrears is a positive function of unemployment, the loan-to-income ratio for first-time buyers and the debt service ratio and a negative function of income and unwithdrawn equity.

Table 2(a): Cointegrating Vector, Johansen Estimate, 1970 H2-1991 H1

$$ln\, ARR/M = 0.27\, ln\, UR - 0.61\, ln\, RPDI + 3.29\, ln\, AYR - 11.09\, ln\, UNEW + 0.49\, ln\, DSR$$

Maximum lag in VAR = 2

Where			
	ARR	=	Arrears over 6 months
	M	=	The number of outstanding mortgages
	UR	=	Unemployment rate
	$RPDI$	=	Real disposable income
	AYR	=	Loan to income ratio for first-time buyers
	$UNEW$	=	Unwithdrawn equity
	DSR	=	Debt service ratio

The resulting dynamic equation based on this cointegrating vector is shown in Table 2(b). Given the volatile nature of the bi-annual data, the equation appears to fit the data reasonably well. In addition to a highly significant cointegrating vector (a unit coefficient restriction was accepted by the data but not imposed), the equation includes growth terms in the lagged dependent variable, the debt service ratio, unemployment and unwithdrawn equity. The equation passes the usual diagnostic statistics, although there is some evidence of serial correlation, and estimation on a sub-sample excluding the post-1985 period suggests it is stable ($\chi^2(8)=14.2$). Given the rise in arrears post-1985 (see Chart 2) this was a relatively strong test of the equation.

Table 2(b): OLS Estimate of the Arrears Equation, 1971 H1-1991 H1

$$\Delta \ln ARR/M = \underset{(6.4)}{-3.54} \; \underset{(5.5)}{+0.69\,\Delta(\ln ARR/M)_{t-1}} \; \underset{(1.8)}{+0.27\,\Delta \ln DSR_{t-1}}$$

$$\underset{(2.5)}{+0.40\,\Delta \ln DSR_{t-2}} \; \underset{(4.8)}{+0.82\,\Delta \ln UR} \; \underset{(2.5)}{+0.33\,\Delta \ln UR_{t-2}}$$

$$\underset{(5.8)}{-13.69\,\Delta \ln UNEW} \; \underset{(6.4)}{-0.99\,Z1_{t-1}}$$

$R^2 = 0.82$; SE = 0.076; DW = 2.3; LM(1) = 2.3; LM(2) = 4.7;
RESET(1) = 1.3; NORMALITY (2) = 1.5; HETEROSCED (1) = 1.6

Where $Z1_{t-1}$ = the lagged residuals from the cointegrating regression reported in Table 2(a).

The absolute value of t-ratios are given in parentheses.

(iii) Possessions

We estimated a log-linear representation of equation (10) with the dependent variable defined as the logarithm of the ratio of possessions to the number of outstanding mortgages. This functional form was chosen for the same reasons as in the case of the arrears equation. Unit root tests suggested that, with the exception of house price inflation, measures of all the explanatory variables included in (10) were I(1) and could therefore be potentially included in a cointegrating vector. Table 3(a) shows our preferred long-run cointegrating vector estimated using the Johansen procedure. As in the case of the arrears equation, this vector appears to represent a unique cointegrating vector according to the test based on the maximal eigenvalue of the stochastic matrix, although the test based on the trace suggested the possibility of two vectors. The second vector was impossible to interpret in terms of a possessions equation, however, and its residuals did not appear to be stationary.

As can be seen from the table, the preferred equation contains a term in mortgage interest rates, which captures the impact of interest rates both on the probability of debt repayment by borrowers and on the opportunity cost of not possessing for lenders. Unwithdrawn equity also enters the equation, with a negative sign as expected [house price changes do not appear since they are I(0)]. The other main determinant of arrears in the long-run was found, not surprisingly, to be the rate of mortgage arrears. However, the elasticity on arrears is slightly above one when the vector is freely estimated and this seems slightly implausible. The second row of the table therefore shows the effect of imposing a unit arrears elasticity, which is easily accepted by the data, and this is the vector we used for our dynamic equation.

