Bank of England

Discussion Paper No.11

Building societies: an econometric model

by

M.J.Pratt

August 1980

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Building societies: an econometric model

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M.J.Pratt

The object of this series is to give a wider circulation to research work being undertaken in the Bank and to invite comment upon it; and any comments should be sent to the author at the address given below. The views expressed are his, and not necessarily those of the Bank of England.

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Contents

Introduction[1]

1 This paper describes the specification and estimation of a model of building society deposit taking and lending. This model was designed to form the building society sector of the Bank's quarterly econometric model and to be used for forecasting and policy simulations.

2 The organisation of this paper broadly reflects the approach which was adopted to the modelling of building society activities. Section 2 discusses the specification of the model: the salient features of societies' operations are described; other attempts at modelling societies' behaviour are reviewed; and a proposed model of societies' interest rates, deposit taking and lending is outlined. Sections 3-6 describe the detailed specification and estimation of the model. Section 3 describes the general approach to estimation, and Sections 4-6 the specification and estimation of the four main behavioural equations in the model - for net inflows, net advances, share and mortgage rates. Finally, in Section 7, the results of various simulations, designed to assess the properties of the whole model, are described.

[1] The author is indebted to M.J.Boleat, D.F.Hendry, D.T.Llewellyn, J.G.Nellis, S.T.Pickford and colleagues in the Economics Division of the Bank for helpful comments on earlier drafts of this paper.

Model specification

Scope of the model

3 The aim of the exercise described in this paper was to produce a building society sector for the Bank's quarterly model of the UK economy.[1] This limited the research which was undertaken in three ways.

4 First, the scope of the model of building society behaviour was determined by the requirements of the Bank model. These were twofold: to show the effect of building society lending and also possibly of mortgage rates, on the level of house prices and housing investment, and to show the effects of building society deposit taking and lending on the overall flow of funds in the economy. It was decided, therefore, that the building society model should be able to explain net lending, net receipts of shares and deposits and share and mortgage rates. There was less need to explain building society investments other than mortgages.

5 Second, the choice of variables to explain the behaviour of building societies was limited to variables already in the Bank model. This rule had to be followed to prevent excessive growth in an already large model.[2] The occasions when this was a significant constraint are highlighted in the sections dealing with estimation of equations. For example, it limited the choice of interest rates which could be used as representative competing rates in explaining net inflows of shares and deposits.

6 Finally, it was necessary to use quarterly seasonally-adjusted data in estimating this model of building society behaviour. Monthly data may be better for modelling building societies because

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[1] The equations presented in this paper are a revised version of those described in Bank of England (1979).

[2] New variables could be added, but they had to be justified and capable of being forecast.

societies issue monthly statistics and because decisions on share and mortgage rate are made at monthly intervals. Another reason for preferring monthly data is that there are reasons to believe that building society rate-setting behaviour has changed since the introduction of the new system of credit control for banks in 1971 - competition and credit control (CCC). Only monthly data would provide sufficient information to model present day rate-setting behaviour. Despite these implicit objections to quarterly data, it was not thought worthwhile to transform monthly equations for incorporation in the Bank model. It was therefore decided to use quarterly data.

Building society operations

7 Building societies operate in much the same way as other financial intermediaries. They attract deposits (strictly, shares and deposits) mainly from persons. The level of inflows of new deposits depends on the preferences of investors; societies can influence these, not only by altering the competitiveness of the return offered on their deposits, but also by providing a variety of savings schemes and convenient deposit and withdrawal facilities. The majority of societies offer the same, collectively agreed, deposit and mortgage rates. Most of the money deposited with societies is lent to house buyers, although some 15%-22% is invested in financial assets which are held partly to finance withdrawals from deposits and other cash needs. Building societies, being mutual organisations, do not distribute profits, but they must earn sufficient surplus on their activities to ensure that their reserves remain adequate. They do this by maintaining a sufficiently large margin between share and mortgage rates.

8 Building society operations are, however, distinctive in several respects. For the purposes of the paper, the two most relevant are:

(i) the relative stability of share and mortgage rates; and

(ii) their policy of setting mortgage rates below market clearing levels.

9 These features of societies' behaviour would appear to reflect long-held attitudes: that mortgagors should be protected as far as

possible from fluctuations in market rates, and that the cost of borrowing for house purchase should be kept low in order to promote widespread home ownership. Societies have reportedly also been reluctant to change mortgage rate, because of the administrative costs of notifying each mortgagor individually.

10 A consequence of societies' reluctance to change their rates is that share rate tends to alternate between being competitive and uncompetitive. This leads to fluctuations in inflows of new deposits, and ultimately in levels of lending for house purchase. Building societies, however, deliberately lessen fluctuations in lending by using their liquid investments as a stabilising buffer. For example, when inflows are reduced because of a loss of competitiveness, societies tend to run down their liquidity so as to lessen the reduction in their lending. Conversely, liquidity is built up following an improvement in competitiveness.

11 This description implies a threefold reaction by societies to a change in inflows of new deposits: first, liquidity is changed; second, lending levels are altered; and, third, generally only as a last resort, share and mortgage rates are changed. A model of building society behaviour must capture this interdependence between liquidity, lending and share rate.

12 Societies cannot protect mortgagors indefinitely from movements in market rates. When share rate remains uncompetitive, the consequent slow growth in deposits, and reductions in liquidity and lending, will eventually encourage societies to raise their rates. In this way, societies reveal their concern for satisfying the demand for mortgages. When share rate is particularly competitive, however, pressures to reduce share rates may be less immediate. This is because societies may be content for deposits to grow relatively fast. However, to the extent that liquidity is built up, and to the extent that holding liquid investments is unprofitable, this will encourage societies to reduce share rate. The main pressure to reduce share rate is, however, usually derived from pressure, often from outside sources, to reduce mortgage rate.

13 Societies have also maintained mortgage rate at less than its market clearing level. This policy reflects their friendly society origins. It has meant, however, that there has generally been an excess demand for funds at the prevailing mortgage rate. This has compelled societies to implement methods of rationing mortgages. These include both passive and active methods of rationing. Passive methods include societies being unduly cautious in their lending; active rationing involves them forming a queue of prospective borrowers. Although the severity of rationing depends on the relative scarcity of funds, the fact that there is rationing implies that it has been the ability and willingness of societies to lend which has mainly determined the level of lending for house purchase. The demand for loans influences the level of lending only in so far as this is a factor which influences societies' willingness to lend.

Other econometric studies of building societies

14 Economists in the United Kingdom have, until recently, devoted relatively little effort to explaining the behaviour of building societies, despite their importance as recipients of personal savings, as lenders for house purchase and as participants in the market for public sector debt. The first non-descriptive study, by O'Herlihy and Spencer, was published in 1972. Since then, interest in building societies has become keener: Ghosh (1974), Riley (1974), Artis *et al.* (1975), Hadjimatheou (1976), Hendry and Anderson (1976), Hewitt and Thom (1977), the Department of the Environment (1977) and Mayes (1979) have all described attempts to model building societies' behaviour. The Treasury and London Business School models also contain equations describing building society behaviour. In the main, these studies have reflected an interest in examining the effect of building society lending and rates on house prices and housebuilding. Mayes, for example, set out specifically to explain the causes of the house price explosion in the 1970s. These models therefore are primarily concerned with explaining the volume of lending for house purchase; this then feeds into separate equations for house prices and housing starts. Ghosh, however, attempted to explain the composition and size of societies' portfolio of non-mortgage investments, as well as the level of lending.

