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<th><strong>Title</strong></th>
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<tr>
<td><strong>Authors(s)</strong></td>
<td>Nellis, Joseph G.; Thom, Rodney</td>
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<tr>
<td><strong>Publication date</strong></td>
<td>1982-10</td>
</tr>
<tr>
<td><strong>Series</strong></td>
<td>UCD Centre for Economic Research Working Paper Series; No. 4</td>
</tr>
<tr>
<td><strong>Publisher</strong></td>
<td>University College Dublin. School of Economics</td>
</tr>
<tr>
<td><strong>Item record/more information</strong></td>
<td><a href="http://hdl.handle.net/10197/1397">http://hdl.handle.net/10197/1397</a></td>
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<td><strong>Notes</strong></td>
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NON-INTEREST CREDIT RATIONING IN THE UK
MORTGAGE MARKET

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and
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Working Paper No. 4

October 1982

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Precis

UK data is used to test the hypothesis that non-interest terms adjust to clear the mortgage market when the mortgage rate is sluggish in adjusting to its market equilibrating level. This hypothesis is not supported by the data. An alternative approach is suggested and conjectures that non-interest terms are varied so as to discriminate among borrowers, satisfying some but leaving the market not cleared. Empirical tests offer support for the alternative approach.
Non-Interest Credit Rationing in the UK Mortgage Market.

1. Introduction

A problem sometimes encountered when estimating market demand functions is that observed price quantity relationships may not correspond to combinations given by the desired, or ex ante, demand curve. The market for home mortgages is a case where this identification problem is believed to be particularly severe. British and US studies suggest that lending institutions are generally slow to adjust mortgage interest rates to market clearing levels, especially when the general level of capital market rates is rising. Given that observed mortgage flow must equal MIN (demand, supply), failure to adjust interest rates to equilibrium levels implies that we may experience periods during which market observations fall on the supply curve only, and it is this disequilibrium feature of the interest rate which may prevent simultaneous estimation of both functions from the same data set.

Studies of the US mortgage market by Kent (1980) and by Ostas and Zahn (1975) have attempted to deal with this identification problem by treating mortgage demand as a function of non-interest terms such as the loan to value ratio and maturity. During periods of excess demand these terms are assumed to adjust so as to induce equality between aggregate demand and supply thereby enabling both functions to be estimated from the same data. We call this approach
the Equilibrium Rationing Hypothesis (ERH) because it assumes that the market is continually cleared at each level of the mortgage interest rate.

Section 2 of the present paper uses British data to test the ERH and concludes that this hypothesis does not provide a satisfactory rationale for estimating market demand functions when interest rate adjustment is sluggish. Whereas the ERH predicts that non-interest credit terms should be eased (tightened) as the mortgage rate is raised (lowered), our results suggest the opposite—that a rising (falling) mortgage rate is associated with tighter (easier) non-interest terms. We argue that this result is evidence that variations in non-interest terms are a means by which lending institutions may discriminate among borrowers, satisfying some but leaving the market not cleared. For example, lowering loan to value ratios may be a means of allocating available supply to those borrowers whose demand satisfies more stringent non-interest conditions. Successful mortgage applicants will be on their desired demand curves but the number of mortgages offered may be reduced and aggregate excess demand will remain a feature of the market. That is, variations in non-interest terms determine which borrowers are accommodated, but do not shift the market demand curve.

Section 3 develops this alternative approach and presents estimates of demand and supply relationships for the UK mortgage market. We do not, however, estimate market demand functions and do not force the data to satisfy market
2. The Equilibrium Rationing Hypothesis

The possible disequilibrium character of the mortgage rate presents a fundamental problem in modelling the mortgage market. Jaffee and Rosen (1979) and Ostas and Zahn (1975) assume that lending institutions adjust the mortgage rate so as to minimise cost and employ an adjustment mechanism described by,

$$ MR_t = kMR^* + (1-k)MR_{t-1}; 0 < k < 1 $$

where, $MR$ = the current mortgage rate, $MR^*$ = the market clearing level of MR, $k$ = the adjustment coefficient and $t$ = time. If (1) adequately describes the process by which the mortgage rate is changed then, in any given period, $MR$ may differ from $MR^*$ and observations on current mortgage flow may not lie simultaneously on the market demand and supply curves.