Table 3 (a): Cointegrating Vector, Johansen Estimate, 1970 H2-1991 H1

Unrestricted

$$ln\ POSS/M = 1.08\ ln\ ARR/M + 0.38\ R_m - 5.12\ ln\ UNEW$$

Restricted

$\ln POSS/M = 1.00 \ln ARR/M + 0.40 R_m - 7.41 \ln UNEW;$
LR test of the unit restriction on $\ln ARR/M$: χ^2 (1) = 0.033

Maximum lag in VAR = 2

Where	$POSS$	=	Possessions
	M	=	Number of outstanding mortgages
	ARR	=	Arrears over 6 months
	R_m	=	Mortgage interest rate
	$UNEW$	=	Unwithdrawn equity

Our preferred dynamic equation for possessions is shown in Table 3(b), which incorporates the cointegrating vector from Table 3(a). The equation performs reasonably well, except over the 1973 period which had to be dummied out; partly in consequence the equation exhibited some heteroscedasticity which was adjusted for using White's (1980) method to obtain consistent standard errors. The equation had to be estimated by instrumental variables because of the inclusion of a contemporaneous term in house price inflation. As expected, we found that possessions responded negatively to house price inflation in the short run, through the impact on unwithdrawn equity. Future house price inflation did not appear to be statistically significant, however, presumably because the process of obtaining a court order necessitates there being a lag between when a lender decides to possess and the actual implementation of that decision. Perhaps surprisingly, we also found a strong negative effect from the rate of change of the loan to value ratio, which we interpret to be picking up laxer lending and possession policies by lenders. Less surprisingly, we also found a strongly statistically significant effect from a term in the rate of long-term arrears, which provides a measure of the seriousness of arrears. Estimation over a sub-sample excluding the post-1985 period suggests the equation is stable up to the end of 1990. However, the equation appears to breaks down in the first half of 1991 (when the equation seriously overpredicts possessions) and for this reason the reported equation was estimated up to the end of 1990. This finding supports the analysis given above in Section 2(c), since it was during this period that lenders began to anticipate what effect their possessions policies would have on house prices and began to hold on to stocks of possessed dwellings. The analysis in Section 2(c) would also suggest that, when this change to possessions policies is incorporated into household's expectations, we may expect to see an increase in arrears above that predicted by the arrears equations. This may occur because those close to going into arrears will perceive a reduction in the cost of doing so.

Table 3(b): IV Estimate of the Possessions Equation, 1970 H2-1990 H2

$$\Delta ln\ POSS/M = \underset{(1.9)}{-0.56} \underset{(1.9)}{+0.24\ \Delta(ln\ POSS/M)_{t-1}} \underset{(2.3)}{-2.17\ \Delta\ ln\ PAHM}$$

$$\underset{(4.2)}{-5.13\ \Delta ZLVF} \underset{(4.5)}{+0.29\ \Delta\ ln\ ARR12/M} \underset{(3.0)}{-0.09\ Z2_{t-1}}$$

$$\underset{(4.2)}{-0.28\ D73H1}$$

$R^2 = 0.91$; SE = 0.08; DW = 1.7; LM(1) = 0.5; LM(2) = 0.6;
RESET(1) = 0.4; NORMALITY (2) = 0.1; MISSPEC(1) = 0.9;
Instrumented variable: $\Delta\ ln\ PAHM$;
Additional instruments: $\Delta\ ln\ RPDI$ and $\Delta\ ln\ RPDI_{t-1}$.
The absolute value of asymptotic t-ratios are given in parentheses.

Where	$Z2_{t-1}$	=	the lagged residuals from the cointegrating regression reported in Table 3(a).
	$D73H$	=	dummy variable defined as 1 in 1973 H1, -1 in 1973 H2 and 0 elsewhere
	$PAHM$	=	Mix-adjusted house prices
	$ARR12$	=	Arrears over 12 months
	$ZLVF$	=	loan to value ratio for first-time buyers.