15 Despite publication of these studies, a widely-accepted analysis of the factors underlying building society decisions on share and mortgage rates and lending has yet to emerge. The chief difficulty is that the business objectives of societies, which presumably govern these decisions, are not clear. This is a general problem which hinders the modelling of most organisations, although the fact that building societies are mutual organisations, administered by professional managers, makes identification of their objectives particularly difficult.

16 Most writers have assumed that the societies' prime objective is the growth of their business. Ghosh, for example, assumed that the societies' sole objective is to maximise the rate of growth of their reserves, since, as reserves are related to total assets, societies would thereby maximise the growth of their business. The view that growth maximisation is an important objective of individual building societies seems plausible (although the growth of the building society movement as a whole is constrained by the rates cartel). However, the fact that building societies have usually kept mortgage rate below the market clearing level and have rationed their mortgage funds suggests that they are motivated by other objectives besides concern for the growth of their business. A different view is that the requirements to maintain adequate reserves and liquidity are constraints on the growth of mortgage lending. This is the view which Clayton et al.(1975) adopted on the basis of information from the Secretary General of the Building Societies Association (BSA).

17 A generalised model of building society behaviour was advanced by Hendry and Anderson (1976). They argued that building societies, like other organisations, have a variety of objectives, some of which conflict, and that societies, in deciding their lending and interest rates, seek to reconcile these. Hendry and Anderson suggested that the following objectives were relevant:

(i) societies advance a constant proportion of their expected deposits - this implies a constant 'desired' liquidity ratio;

(ii) they aim to generate sufficient surplus to maintain a constant reserve/total assets ratio;

(iii) they attempt to satisfy creditworthy demand for mortgages;

(iv) they attempt to avoid changes in the mortgage and share rates.

18 In this study, the view is taken that building societies are essentially optimisers; they weigh up the relative importance of different objectives in deciding their lending policy and interest rates. For example, the level of lending is seen as a compromise between trying to satisfy the demand for mortgages and the need to maintain adequate liquidity. Similarly, decisions on changing share and mortgage rates are seen as a trade off between the wish to maintain stable rates and the need for share rate to be competitive.

A proposed building societies' model

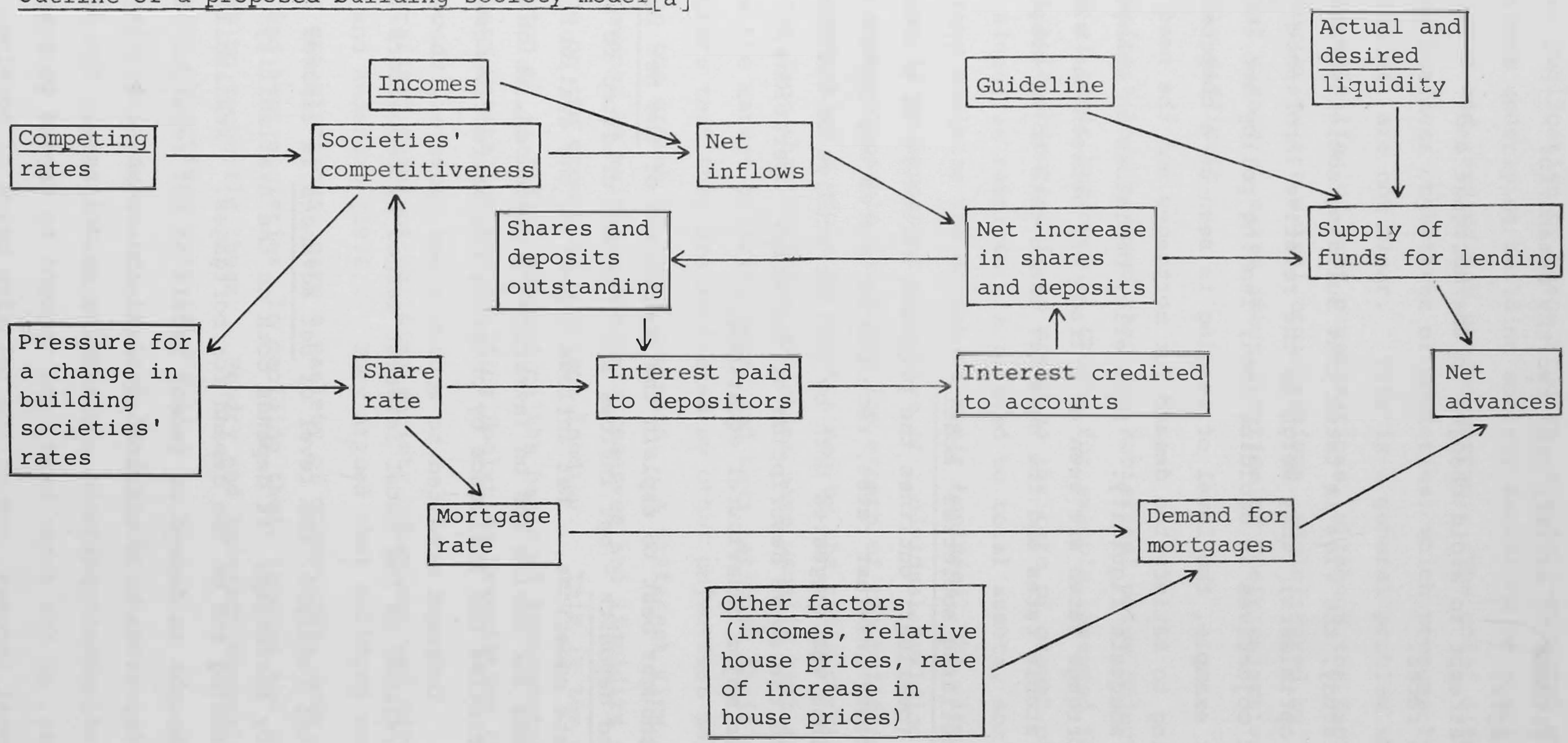
19 Chart A (overleaf) outlines the proposed structure of a model of building society interest rates, receipts of shares and deposits, and lending. This was suggested both by earlier studies of building societies and the above description of societies' operations. It contains four major behavioural equations.

20 It was thought best to explain the components of the net increase in shares and deposits - net inflows and interest credited to accounts - using separate equations. Net inflows depend on the availability of persons' funds for saving and on investors' preferences, which building societies can influence by changing the attractiveness of share rate. Interest credited to accounts was, however, thought to be closely related to the total interest earned by depositors.

21 Unlike net receipts, the level of net advances is assumed to be controlled by societies; it depends both on the availability of funds for lending and on the demand for mortgages. Availability of funds was thought to depend on recent levels of net receipts of shares and deposits, on societies' desired and actual liquidity position, and, when applicable, on lending guidelines. The demand for mortgages, on the other hand, was thought to depend on mortgage rates, personal incomes, and on the relative price of housing.

Chart A

Outline of a proposed building society model[a]



[a] Underlined variables are exogenous.

22 A two-stage method is used to explain changes in share and mortgage rates. In the first stage an attempt is made to explain the timing of changes in share rate. This is done by considering the pressure for a change in share rate. This was thought to depend on the existing competitiveness of share rate and on the liquidity of societies (although the effect of this latter variable was subsequently found to be unimportant). When pressure for a change in rates is deemed sufficiently strong, societies are assumed to change both share and mortgage rates. The direction and extent of change are dictated by current and expected levels of competing rates.