Models developed by Kent (1980) and by Ostas and Zahn (1975) attempt to solve this problem by treating market demand as a function of non-interest terms which are assumed to adjust to eliminate excess demand at any given $MR$. Figure 1 illustrates the ERH. The curves D and S represent nominal flow demand and supply as functions of $MR$. Consider an initial equilibrium at E1 which is disturbed by a supply side shock shifting S from S1 to S2. Sluggish interest rate adjustment implies that the mortgage rate may be initially raised to a level such as $MR = r2$ which is below the new
Figure 1: The Mortgage Market.
market clearing level r3. The ERH suggests that lending institutions will tighten non-interest terms and shift D to D2 giving a short-run equilibrium at F. As the mortgage rate is subsequently adjusted towards r3 non-interest terms are eased to induce a rightward shift in D until the new long-run equilibrium is achieved at E2. If the assumptions underlying the ERH are valid then it is possible to simultaneously estimate demand and supply functions even though the mortgage rate may differ from its long-run equilibrium level.

As presented by O斯塔s and Zahn (1975) the main evidence in favour of the ERH is based on a statistically significant negative relationship between aggregate mortgage demand and the downpayment ratio which, given that all non-interest terms change in the same direction, can be considered an appropriate indicator of such changes. O斯塔s and Zahn also report a significant relationship (negative) between demand and the mortgage interest rate and a positive relationship with real income. Hence if their estimated demand function is expressed in inverse form with the downpayment ratio on the LHS, then this variable would be negatively related to MR and positively related to income. Such a result is, of course, consistent with the ERH. In terms of Figure 1, for example, a rise in income which shifts the demand curve to the right requires a compensating rise in the downpayment ratio if MR is held below its new market clearing level.

To test the ERH with UK data we first specified market demand as a function of real disposable income, YD, the
tax-adjusted mortgage rate, MR(1-v) v = marginal tax rate, lagged housing starts, HST, and the relative tax advantage of owner-occupation, Z and the average loan to value ratio on new mortgage commitments by UK building societies, LV. This ratio is given by L/PH where L = average mortgage commitment and PH = house price. LV also equals 1 minus the average downpayment ratio. An important feature of the UK tax system is that imputed income from owner-occupation is not treated as part of gross household income for tax purposes. Following Atkinson and King (1980) we approximate imputed income by R.PH, where R = representative return on non-housing assets; that is, R.PH equals the sum which PH would yield in non-housing assets. Given that the returns to non-housing assets are generally taxed the relative real tax advantage of holding wealth in housing capital can be approximated by Z = vRPH/P, where P = a generalised price index. As an increase in Z will induce households to reallocate wealth towards housing equity we would expect mortgage demand to be negatively related to Z.

The inverse form of the demand function is given by,

\[ LV = D(YD, MR(1-v), Z, HST, AD/PH) \]  

(2)

Where AD = noninal aggregate mortgage demand. Apart from the use of Z (2) differs from Ostas and Zahn’s specification in that we specify flow demand in real rather than in nominal terms. As the ERH assumes market clearing at each interest rate we replace AD by the observed mortgage flow A. To accommodate possible simultaneity problems, instrumental variables were used in place of MR, Z and A/PH. Instruments
were obtained by first regressing MR, PH, and A on the other variables, the lagged mortgage rate, the stock of building society share and deposit liabilities lagged four quarters, and the exogenous variables in the supply function as specified in Section 3 below. Predicted values were then used to compute the tax adjusted mortgage rate, Z and real mortgage supply. As the initial estimate, R1 below, indicated the possibility of serial correlation the equation was re-estimated using the Cochrane-Orcutt procedure, R2. The results, assuming a log-linear specification are,

\[
\begin{align*}
\text{Ln}(L/PH)_t &= -1.867 + 0.208 \text{Ln}YD_t - 0.296 \text{LnMR}_t - 0.037 \text{Ln} HST_{t-1} \\
& \quad - 0.057 \text{Ln}Z_t + 0.629 \text{Ln}(A/PH)_t + \text{Seasonals} \\
(3.17) & \quad (3.26) \quad (7.95) \quad (1.94)
\end{align*}
\]