4. Simulation Results

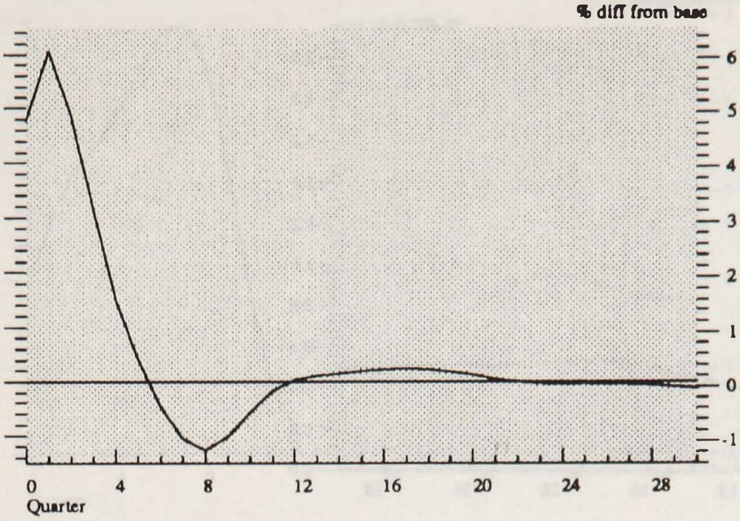
The equations outlined above imply a contemporaneous feedback between house prices, possessions and arrears. Arrears and possessions affect house prices through their impact on demand and expected capital gains, while house prices affect arrears and possessions through their impact on housing equity. This section describes a number of simulations of this three equation system.

In order to carry out the simulations, quarterly representations of the arrears and possession equations were constructed, so that the data frequency of all three equations was the same. The forward-looking term in the house price equation was simulated with model consistent expectations using a Fair-Taylor (1983) algorithm with a constant rate of growth terminal condition.

Simulation 1: Reduction in possessions of 20,000 for one year

In response to the growth of possessions, the Government announced at the end of 1991 that it would be introducing legislation to facilitate direct payment of income support to mortgage lenders. At the same time, UK building societies announced their intention to set up mortgage rescue schemes, which would enable homeowners facing possession to become part owners or tenants in their properties. Such schemes would have the effect of reducing the excess supply of housing, by ensuring that possession is avoided. In order to simulate the potential effect of these (or similar) schemes on house prices, the three equation model was solved on the assumption that the schemes were to reduce possessions by 20,000 for one year and were then stopped. This simulation allowed for feedback from the rest of the model but not from the lagged dependent variable in the possessions equation (ie it was a shock to the dynamic residuals of the equation). This is equivalent to reducing the equilibrium level of possessions by 20,000 instantaneously. The simulation assumes that the reduction in possessions is unanticipated and that the possessions policy for all homeowners other than the 5,000 affected every quarter is unchanged. It should also be noted that this simulation does not allow for the credibility effect of a laxer possession policy discussed in Section 2(c).

Simulation 1: Effect on house prices of a 20,000 reduction in possessions for one year

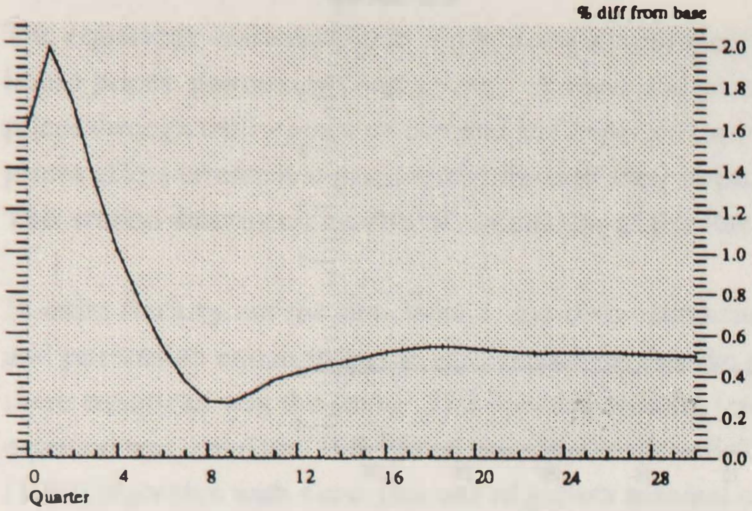


The first chart shows that the effect of a reduction in possessions is quite dramatic with house prices rising by 5% above base in the first year. This results in an indirect effect on possessions which is about 30% of the direct effect (ie for each 1,000 possessions averted by the scheme another 300 are avoided by the increase in house prices). Nevertheless, the fact that possessions are reduced for one year only means that house prices briefly fall back again below their base level when the schemes are ended following the sudden increase in the excess supply of housing.