23 The ultimate output of this model is an estimate of net lending for house purchase. In the context of the Bank model, this feeds into an equation for new house prices. Estimates of the net increase in shares and deposits and in net lending also feed into the flow of funds matrix incorporated in the Bank model.

Estimation - general remarks

25 Four behavioural equations were estimated - for net inflows, net advances and share and mortgage rates. Since the model, as eventually preferred, had a recursive structure, it was not thought important to allow for simultaneity in estimation. These equations were therefore estimated using ordinary least squares and data for the period 1965-78. It is none the less hoped that the model will eventually be re-estimated using an appropriate simultaneous estimation technique, in particular to take account of simultaneity between building society lending and house prices.

26 The choice of preferred equations was based on conventional statistical criteria - standard error, 't' statistics and Durbin-Watson statistic. When there was evidence of autocorrelation, which could not be subsequently explained by misspecification of the equation, this was allowed for in the estimation. This was necessary only in the net advances equation.[1]

27 The stability of the estimated coefficients of each equation was tested using a Chow test and by considering the *ex post* forecasting behaviour of equations since end-1976. The following hypotheses in particular were tested:

(i) that net inflows had become steadily more interest-sensitive;

(ii) that societies are at present more willing to change share and mortgage rates than in the 1960s.

28 Statistical results did not support the first hypothesis. There was, however, strong evidence, both *a priori* and estimated, to support the second hypothesis. For this reason the equations for share and mortgage rates are estimated using data from 1972 onwards.

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[1] It possibly reflects a misspecification of the relationship between inflows and advances. See paragraph 60.

Net receipts of shares and deposits

Equation specification

29 There is a long history of attempts to estimate equations to explain net receipts of building societies.[1] None, however, has been entirely satisfactory. The main problem is that the conventional asset demand equation below, which is derived from Tobin/Markovitz portfolio theory, fails to produce convincing estimated results.[2]

$$D = f(W, r_1 \ldots r_n) \qquad (1)$$

where: D = stock of building society shares and deposits;

W = personal sector wealth; and

$r_1 \ldots r_n$ = share rate and competing rates.

30 A possible reason for this is that the typical building society depositor does not conform to the sophisticated 'utility maximising' investor on which Tobin/Markovitz portfolio theory is based. Rather, building society deposits are held by different classes of investor for a variety of motives. The traditional building society depositor is the small, personal saver who is attracted by the convenient deposit and withdrawal facilities offered by societies, the risklessness of building society deposits and the variety of savings schemes as well as by the superior returns which building society shares have offered compared with, say, clearing bank deposit accounts, the trustee savings banks (TSB) and national savings. Also, most prospective housebuyers are encouraged to open one or more building society accounts because societies reportedly give preference to depositors when allocating mortgage funds.

31 Building societies have, however, increasingly attracted deposits from more sophisticated investors, whose behaviour is probably akin to that subsumed in Tobin/Markovitz theory. For these investors, the return offered on building society shares relative to that on alternative

[1] See Foster (1975).

[2] Results usually imply an implausibly slow adjustment of building society deposits to changes in relative yields.

risk-free liquid assets, such as bank deposits or local authority deposits, is of paramount importance.

32 This discussion suggests that building society shares and deposits comprise both precautionary and interest-sensitive speculative balances. It is, however, not possible to distinguish balances according to the motives of depositors. A single equation must therefore suffice to capture the varying patterns of behaviour of different building society depositors.[1]

33 The main difference between small savers and more sophisticated investors is probably their sensitivity to changes in relative interest rates. Small savers, because of inertia and the lack of comparable alternative outlets, are likely to be slow to switch existing savings. They may, however, be quicker to reallocate new saving. Larger investors are more concerned with relative rates of return. Societies' experience confirms this; large sums can be quickly switched between building societies and, say, banks or local authority deposits, depending on changes in relative returns.

34 It is important, therefore, to derive an equation which can adequately capture the effects both of reallocation of new savings flows and of existing investments. Foster (1975) has reviewed alternative specifications. In deriving his preferred equation, however, he argued that the effects on building society net receipts of switching existing investments were not important. This considerably simplifies the specification of equations, but it needs to be justified before it is accepted.

35 The approach adopted in this exercise to explaining flows of new building society deposits attempts to deal with the reallocation both of new savings flows and of existing investments. Two types of building society depositor were postulated - interest-sensitive speculators and precautionary savers. It was thought that the

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[1] The largest building societies provide a classification of receipts and withdrawals by size of transaction. Simple analysis suggests that large receipts (£2,000 or more) are extremely interest sensitive; small receipts (£500) are, however, not interest sensitive, but are seasonal.

behaviour of speculators could be represented by a conventional asset demand equation:

$$D^{spec} = a + \sum_{i=0}^{N} b_i r_i + cW^{spec}. \qquad (2)$$

The behaviour of precautionary savers was, however, thought best represented by:

$$\Delta D^{prec} = d + \sum_{i=0}^{N} e_i r_i + f.y^{prec} \qquad (3)$$

where: $\left.\begin{array}{l} D^{spec} \\ D^{prec} \end{array}\right\}$ = building society speculative and precautionary deposits;

r_i = share rate and competing rates;

W^{spec} = investments of speculators; and

y^{prec} = income of precautionary savers.

Equation 2 emphasises investment of existing wealth and equation 3 the investment of new wealth.

36 Differencing equation 2 and combining with equation 3 yields the following equation for total net receipts of building societies:

$$\Delta D = d + \sum_{i=0}^{N} b_i \Delta r_i + \sum_{i=0}^{N} e_i r_i + c\Delta W^{spec} + fy^{prec}. \qquad (4)$$

This equation contains both levels and changes in interest rates as explanatory variables. A lasting improvement in the competitiveness of share rate will have a continuing effect on new deposits from income, and will also cause a temporary switching of existing investments into building societies. These effects may, in practice, be gradual.

Estimation

37 To estimate equation 4, appropriate interest rates must be chosen, and ΔW^{spec} and y^{prec} proxied. Also, it had to be decided whether to estimate an equation for net receipts of shares and deposits, or separate equations for net inflows and for interest credited to accounts.

Choice of interest rates

38 Different writers have chosen different rates to represent the returns available on assets which are substitutes for building society shares. O'Herlihy and Spencer (1972) found that Bank rate performed better in estimated equations than gilt-edged yields, interest rates on national savings and recent changes in equity prices (as a measure of expected capital gains in the stock market). Foster (1975) discusses

the merits of different competing rates. After comparing changes in these, he chose the TSB rate to represent alternative returns available to 'small' depositors and the London clearing banks' (LCB) seven-day deposit rate to represent returns available to 'large' depositors. Riley (1974) obtained better results with the three-month local authority (LA) rate than with either the LCB deposit rate or equity yields.

39 In this exercise, the choice of competing rates was essentially limited to those rates included in the Bank's econometric model. The central domestic short rate in this model is the three-month LA rate. It was therefore chosen as a proxy for short-term rates which compete against share rate. Earlier research within the Bank had shown that it gave better results than using the LCB seven-day deposit rate.[1]

40 In addition, initial estimated results suggested that a long rate should be included and that allowance should be made for the issues of national savings certificates. Accordingly, the rate on twenty-year gilt-edged stocks was included in estimated equations, as was a term measuring the return on national savings certificates. During the estimation period (1965-79), there were five issues of national savings certificates. Preliminary statistical research suggested that building society receipts fell temporarily following these issues, and that the extent of this fall depended on the competitiveness of the new certificate.