(R1)

\[
R^2 = 0.89 \quad \text{SEE} = 0.025 \quad DW = 1.12
\]

\[
\begin{align*}
\text{Ln}(L/PH)_t &= -1.877 + 0.223 \text{Ln}YD_t - 0.281 \text{LnMR}_t - 0.043 \text{Ln} HST_{t-1} \\
& \quad - 0.066 \text{Ln}Z_t + 0.513 \text{Ln}(A/PH)_t \\
(2.26) & \quad (2.43) \quad (6.27) \quad (1.87)
\end{align*}
\]

(R2)

\[
R^2 = 0.76 \quad \text{SEE} = 0.022 \quad DW = 2.00 \quad \text{RHO} = 0.463
\]

\(t\)-statistics are in parenthesis.

A full description of the data is given in the appendix.
The results presented above are in direct contrast to those predicted by the ERH. For example, returning to Figure 1 consider the implications if an initial equilibrium at E1 being disturbed by a ceteris paribus rise in real income which shifts D to the right. The ERH suggests that "since the mortgage rate is sluggish in adjusting to its market equilibriating rate the downpayment ratio will increase [loan to value ratio fall] to clear the market of excess demand in the short run." (Ostas and Zahn, p. 193) Our results for the inverse demand function suggest the opposite - that the loan to value ratio is a positive function of real income. Alternatively, consider the adjustment process from the short-run equilibrium at F towards the long-run equilibrium equilibrium at E2. The ERH predicts that as MR is raised towards r3 non-interest terms must be relaxed to shift market demand to the right along S2. Once again our results suggest the opposite - a ceteris paribus rise in MR is associated with a tightening of non-interest terms.

Given the divergence in empirical evidence it is important to re-examine the assumptions underlying the ERH. Indeed, a contention of the present paper is that these assumptions may be invalid. Even though variations in non-interest terms may be strongly correlated with observed mortgage flow, it does not necessarily follow that the former will generate shifts in the market demand curve. As developed by Ostas and Zahn, the rationale underpinning the ERH is that tightening non-interest terms raises the
marginal cost of equity in housing capital. They argue that increasing the downpayment ratio leads to higher marginal costs of equity and induces borrowers to defer purchase or to purchase smaller homes thus generating a decline in mortgage demand. The problem with this approach is that it confuses the concepts of total cost and marginal cost of housing equity.

Mortgages are the means by which individuals finance part of house purchase, with the remaining part being financed by holding equity in housing. When an individual decides to demand a particular mortgage size, he/she is making a current account, or expenditure decision and a capital account, or portfolio decision. The current account decision concerns the allocation of present and future income to financing contractual payments of interest and capital over the life of the mortgage. The capital account decision implies reallocation of existing wealth. For example, if an individual wishes to increase his mortgage liability but to reduce his equity in housing then he is deciding to reallocate existing wealth from housing to non-housing assets. Likewise, if a first time buyer decides to demand a loan equal to \( x \) per cent of house value then he is simultaneously deciding to reallocate existing wealth (equal to \( 1-x \) per cent of house value) from non-housing assets.

The total cost of housing equity is the income foregone by holding wealth in housing as opposed to non-housing assets. The marginal cost is the change in total cost from
reallocating an additional unit of wealth. Marginal cost may therefore be interpreted as the average yield on non-housing assets, or the opportunity cost of the marginal unit of housing equity. Rising capital market yields may therefore induce individuals to reduce housing equity and to increase mortgage demand. However as individual borrowers can reasonably be assumed to be price takers in asset markets, the marginal cost of housing equity will not only be exogenous with respect to individual mortgage decisions, but will also equal average cost. It follows that when individuals are offered loan to value ratios less than desired, then the total cost of housing capital, but not the marginal cost, will increase.

Given that decisions on the desired amount of housing equity depend upon marginal cost, it follows that individuals will not willingly change their ex ante demand when offered a loan size less than that which they desire. If individual borrowers are quantity constrained in this sense then some may accept a non-optimum solution by increasing equity to a level in excess of their planned level. But this does not imply that individual demand curves are shifting and, as the market demand curve is the horizontal summation of individual curves, then varying non-interest terms does not necessarily lead to a fall in aggregate demand at any given mortgage rate. Conversely, consider a market equilibrium at F in Figure 1. The ERH implies that if non-interest terms were relaxed then D would shift to the right; that is, individuals would be willing
to accept greater mortgage liability even though the mortgage rate, the opportunity cost of housing equity and real incomes remained constant.