Simulation 2: Reduction in possessions of 4,000 a year

The second simulation takes a similar form to simulation 1, except that a smaller reduction in possessions of 4,000 a year was assumed to continue indefinitely. This results in a 1.7% increase in house prices in the first year which diminishes to about 0.5% over the simulation. In this simulation the indirect second-round reduction in possessions (due to the rise in house prices) averages 50% of the direct effect over the first year.

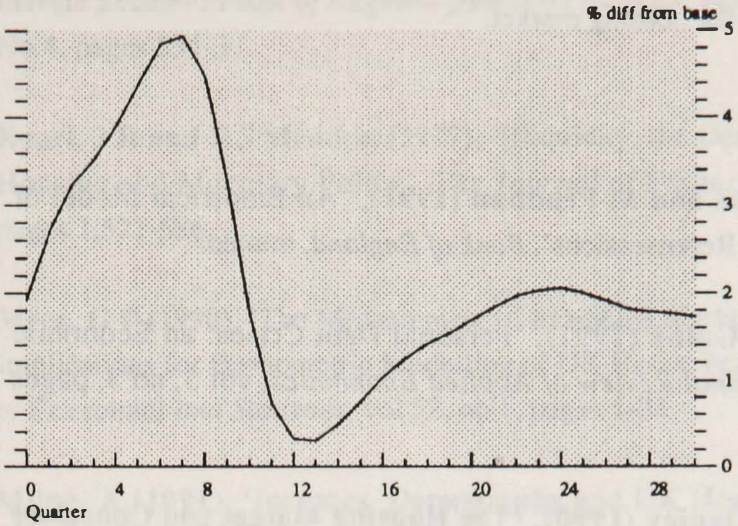
Simulation 2: Effect on house prices of a 4,000 p.a. reduction in possessions



Simulation 3: 1 percentage point reduction in interest rates

The third simulation shows the impact of a permanent 1 percentage point reduction in interest rates on house prices. The effect of lower interest rates on house prices comes from three sources. First, reductions in interest rates reduce user cost. Second, lower interest rates reduce arrears by reducing debt service ratios, and finally, lower interest rates reduce the opportunity cost of not possessing and so reduce possessions. These effects, however, are all relatively small so that, in total, a one percentage point reduction in interest rates reduces possessions by about 1,500 a year. However, it should be borne in mind that this simulation only calculates the direct effect of an interest rate change and excludes the general macroeconomic impact on demand and inflation through which interest rates also operate.

Simulation 3: Effect on house prices of a 1% cut in interest rates



5. Conclusions

In this paper we set out to analyse and quantify the interactions between house prices, arrears and possessions, which arise chiefly through the importance of negative equity as a determinant of arrears and possessions and the impact of the latter on house prices, through demand and expectations effects. These interactions were embodied in a simple three equation model of the housing market, which was estimated on UK aggregate time series data. The house price equation was unusual in incorporating forward-looking behaviour, through an expected capital gains terms modelled according to the rational expectations hypothesis. The empirical results appear to be broadly supportive of the model and confirm that the interactions between house prices and mortgage default are quantitatively significant. Simulations using the model suggest that measures to reduce possessions could have a substantial impact on house prices, which would in turn lead to further reductions in possessions. Two major caveats to this conclusion must be borne in mind, however. First, cutting possessions may increase arrears for moral hazard reasons and this effect is not allowed for in the model presented in this paper. Second, the simulations presented here do not include the general macroeconomic effects of a cut in interest rates, nor do they allow for second-round effects on the supply of housing. Our simulations therefore only give a partial view of the likely implications for the housing market.

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Appendix A: User Cost

The nominal user cost measure used in the empirical work reported in Section 3 above was defined as follows:

$$USERC = ((1\text{-}\psi)*R_m*\alpha)+((1\text{-}t_i)*R_b*(1\text{-}\alpha))+\kappa+\tau+\delta$$

ψ	=	Rate of mortgage interest tax relief for the standard rate tax-payer
R_m	=	Mortgage rate
α	=	Proportion of housing expenditure financed by mortgages (ie loan to value ratio, ZLVF)
t_i	=	Income tax rate
R_b	=	Base rates
κ	=	Property taxes (rates only) (source: National Accounts, CSO code ADAB divided by the value of the housing stock)
τ	=	Transactions costs
δ	=	Depreciation rate (rate of capital consumption) (source: National Accounts, CSO code EXCT divided by the value of the housing stock)

Most terms in this equation are self explanatory though a few need further definition.