Proxies for ΔW^{spec} and y^{prec}

41 As with interest rates, the range of possible proxies for these variables was limited to the variables in the Bank model. The general difficulties of measuring wealth are well known. In this case, there is an additional need to identify the wealth and income of different sorts of building society depositor. As this was not possible, it was decided to assume that ΔW^{spec} is proportional to discretionary personal saving and y^{prec} to total household income.[2]

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[1] See Hacche (1976).

[2] Discretionary saving was measured by total personal saving net of receipts by life assurance companies and pension funds. Household income is an estimate of income received by households. This is not the same as personal income as measured in the National Accounts (see Appendix 2). Household income was initially split into permanent and temporary components on the ground that a higher proportion of temporary income is saved with building societies. Estimated results did not, however, support this idea.

Choice of dependent variable

42 The choice was whether to estimate an equation for the net increase in shares and deposits or for net inflows.[1] Other writers [e.g. Mayes (1979)] have estimated separate equations for receipts and withdrawals, but, in the context of the Bank model, this extra detail was not considered practicable.

43 After preliminary analysis, it was decided that 'net inflows' was the more suitable variable. In terms of fit, there was little to choose between equations for the net increase in shares and deposits and for net inflows. However, 'net inflows' was favoured on the ground that interest credited to accounts is a component of personal income, which, because of inertia, is comparatively insensitive to changes in competing interest rates. A net inflows equation was therefore thought to have better simulation properties.[2]

Results

44 For estimation, 'net inflows' were deflated by the consumer price deflator. This was to allow for the effects of inflation on the scope for switching of assets. Other variables, which are perhaps more suitable, including the stock of building society shares and deposits and persons' liquid assets, were tried instead of the consumer price deflator but these did not give as good estimated results. A linear equation was preferred to a log-linear specification on grounds of fit.

45 Results are shown in Table A. Equation 1 is disappointing. The coefficient on discretionary saving, although correctly-signed, is not statistically significant at 5%. This probably reflects the inadequacy of this variable as a proxy for the change in the wealth of speculative investors in building societies, as well as colinearity between saving and income.

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[1] Net inflows (of shares and deposits) = receipts less withdrawals. Net increase in shares and deposits = net inflows plus interest credited to accounts.

[2] Interest credited to accounts was explained using the equation for SI shown in Appendix 1. This implies that, at the margin, 71% of interest earned on building society shares and deposits is credited to accounts.

46 The other statistically-insignificant coefficient is that of the difference between share rate and the rate on long-dated gilt-edged stocks. The coefficient of the change in this differential is, however, significant and correctly-signed. These results imply that changes in the state of the gilt-edged market are an important influence on flows of speculative money to and from building societies. This result is plausible.

47 The third unsatisfactory feature of equation 1 is that the coefficient on the change in the differential between share rate and LA rate is wrongly-signed. This implies that changes in the relative competitiveness of short-term investments do not have a strong portfolio adjustment effect involving building societies.

48 Further experimental equations were estimated omitting variables whose coefficients were either wrongly-signed or which did not significantly add to the explanatory power of the equation. Attempts were also made, using Almon variables, to allow for delays in inflows adjusting to changes in competitiveness. The resulting, preferred equation is shown as (2) in Table A. This equation implies, ceteris paribus, that:

(i) a 1% widening in the differential between share and LA rates increases net inflows by £120 million a quarter (1975 prices) - this is a lasting effect, reflecting a reallocation of income;

(ii) a 1% fall in the rate on long-dated gilt-edged stocks increases building society net inflows by £31 million in that quarter;

(iii) an issue of national savings certificates with a 1% yield advantage over building society shares will reduce net inflows by £162 million in the three months following the issue;

(iv) at the margin, 15% of household income is invested with building societies; the fact that the constant term of this equation is negative implies that a rising proportion of income is invested with societies.[1]

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[1] This coefficient on household income was thought too high, although its estimated size was robust. Possibly this coefficient is also picking up the effects of the growth in societies' marketing expenditure over the last fifteen years, as well as inflows arising not from income, but from reallocation of existing investments.

49 This equation therefore highlights the sensitivity of building society inflows to changes in the competitiveness of share rate. It also implies that changes in yields on gilt-edged stocks are an important influence on speculative flows to and from societies. It is a pity, however, that a satisfactory wealth variable could not be included.

Table A

Estimated equations for real net inflows

Estimation period was 1965Q1-1978Q4

	$\frac{HDI-ICA}{PC}$	$\frac{SJ-LVJ}{PC}$	CNST	RSG-RLA	RSG-RUKG	DNSC (RSG-RNSC)	Δ(RSG-RLA)	Δ(RSG-RUKG)	se	$\bar{R}^2$	dw
(1)	0.135 (7.3)	0.072 (1.5)	-1313.519 (5.9)	124.581 (19.3)	9.193 (0.6)	138.809 (3.2)	-19.345 (2.0)	37.211 (2.0)	75.5	0.91	1.66
(2)	0.154 (14.4)		-1512.458 (10.6)	120.077 (9.7)		161.792 (4.0)		31.463 (2.1)	76.0	0.90	1.75

where:

$\frac{HDI-ICA}{PC}$ = real household disposable income net of interest credited to accounts;

$\frac{SJ-LVJ}{PC}$ = real personal discretionary saving;

RSG = gross share rate;

RLA = three-month LA deposit rate;

RNSC = rate on latest national saving certificates;

RUKG = rate on twenty-year gilt-edged stocks;

DNSC = dummy variable to mark the issue of a national saving certificate.

A model of building society lending behaviour

The objectives of building societies

50 It was argued above that there has been persistent excess demand for mortgages; thus the ability and willingness of building societies to lend have effectively determined the volume of funds advanced. It was then argued that societies' willingness to lend depends on their business objectives. It was suggested that societies have a variety of business objectives, some of which may at times conflict.

51 In this paper it is assumed that the following three objectives of societies influence their willingness to lend:

(i) to maintain adequate liquidity;

(ii) to satisfy the demand for mortgages; and

(iii) to meet any 'guideline' restrictions on lending.

These are discussed in turn below.

(i) To maintain adequate liquidity

52 In common with other financial institutions, building societies keep part of their assets in liquid form to ensure that they can meet likely cash requirements. By law, societies must hold at least 7.5% of their assets in liquid form, but their liquidity has always been well above this minimum. Indeed, over the last twenty years until recently, there has been a tendency for the liquidity of societies to increase. This is thought to reflect both the societies' success in attracting deposits of interest-sensitive funds and a tendency to use building society accounts as substitutes for bank current accounts.

53 The relevance of this analysis is that it implies a fall over time in the proportion of shares and deposits which societies are willing to on-lend for house purchase. This point is discussed further below.

(ii) To satisfy the demand for mortgages

54 Despite the enormous growth of building societies over the last decade, it is usually assumed that there has been persistent excess demand for mortgages. As the raison d'etre of building societies is to lend money for house purchase, it is likely that they feel an obligation to satisfy the demand for mortgages.