Using the ERH as a rationale for estimating market demand functions may therefore give excessive elasticity estimates. For example, the ERH assumes that observations lie on relationships such as D in Figure 1. If, on the other hand, the demand curve does not shift then we are actually estimating a relationship such as C in which case the estimated elasticity with respect to MR will exceed the "true" value as implied by D1.4

Further, rising marginal costs may reduce the demand for housing services, but does not imply that the planned portion of any given purchase financed by a mortgage will be reduced. On the contrary, we would expect desired loan to value ratios to be an increasing function of marginal costs. The ERH is therefore deficient in two respects. First, tightening non-interest terms increases the total but not the marginal cost of housing equity. Second it is incorrect to argue that increasing marginal costs of housing equity will necessarily reduce mortgage demand. Rising marginal cost diminishes the attractiveness of housing as a store of wealth and, ceteris paribus, increases mortgage demand.

3. The UK Mortgage Market

In this section we present estimates of mortgage demand and supply relationships using UK quarterly data for 1969 to 1981. We do not employ the ERH approach and do not force the data to specify aggregate market conditions. Our
approach concentrates on the determinants of average loan size by assuming that successful mortgage applicants are on their desired demand curves. To illustrate our approach we distinguish two types of rationing - borrower specific and loan specific. Borrower specific rationing is defined as a process by which lending institutions discriminate in favour of certain types of borrower such as first time house buyers and applicants who have accumulated a certain volume of deposits with the institution concerned. Loan specific rationing means that institutions adjust the terms on which any given loan is offered. During periods of credit restraint, we assume that institutions use the former type of rationing to determine priority. Variations in non-interest terms are viewed as the method for determining which borrowers are accommodated but not as a means of inducing shifts in the aggregate flow demand curve. Note that borrower specific rationing may, ex post, appear to be loan specific if institutions discriminate in favour of applicants with relatively low loan to value ratios and/or maturity.

Given this approach we cannot simultaneously estimate market demand and supply functions. We can, however, provide demand estimates by by concentrating on average mortgage size. To illustrate, consider a situation in which an initial market equilibrium is disturbed by a leftward shift in aggregate supply. If the mortgage rate always adjusted to clear the market then the average loan to value ratio would fall as individual borrowers responded to an
increase in MR by reducing the proportion of house price financed by borrowing - individuals would be moving along their demand curves. In terms of Figure 1 adjustment from E1 to E2 implies a decline in mortgage flow and a fall in the observed average loan to value ratio given that real mortgage demand is an inverse function of financing cost. If, on the other hand, mortgage rate adjustment is sluggish and MR initially rises to MR=r2 then lending institutions must find some other means of allocating available supply which now falls short of market demand. If the rationing criteria employed is borrower specific then institutions may discriminate in favour of applicants with relatively low loan to value ratios. We would then expect the observed average loan to value ratio to fall because there is some upward movement in MR and because mortgage supply has declined relative to demand. In other words, at any given MR a decline in mortgage availability will lead to a change in observed loan to value ratios. Excess demand will remain a feature of the market but successful applicants will be on their desired demand curves.

To test this approach we assume that the average desired loan to value ratio (or real mortgage demand) depends upon real per capita income, Y, the tax adjusted mortgage rate and the relative tax advantage of owner-occupied housing as defined in Section 2. The desired average loan to value ratio is therefore given by,

\[ \frac{L}{PH} = F(Y, MR(1-v), Z) \]  

As aggregate flow demand may not equal supply at the current
mortgage rate, observed, or ex post, mortgage size will also depend upon mortgage availability, that is

\[ (L/PH) = G(A/PH, (L/PH)^*) \]  

(4)

Where \( A \) = the flow of new mortgage approvals which must equal the product of average mortgage size, \( L \), and the number of mortgages granted, \( N \).

\[ A = L \cdot N \]  

(5)

Using a log-linear specification gives the following relationship to explain the average loan to value ratio,

\[ \ln(L/PH)_t = a_0 + a_1 \ln Y_t + a_2 \ln MR_t + a_3 \ln Z_t + a_4 \ln N_t \]  

(6)

If rationing favours applicants with low loan to value ratios we would expect \( a_4 \) to be positive.