1) ψ is calculated by weighting the standard rate of income tax by the proportion of mortgages that exceed the tax limit. For example, for the period 1982/88, it is defined as:

$$\psi=t_i*(1\text{-}(\beta*PG30+PG60))$$

β	=	proportion of single income mortgages
$PG30$	=	proportion of mortgages over £30,000
$PG60$	=	proportion of mortgages over £60,000

2) τ is defined as the sum of transactions cost including estate agents fees (0.75%), legal costs (1%) and stamp duty. This is then divided by 32 to spread

the cost over the average holding period of a house (8 years) and scaled up to allow for discounting.

Most of the data not already defined here or in Appendix B were kindly supplied by the Department of Environment.

Appendix B: Data Definitions and Sources

ARR	=	Mortgage arrears over six months; source: Housing Finance
ARR6	=	Mortgage arrears six to twelve months; source: Housing Finance
ARR12	=	Mortgage arrears over a year months; source: Housing Finance
FW	=	Gross financial wealth; source: Financial Statistics
KHPT	=	Stock of mortgage lending; source: Bank of England
KOHS	=	Stock of owner-occupied dwellings (000's); source: Housing and Construction Statistics
PAHM	=	Mix-adjusted house prices, all dwellings UK (1985=1); source: Department of Environment
PC	=	Consumers' expenditure price deflator; source: Economic Trends
P2529	=	Proportion of population aged 25-29; source: Annual Abstract of Statistics
NLA	=	Net liquid assets; source: Financial Statistics
POSS	=	Possessions; source: Housing Finance
R_m	=	Building Societies mortgage interest rate; source: Financial Statistics
RPDI	=	Real personal disposable income: source: Economic Trends
M	=	Total number of outstanding mortgages; source: Housing Finance
UNEW	=	Unwithdrawn equity, defined as: ((M/1000)*PAHM - KHPT)/((M/1000)*PAHM)
USERC	=	User cost of housing - see Appendix A
ZLVF	=	Loan to value ratio for first time buyers; source: Housing Finance

Appendix C: Unit Root Tests

	I(0) DF	ADF	I(1) DF	ADF	Conclusion
ARR/M	-0.75	-1.6	-4.1	-2.9	I(1) or I(2)
ln AYR	-0.9	-1.0	-5.5	-2.9	I(1) or I(2)
DSR	-2.1	-1.8	-5.9	-4.1	I(1)
EER	-1.8	-2.1	-8.3	-4.9	I(1)
ln KOHS	-0.3	-2.0	-2.8	-2.4	I(1) or I(2)
P2529	-0.5	-3.2	-1.7	-2.5	I(1) or I(2)
ln PAHM	-1.3	-4.4	-4.3	-3.9	I(1)
POSS/KOHS	2.7	-1.2	-0.8	-3.0	I(1) or I(2)
ln PPOX	0.8	-1.4	-3.0	-2.4	I(1) or I(2)
ln RFW	-1.1	-1.4	-7.3	-6.6	I(1)
ln RHP	-1.0	-4.2	-4.3	-3.8	I(1)
ln RNLA	0.4	-0.5	-10.3	-4.9	I(1)
ln RPDI	-2.4	-2.2	-12.8	-4.7	I(1)
RUSER	-3.8	-4.5			I(0)
ln UNEW	-1.8	-3.4	-3.4	-4.8	I(1) or I(2)
ln UR	-0.1	-1.3	-2.4	-3.7	I(1) or I(2)
ZLVF	-2.6	-4.1			I(0)

Sample period for quarterly data : 1967:1 - 1990:4 (except ZLVF, 1968:2 - 1990:4, RUSER, 1969:3 - 1990:4 and POSS/KOHS, 1963:3 - 1990:4). Sample period for half-yearly data 67H1 - 90H2

All tests with the exception of ZLVF included a constant, a time trend and lagged difference terms to the fourth lag (second for half yearly data). The ZLVF DF/ADF regressions included a step dummy variable, set to 0 before 1981 Q1 and 1 thereafter to allow for a deterministic shift.

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