(iii) To meet any 'guideline' restrictions on lending

55 From June 1975 until recently the BSA has undertaken to regulate lending by its members. There is, however, disagreement about the impact of the 'guidelines' on building society lending. Such a quota system is unnecessary if the guideline is higher than building societies would otherwise lend, and ineffective if building societies were to ignore the guideline. Certainly there is a strong case for arguing that in the second half of 1976 and the first half of 1977 the guidelines were unnecessary, as building society lending was restricted by low inflows stemming from their then uncompetitive position.

An equation for net advances

56 It was assumed that building societies assess the relative desirability of each of the above three objectives in determining how much to lend. Such optimising behaviour suggests the following equation to explain the level of net advances:[1]

$$NA = \alpha NA^S + (1-\alpha)\ NA^D \qquad (5)$$

where:

NA = actual net advances.

NA^S = a supply estimate of advances - determined by the liquidity considerations of building societies and by the possible existence of a guideline on lending; and

NA^D = the demand for net advances.

57 This equation implies that actual net advances will be a weighted average of the supply and demand targets for net advances.

[1] Assuming that societies behave as if they minimised the following quadratic loss function:

$$L = W_1(NA-NA^S)^2 + W_2(NA-NA^D)^2$$

Estimation

Definitions of variables

58 As they are unobservable, proxies for the two explanatory variables of equation 5 had to be found.

The supply of funds for lending (NA^S)

59 In periods when no guideline is operating, it was assumed that the supply of funds for lending by societies depends on desired liquidity levels, and on recent and expected levels of net receipts. The following expression captures this:

$$NA^S = (1-L^*).\frac{1}{N}\sum_{i=0}^{N-1} NREC_{-i} + \beta[(L-L^*)DEP]_{-1} \quad (6)$$

where:

NA^S = supply of funds for lending;

NREC = net receipts;

DEP = stock of shares and deposits;

L = societies' actual liquidity ratio; and

L* = societies' desired liquidity ratio.

60 The first part of this expression suggests that building societies base their lending plans on average net receipts over the last N quarters. This provides a plausible explanation for the fact that, because building societies prefer to maintain a steady flow of lending, lending adjusts only gradually to changes in levels of net receipts. A four-quarter moving average of net receipts seemed credible - i.e. that lending depends on receipts during the previous twelve months - and gave better estimated results than two or three-quarter moving averages or more complex lagged relationships, estimated using the Almon variable technique.[1] The second half of this expression implies that societies adjust their lending in line with their liquidity position; the higher the liquidity of societies, the more willing they are to lend.

61 A measure of 'desired liquidity' was more difficult to define. Most writers have assumed that societies aim to hold a constant proportion

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[1] The fact that estimated equations for net advances exhibit evidence of first order autocorrelation perhaps suggests that the relationship between receipts and lending is not as mechanical as equation 6 would imply.

of their assets in liquid form.[1] Levels of liquidity have, however, tended to rise since the 1960s. A linear time trend was initially used to proxy desired liquidity, but, although it gave better estimated results than using a constant ratio, it was, upon reflection, considered unsatisfactory. The main reason for this was that the most recent evidence suggests that liquidity levels may have stabilised. After some experimentation, the following definition of 'desired liquidity' was adopted: that desired liquidity was 16% before 1974, but was 18 1/2% after that date.[2] The increase in desired liquidity was undoubtedly more gradual in reality; it was thought to reflect a realisation by societies that interest rates and therefore their inflows were going to be more volatile as a result of competition and credit control (CCC).

62 The above expression was altered in the following way in an attempt to take account of the effects of the guideline:

$$NA^{S*} = NA^{S} - \gamma(NA^{S}-GL)^{+} \qquad (7)$$

where:

NA^{S} = societies' willingness to lend if there were no guideline (given by equation 6 above);

$(NA^{S}-GL)^{+}$ = the amount by which willingness to lend exceeds the guideline expressed in terms of net advances.

63 This expression suggests that societies' willingness to lend, if there were no guideline, is reduced by a proportion of the amount by which this exceeds the guideline. The extent to which the guideline restricts lending is therefore measured by γ: the closer γ is to 1 the greater the impact of the guideline.

The demand for mortgages

64 The following implicit equation was used to represent the demand for building society advances:

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[1] See, for example, Hadjimatheou (1976).

[2] In this simple model of building society behaviour, one less the ratio of mortgages to shares and deposits is used to proxy liquidity. This is not the conventional definition of societies' liquidity, but was used to avoid adding an extra variable to the model. It is about 3%-3 1/2% less than the conventional measure. See Appendix 1.

$$\frac{M^d}{PNH} = a+b.\frac{W}{PNH} + c.\frac{PC}{PNH} + d.[(PNH/PC)/(PNH/PC)_{-2}-1]+e.RMN \tag{8}$$

where:

M^d = desired stock of building society mortgages (£ millions);

W = persons' wealth (£ millions);

PNH = index of new house prices (1975 = 1);

PC = index of consumer prices (1975 = 1); and

RMN = post-tax mortgage rate (per cent).

This is a conventional demand equation stressing the influence on demand of levels of wealth, the relative price of housing and the cost of borrowing for house purchase. The percentage change over the last six months in the relative price of housing was also included to capture the 'speculative' demand for housing.

65 By differencing equation 8 and re-arranging terms, we obtain the following implicit equation for the demand for net advances:

$$NA^d = \Delta M^d = a^1\Delta PNH + bY + c^1\Delta(PNH - PC) + d\,\Delta\left\{\left[\left(\frac{PNH}{PC}\right)/\left(\frac{PNH}{PC}\right)_{-2} - 1\right].PNH\right\} + e\Delta(RMN.PNH) \tag{9}$$

where:

NA^d = demand for net advances (£ millions); and

Y = households' disposable income (assumed to be $\simeq \Delta W$).

Estimated results

66 Combining equations 6, 7 and 9 yields the following estimatable equation for net advances:

$$\begin{aligned} NA = {} & \alpha\left\{(1-L^*)\,\overline{NREC} + \beta[(L-L^*)DEP]_{-1} - \gamma[(1-L^*)\overline{NREC}-GL]\right\} \\ & + (1-\alpha)\left\{a^1\,\Delta PNH + bY + c^1\Delta(PNH-PC) + d\,\Delta\left\{\left[\left(\frac{PNH}{PC}\right)/\left(\frac{PNH}{PC}\right)_{-2} - 1\right].PNH\right\} \right. \\ & \left. + e\,\Delta(RMN.PNH)\right\} \end{aligned} \tag{10}$$

where:

$0<\alpha<1$, $0<\beta<1$, $0<\gamma<1$

$0<b<1$, $c^1<0$, $d>0$, $e<0$

$$\overline{NREC} = \frac{1}{N}\sum_{0}^{N-1} NREC_{-i}.$$

67 Estimated results are shows as equation 11.[1] This equation satisfies most of the usual statistical criteria: all coefficients are correctly-signed but only two are statistically significant at 5%.

$$\begin{aligned}
NA = {} & \underset{(4.7)}{0.73297}\ (1-L^*)\ \overline{NREC} + \underset{(2.7)}{0.12222}\ [(L-L^*)\ DEP]_{-1} \\
& - \underset{(0.7)}{0.23478}[(1-L^*)\overline{NREC}-GL]^{+} \\
& + \underset{(1.0)}{1252.78}\ \Delta PNH + \underset{(1.8)}{0.01338}\ HDI \\
& - \underset{(1.8)}{42.46713}\ \Delta(RMN.PNH) - \underset{(0.3)}{306.93326}\ \Delta(PNH-PC) \\
& + \underset{(1.7)}{8.80743}\Delta\left\{\left[\left(\frac{PNH}{PC}\right)/\left(\frac{PNH}{PC}\right)_{-2} -1\right].PNH\right\} \\
& + \underset{(2.2)}{0.35807}\ U_{-1}
\end{aligned} \tag{11}$$

$\bar{R}^2 = 0.97$ SE = 56.0

Estimation period: 1966 QI - 1978 QII

68 These results imply that net advances depend mainly on societies' <u>ex ante</u> willingness to lend, although the pressure of demand for mortgages also has a significant (at 5%) influence. The implied weights given to 'supply' and 'demand' targets in determining net advances are 0.73 and 0.27.