On the supply side we assume that mortgage availability can be measured by new commitments made by building societies. Over the sample period building societies supplied more than 80 per cent of all mortgage commitments in the UK. These societies are mutual institutions whose primary function is to attract funds, mainly from households, and to purchase mortgages on owner-occupied dwellings. They typically hold about 80 per cent of their assets in home mortgages with the bulk of the remainder being held in "liquid assets" which consist of cash and short-term public sector securities.

We model new commitments as depending on the availability of funds and liquidity considerations. The availability of funds is assumed to depend on the net change in share and deposit liabilities plus repayments of
principal on existing mortgages. Hence,

\[ A = f(DSK, REP, LR^*/LR) \]  \hspace{1cm} (7)

where DSK = change in the stock of building society shares and deposits, REP = repayments of principal, LR* = desired liquidity and LR = the liquidity ratio at the end of the previous period. Our a priori expectations are that A is positively related to DSK and REP, and negatively related to LR^*/LR. To model LR* we assume that building societies have two motives for holding liquid assets.

(i) A precautionary motive which arises from the uncertainty regarding future deposit inflows. Mortgage commitments made in the current quarter may not be taken up until future quarters with the consequence that societies must gear current lending to expected inflows. We assume that lending behaviour will be curtailed if societies are relatively uncertain about future inflows and that uncertainty is positively related to the variance of DSK.

(ii) An income motive. Building societies finance interest payments on their liabilities plus management expenses and additions to reserves from interest earned on mortgages and liquid assets. Given that the mortgage rate may not be responsive to trends in financial markets, a relative increase in short-term interest rates may therefore lead to an increase in desired liquidity. Hence,

\[ LR^* = L(V, MR/CR) \]  \hspace{1cm} (8)

\[ V = 0.25 \sum_{t=0}^{4} (DSK - MDSK)^2 \]  \hspace{1cm} (9)

\[ MDSK = 0.25 \sum_{t=0}^{4} DSK \]  \hspace{1cm} (10)

CR = a measure of the return on non-mortgage assets.
Substituting (8) - (10) into (7), using a log-linear specification and remembering that \( A = N \cdot L \) gives the following relationship to explain the number of loans granted per period,

\[
\ln N = b_0 - \ln L_c + b_1 \ln DSK_c + b_2 \ln REP_t + b_3 \ln V_t + b_4 \ln (MR/CR)_t + b_5 \ln LR_{t-1}
\]  

(11)

Equations (6) and (11) explain the average loan to value ratio and the number of mortgages granted at given levels of MR. These equations were estimated using instrumental variables in place of the RHS variables in (6) and in place of MR, DSK, \( V \) and \( N \) in (11). Instruments where obtained as in estimating (2). The income variable in (6) is the average income of successful mortgage applicants valued at 1975 prices. Given the assumption of borrower specific rationing \( Y \) is treated as endogenous. The results are presented in Tables 1 and 2. Seasonal dummies were included in all regressions and a dummy = 1 for 1973(1) to 1973(3) was included in (11) to account for a government loan paid to societies in an attempt to prevent a rise in the mortgage rate. Equation (6) was also estimated without the restriction that average loan demand is unit elastic with respect to \( RH \) and (11) was estimated with and without the restriction that the coefficient in \( \ln N \) = -1. The results are satisfactory on the normal criteria and all coefficients have their expected signs.

The following example illustrates one method of interpreting the model and results. Assume that an initial
Table 1: Estimates of Equation 6

<table>
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<th>Independent Variable</th>
<th>Const.</th>
<th>LnPH&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnY&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnMR&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnZ&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnN&lt;sub&gt;t&lt;/sub&gt;</th>
<th>R&lt;sup&gt;2&lt;/sup&gt;</th>
<th>DW</th>
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<td>L/(PH)&lt;sub&gt;t&lt;/sub&gt;</td>
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Table 2: Estimates of Equation 11

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<th>LnDSK&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnREP&lt;sub&gt;t&lt;/sub&gt;</th>
<th>LnY&lt;sub&gt;t&lt;/sub&gt;</th>
<th>Ln(MR/CR)&lt;sub&gt;t&lt;/sub&gt;</th>
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statistics are in parentheses
average loan approval, PH = average price of houses financed by holding society
mortgages, N = number of mortgage approvals, DSK = four quarter moving average of
- SK<sub>t-1</sub>, SK = stock of share and deposit liabilities, REP = repayments of
principal, LR = liquidity ratio, CR = yield on 3-month deposits with Local Authorities,
average real income of borrowers valued at 1975 prices and R = yield on 20 year
government bonds.
market equilibrium is disturbed by an increase in income which shifts individual demand curves to the right. As the market demand curve is the horizontal summation of individual demand curves there will be aggregate excess demand at the current mortgage rate. We assume that successful applicants will be on their desired demand curves but that the number of loans adjusts to give equality between availability and N.L. This implies that building societies discriminate among borrowers on loan characteristics. As the estimate for (6) indicates that the average loan to value ratio is positively related to loan numbers we conclude that rationing tends to discriminate in favour of borrowers with relatively low loan to value ratios. Table 1 therefore confirms that the average loan to value ratio is a positive function of loan numbers and declines during periods of credit restraint.

In contrast with the ERH, our results suggest that the loan to value ratio is a negative function of MR. In the approach used by Ostas and Zahn, for example, increasing MR requires that institutions ease non-interest credit terms. They assume continuous market clearing so that increasing MR generates excess supply at any given loan to value ratio, with the consequence that L/PH must be increased to simultaneously shift the market demand curve to the right. Our approach on the other hand, suggests that increasing MR permits a decline in the loan to value ratio because individuals will, on average, seek smaller loans (accept greater equity) as the mortgage rate rises.
The results also indicate that MR is a significant determinant of loan size but the elasticity is relatively small. If this result is interpreted as implying that mortgage demand is relatively inelastic with respect to MR, then we can suggest the following "rationale" for rationing behaviour. A low demand elasticity implies that a relatively large mortgage rate increase may be required to eliminate any given level of excess demand. In the UK mortgages are normally granted for a fixed term, usually 20-25 years, but with a variable interest rate. Give that the rate applied to outstanding mortgages is variable, increasing MR not only raises the cost of new commitments but also creates financing problems for existing mortgage holders. Building societies may therefore prefer to accept the problems of extending the mortgage queue in order to avoid the generally unpopular and politically sensitive alternative of imposing "hardship" on relatively large number of households who are currently using mortgage finance.

(4) Conclusions

Section (2) of this paper used UK data to test the hypothesis that non-interest terms adjust to clear the mortgage market when interest rate adjustments are sluggish - the ERH. The evidence suggests that this hypothesis cannot be accepted and criticisms of its underlying assumptions are offered. Section (3) provides an alternative approach which assumes that rationing is a means by which institutions discriminate among borrowers.
Individual borrowers are assumed to be on their desired demand curves but market demand is not modelled as a function of non-interest terms and variations in these terms do not shift individual demand curves and, consequently, the aggregate demand curve. The regression results, which offer support for this alternative approach, do not therefore force the data to satisfy market clearing conditions.
NOTES

(1) See, for example, Jaffee and Rosen (3) and Pratt (8).

(2) Specifications using nominal mortgage flow yielded similar results in terms of the signs of individual coefficients but the overall regression statistics were inferior to those using the real mortgage flow.

(3) As tax relief is granted on mortgage interest the mortgage rate was adjusted to $\text{MR}(1-v)$.

(4) See Dhrymes and Tubman (2).
DATA

DSK Change in stock of building society share and deposit liabilities, 4-quarter moving average. Source BSA fm.

L Average approval. Source BSA £000.

LAR Local Authority 3-month deposit rate. Source ET \%

LR Building Society liquidity ratio. Source BSA \%

MR Building Society mortgage interest rate. Source BSA \%

N Number of mortgage commitments. Source BSA 000's.


PH Average price of houses financed by building society mortgages. Source BSA £000.

R Yield on 20 year government bonds. Source ET \%

REP Repayments of principal. Source BSA fm.

Y Average real income of mortgage borrowers at 1975 prices. Source BSA

Sources: BSA Bulletin of the Building Societies Association.

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