69 Willingness to lend is seen to depend not only on recent levels of net receipts of shares and deposits, but also on the liquidity position of societies - normally about 12% of excess liquidity is used to boost lending in a quarter. The guideline also seems to have had a restrictive influence on net advances, but this effect was not found to be important.[2] The real demand for net advances is increased by rising real incomes, and by house prices accelerating at a faster rate than other prices; demand is, however, reduced by

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[1] For estimation, the equation was transformed to real terms by deflating variables by the index of house prices but is shown as above for reasons of clarity.

[2] This conclusion is especially tentative because it is based on limited experience of the guideline.

increases in the mortgage rate. Increases in the relative price of housing also reduce demand, but this influence does not seem important.

70 Further experimental equations were estimated, omitting variables whose coefficients were not statistically significant in equation 11. The final preferred equation is shown in Appendix 1. It is not very different from equation 11.

6

Share and mortgage rates

Introduction

71 The purpose of this section is to describe the specification and estimation of explanatory equations for building society share and mortgage rates.

72 A two-stage procedure is used to model changes in share rate; in the first stage their timing is explained and, in the second, their size. This method was adopted because, unlike market rates, building society rates change only occasionally. Changes in mortgage rate are, however, modelled by comparison with changes in share rate The results of this paper show that this approach provides a reasonable explanation of changes in share and mortgage rates since 1972.

Share rate: timing of changes

73 Share rate is an administered rate. Recommended levels, which are adopted by most societies, are decided at monthly meetings of the BSA Council. When deciding whether or not to change their rates, building societies are assumed to compare the pressures on them to change their share rates with their unwillingness to change mortgage rate. The factors which are thought to influence this decision are discussed below.

Pressures for a change in building society rates

74 Various pressures influence decisions on share rate. The most important is the attractiveness of share rate to investors. The societies' traditional competitors for small personal savings are deposit accounts of banks and national savings schemes. Although it is thought that such deposits are not very interest-sensitive in the short run, building societies also attract deposits from more sophisticated investors who are conscious of relative rates of return. Such deposits have formed an increasing proportion of societies' total deposits in recent years. Share rate must be competitive if these deposits are to be retained.

75 Despite the need for share rate to be competitive, societies have not adopted a policy of changing share rate whenever short-term market rates change. Rather they have also attempted to maintain as stable a share rate as possible. They have done this to avoid having to change mortgage rate, which has been linked to share rate.[1] A stable mortgage rate has been regarded as desirable not only to protect mortgagors from fluctuations in market rates, but also because changes in the mortgage rate are administratively expensive.

76 Thus, in deciding whether or not to change share rate, societies have tried to ignore temporary changes in market rates, and to follow only lasting trends. In other words, their response to a change in market rates depends crucially upon whether the new level of market rates is expected to be short-lived or more lasting.

77 In the 1950s and 1960s, societies were apparently quite successful in predicting future levels of interest rates. Bank rate was seemingly interpreted as an indicator of the future level of market rates, and share rate was changed only eleven times between 1955 and 1973, usually following a change in Bank rate.[2]

78 It has, however, been more difficult to forecast trends in interest rates since the introduction of CCC. In particular, a change in minimum lending rate could not always be interpreted as signifying a lasting change in the level of market rates. As a result, societies have found it necessary to change share and mortgage rates more frequently in recent years than earlier. These rates were, for example, changed three times in both 1977 and 1978, and twice in 1979.

79 It is difficult to determine just how building societies form expectations of future levels of interest rates. It appears that, at

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[1] This need not be so. Societies could adopt a policy of flexible share rates combined with a stable mortgage rate. Such a policy, however, has little attraction for them, as it would be as difficult to get right as the present policy, and control of reserves and liquidity would be made more difficult.

[2] See Hadjimatheou (1976), pages 76-84.

present, more attention is paid to changes in market rates, especially the three-month LA rate, than in the 1960s. For this reason, it was assumed that the pressure for a change in share rate depends partly on the competitiveness of share rate compared to other short rates, which in this exercise are proxied by the three-month LA rate.

80 Besides competitiveness, the liquidity position of societies and public opinion may influence decisions on share rate.

81 Liquidity is relevant because the more liquid societies are, the better able they are to withstand the effects of what may be thought to be a temporary loss of competitiveness, without having to curtail their lending. Indeed, societies deliberately use their stock of liquid assets as a buffer to allow them to stabilise levels of lending. This analysis implies, for example, that, ceteris paribus, the closer liquidity is to a minimum acceptable level, the stronger is the presure for societies to increase share rate.

82 The influence of public opinion on building society rates is one way - pressuring societies either to reduce mortgage and share rates, or not to increase these rates. Its strength is impossible to quantify, but it has at times seemed crucial. For example, in 1973 and 1974 societies agreed, on two occasions, not to raise mortgage rate, but rather accepted compensatory financial assistance from the Government. Also, societies seem very reluctant to change mortgage rates just before a general election.

Societies' prior unwillingness to change the rates

83 Societies' prior unwillingness to change share rate was thought to depend on their recent experience. This was suggested by the fact that the frequency with which share rate has changed has varied considerably, even in the period since 1972. In particular, it was thought that the following factors were relevant:

(i) the length of time since the last change in societies' rates; and

(ii) the frequency with which their rates had recently changed.

84 It was thought that the longer since the last change in share rate, ceteris paribus, the more willing are societies to recommend a further change. This was rationalised on the ground that societies recognise that they cannot wholly protect mortgagors from fluctuations in market rates; rather they are content to allow mortgage rate to change, say, annually, but resist more frequent changes.

85 However, it was also thought that the more frequent have been recent changes in societies' rates, the more willing are societies to contemplate a further change. This may reflect the fact that societies find it easier to recommend a further change in rates if they feel that recent events have led to their borrowers becoming used to changes in rates.

A model to explain the timing of changes in societies' rates

86 It was assumed that each of these factors influences the decision whether to change share rate. The following model was therefore thought a suitable representation of this decision-making process:

$$P_t = \Sigma\alpha_i . x_i \tag{12}$$

If $P_t > k_t$ then share rate is changed; otherwise share rate is not changed. (13)

Where:

P_t = a measure of the pressure for a change in share rate;

x_i = the factors, outlined above, which influence this decision;

α_i = estimates of their relative importance; and

k_t = the threshold value for the pressure index.

Equation 13 implies that only when pressure is sufficiently strong is a decision made to change share rate.

87 Equations 12 and 13 describe a well-known statistical procedure to discriminate between two types of object or event. In this exercise we seek to distinguish between periods in which share rate is changed and periods in which there is no change.[1]

[1] Such a model has been used by economists to explain, inter alia, the incidence of shiftworking, the choice of mode of transport and the purchase of cars. The estimation of equation 12, however, presents difficult methodological problems, which are discussed in Goldberger (1964).

88 To apply this model, P_t was defined to equal one in those quarters in which share rate was changed, and zero in other quarters, and the coefficients of equation 12 were estimated using ordinary least squares. The determination of k_t is explained below.

Estimation of pressure for a change in share rate

89 The coefficients of equation 12 were estimated using data for 1972Q1-1979Q2. This estimation period was chosen because CCC seemed to have had a considerable impact on building society rate setting. As an estimation period, however, the period since 1972 has several deficiencies: first, in the early part of this period, building society policies were undoubtedly adapting to the increased volatility of market rates of interest, and, second, during much of 1973 and 1974, normal rate setting behaviour was suspended when societies agreed not to raise mortgage rate in return for financial assistance from the Government. Lack of data, however, prevented the use of a shorter estimation period.

90 The best estimated equation for P_t is shown below:

$$P_t = \underset{(1.8)}{0.08881}/RSGE-RLAE/+\underset{(3.4)}{0.23171}\ QUARTER-\underset{(2.3)}{0.59537}\ DLOAN$$

$$-\underset{(2.4)}{0.62606}\ DELC+\underset{(1.9)}{0.11284}\ NCHANGE \qquad (14)$$

$\bar{R}^2 = 0.27$

Estimation period 1972 Q1-1979 Q2.

Where:

P = index of the pressure for a change in share rate;

/RSGE-RLAE/ = absolute difference between last quarter's gross share, and three-month LA rates (both end-quarters);

QUARTER = number of quarters since last change in share rate, [= 0, 1, 2, 3];

DLOAN = dummy variable to take account of government loan to societies in 1974 in return for not raising their rates;

DELC = dummy to take account of the fact that societies have, seemed very reluctant to change their rates in the period immediately before a general election; and

NCHANGE = number of changes in share and mortgage rates in the last twelve months.

91 Equation 14 implies that a decision to change share rate is largely a trade-off between the desire by societies to be competitive and the conflicting aim that share rate should be changed as infrequently as possible.

92 In preliminary estimated equations, a variable representing the liquidity position of societies was also included, but this proved unimportant. Nor did changes in societies' liquidity seem to influence decisions on share rate. These results were thought plausible; they suggest that societies do not allow liquidity to get so out of line that _it_ is the factor which forces a change in share rate.

Determination k_t

93 To assess the predictive performance of equation 14 it is necessary to determine values for k_t, the critical value for the index of pressure. Following usual practice, k_t was represented by the prior probability of share rate not changing. This was estimated as one minus the frequency of changes in share rate over the estimation period. As share rate was changed fourteen times in the period 1972Q1-1979Q2, this method would imply that k_t should be 0.53 and the decision rule: change share rate if $P_t>0.53$.

94 Unfortunately, this decision rule proved impracticable as it led to the unacceptable result that share rate would be changed, at the least, every nine months, irrespective of the circumstances. This property seemed to be a consequence of the choice of estimation period for equation 14, because, since 1972, share rate had on only one occasion been freely allowed to remain unchanged for more than nine months. Put differently, it was thought that, in equation 14, too much weight is given to the length of time since the last change in share rate (QUARTER) and to the number of recent changes in share rates (NCHANGE) in computing pressure for a change in share rate.

95 To remove this unacceptable property of equation 14, it was decided following some experimentation to impose the coefficient of NCHANGE and to estimate this restricted equation. The most satisfactory results were obtained with the following equation:

$$P_t = \underset{(4.6)}{0.08389}/RSGE-RLAE/+\underset{(3.9)}{0.12281}\ QUARTER-\underset{(2.0)}{0.53196}\ DLOAN$$

$$-\underset{(2.4)}{0.62250}\ DELC+0.1325\ NCHANGE. \qquad (15)$$

96 Although ad hoc, and therefore in some sense unsatisfactory, this equation, when combined with a threshold value of $k_t = 0.53$, did not imply that share rate is automatically changed at least every nine months. Moreover, the predictive performance of equation 15 is no worse than that of the freely-estimated equation 14.

97 The predictive performance of equation 15 over its estimation period is summarised in Table B.

Table B

	Change in share rate	No change	Total
Correctly predicted	10	14	24
Incorrect	4	2	6
	14	16	30

98 Decisions on share rate were correctly predicted in twenty-four out of thirty periods. The six quarters when the equation went astray were 1972Q4-1973Q3, when it failed to predict three successive reductions in share rate, and 1976Q1 and 1976Q2, when the equation predicted a change in share rate in 1976Q1 not 1976Q2 when rates were actually changed. Decisions on share rate between 1976Q2 and 1979Q2 were correctly predicted.

99 It is also possible to calculate the implied threshold values for the differential between gross share rate and the three-month LA rate. This has been done for various assumptions about how frequently and how recently share rate has changed. Details are shown in Table C.

Table C

Critical values for the differential between gross share rate and three-month LA rate

Quarters since last change in share rate	Number of changes in previous four quarters[a] 0-1	2	3+
1	4.7	3.1	1.6
2	3.3	1.7	0.1
3	1.8	0.5	X
4+	0.3	X	X

[a] X = impossible combinations.

The extent of changes in share rate

100 It was supposed that, once a decision had been made to change share rate, the size of the change would be determined by reference to competing rates. This suggests the following equation, which would be estimated using data for quarters in which share rate was changed.

$$SR = a(CR - SR_{-1}) + b \qquad (16)$$

where:

SR = net share rate;

CR = a proxy for net competing rates; and

a and b = coefficients to be estimated.

101 If it were thought that societies fully made up for lack, or excess of, competitiveness when they changed share rate, then a would be expected to be close to 1. Estimated results, shown below, did not, however, support this idea:

$$\underset{(4.4)}{RSNE = 0.19428} + \underset{(10.0)}{0.27324}[RLAE(1-TYR) - RSNE_{-1}] \qquad (17)$$

$\bar{R}^2 = 0.48$ se = 0.09

Estimation period 1958Q1-1979Q2 (for quarters in which share rate was changed).

Where:

RSNE = net share rate;

RLAE = three-month LA rate; and

TYR = basic income rate.

102 This equation fits the data well. The direction of every change in rate during the estimation period was correctly predicted. However, the coefficient on relative competitiveness - at 0.27 - may be thought low. It implies that building societies are in general very cautious in moving share rate, presumably hoping that rates will eventually move into line of their own accord.

103 This equation describes societies' average behaviour. The actual amounts by which share rate is changed relative to LA rate, however, vary considerably. For example, in 1978Q3 and Q4 share rate was increased twice. On both occasions it was increased by much more than equation 17 predicted.[1] The increase in share rate announced in July 1979 was, however, more typical.

104 Attempts were made to explain variations in the amount by which share rate is changed relative to LA rate. In particular the following hypotheses were tested:

(i) that societies make greater efforts to eliminate a lack of competitiveness than an excess of competitiveness;

(ii) that societies' reaction to a gap between share rate and LA rate has changed since CCC was introduced in 1971; and

(iii) that societies' liquidity position and/or their relative competitiveness influence the extent by which share rate is changed.

No statistical evidence was, however, found to support any of these hypotheses. The conclusion therefore is that equation 17 provides a reasonable representation of how share rate is changed, when societies have decided that it will be changed.

Mortgage rate

105 As interest on mortgages is their largest source of income, the main consideration of building societies in deciding the level of the rate they charge borrowers is that it should yield an adequate surplus

[1]

	Actual ΔRSNE	Predicted ΔRSNE
1978Q3	1.2	0.4
1978Q4	1.3	0.6

of income over expenditure. An equation for mortgage rate may therefore be derived from the following simplified statement of building society income and expenditure:

$$\ell(rc-rs)+(1-\ell)(rm-rs) = s \qquad (18)$$

where:

ℓ = expected liquidity ratio;

s = planned rate of surplus on deposits (administrative expenses and normal additions to reserves);

rc = the rate on liquid assets;

rm = mortgage rate; and

rs = share rate gross up at the composite tax rate.

This expression simply states that societies' planned rate of surplus is a weighted average of the expected rates of profit on investments and mortgages.

106 Thus, to explain mortgage rate it is necessary to explain societies' planned rates of surplus. The main requirement is that the surplus is sufficient to cover management costs, which comprise mainly staff costs, and necessary additions to reserves.

107 Two other factors may, however, on occasions influence the margin between mortgage and share rates.

108 First, societies may at times be subject to strong public pressures to squeeze their margins so as to keep a prospective increase in mortgage rate as small as possible. This occurred, for example, in 1973 when societies agreed to raise mortgage rate to only 9.5%, rather than to 11.5% and to accept a subsidy from the Government in compensation. More recently, in July 1979, societies bowed to pressure not to raise mortgage rate following a 2% rise in other rates; they recommended an increase in mortgage rate, but its implementation was delayed until January 1980. (By this date it was hoped that the recommendation would have been superseded by a lower recommended mortgage rate.)

109 Societies' margins may also be squeezed if they had recently earned higher than expected surpluses and felt it desirable to distribute this windfall to depositors and/or mortgagors. This happened in late 1977 when certain societies delayed the implementation of a reduction in

share rate in order to distribute to depositors unanticipated capital profits on their liquid investments.

110 It proved extremely difficult, however, to model these influences on the margin between mortgage and share rates. Various 'naive' attempts were made to explain expected levels of management expenses and additions to reserves, but these were not successful.[1] The effect of public pressure for low mortgage rates and of embarrassingly high surpluses is usually to lead to a discrepancy in the timing of changes in share and mortgage rates, rather than to a planned lasting reduction in margins. These influences were ignored; for operational purposes it was only practicable, in the context of the Bank model, to assume that share and mortgage rates are changed at the same time. However, a dummy variable was included in estimated equations to allow for the effects of the 1973 subsidy on mortgage interest.

111 The preferred equation for mortgage rate is shown below:

$$\left(RME - \frac{RSNE}{1-TCR}\right)(1 - \ell^*) + \left(RLAE - \frac{RSNE}{1-TCR}\right)\ell^* = \underset{(25.9)}{1.12935} - \underset{(2.0)}{0.47078}\, D73^* \qquad (19)$$

se = 0.33 dw = 0.9

Estimation period 1964Q1-78Q4.

Where:

RME = mortgage rate;

RSNE = net share rate;

TCR = composite tax rate;

ℓ^* = average of actual and desired liquidity (is a proxy for planned liquidity);

RLAE = three-month LA rate (representing the return on liquid investments); and

D73* = dummy variable to account for the effects of the government subsidies in 1973 aimed at keeping down the mortgage rate.

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[1] Management expenses were thought to depend on the real growth of deposits and mortgages (to represent the 'work load' of building societies) and on average levels of earnings. At the margin, reserves were assumed to be related to the growth in deposits. These variables were all wrongly-signed in equations.

112 This equation implies that societies' rates of surplus have, by and large, been constant from 1965 to 1978. This was not thought implausible, because although management expenses per £100 deposits have increased in recent years, this was, until 1976, offset by a decline in the reserve ratio.[1]

[1] Presumably a reflection of the increasing average size of societies. The recent rise in reserve ratios is, however, difficult to explain.

Simulations of the building society model

113 The preferred estimated building society model is listed in Appendix 1.

114 The purpose of this section is to assess the forecasting and simulation properties of this model. To do this, the following exercises were undertaken:

(i) the model was used to track the recent past; and

(ii) the model was used to predict how building societies would be affected by, and react to, a sustained increase in competing short-term interest rates.

Simulations of the recent past

115 The building society model was programmed to simulate the period 1975Q1 - 1979Q1. This exercise was repeated three times, on each occasion using a different method of solving the model. The characteristics of the three methods of solution are summarised in Table D below, and results of these exercises are summarised in Table E.

Table D

Methods of solving the model

Type of solution	Equations solved simultaneously	Actual/solved values used for lagged endogenous variables
Single equation	No	Actual
Simultaneous single/period	Yes	Actual
Dynamic	Yes	Solved

116 In Table E, two statistics are used to evaluate the tracking performance of the model's equations. These are defined below:

(i) Mean percentage error (MPE)

$$MPE = 100. \frac{\Sigma(A-S)}{N} \Big/ \frac{\Sigma A}{N}$$

where:

A = actual value;
S = solved value; and
N = number of observations.

(That is, the mean error of the estimates expressed as a percentage of the average value of the variable.)

(ii) Root mean percentage squared error

$$RMPSE = 100 \; \frac{\sqrt{\Sigma(A-S)^2}}{N} / \frac{\Sigma A}{N}.$$

(That is, the standard error of the estimates expressed as a percentage of the average value of the variable.)

117 The MPE is a measure of the general bias of the predictions while the RMPSE is a measure of the reliability of the predictions.

Table E

Measures of tracking performance

	(1) Single equation		(2) Single period simultaneous		(3) Dynamic	
	MPE	RPMSE	MPE	RPMSE	MPE	RPMSE
Net share rate	0.2	5.3	0.5	4.9	-3.2	7.5
Mortgage rate	-0.1	4.0	-0.2	6.3	-2.9	8.9
Net receipts	0.4	10.1	-1.1	15.0	-6.7	16.3
Net advances	1.8	12.0	0.8	8.3	-4.1	9.2
Level of deposits	-	-	0.0	0.6	-2.3	2.8
Level of mortgages	-	-	0.0	0.3	-1.8	2.1
Liquidity ratio	-	-	-0.1	4.2	-1.7	5.5
Timing of changes in building society rates						
	√	x	√	x	√	x
Change	8	1	8	1	7	2
No change	6	2	6	2	5	3

(√ => correctly predicted: x => incorrect)

118 Table E is divided into three columns corresponding to the three different ways of solving the model. The statistics of column 1 essentially measure the goodness of fit of behavioural equations. (Note: Identities hold exactly when the model is solved in this way.) Column 2 shows the accuracy of the forecast obtained when the model is solved, not as a sequence of separate equations, but simultaneously. Columns 1 and 2 therefore differ to the extent that those current endogenous variables which feed into other equations are badly estimated. Similarly, the differences between columns 2 and 3 reflect the extent that errors in the solutions for earlier periods are carried forward to influence later solutions.

119 The timing and extent of changes in share and mortgage rates are generally predicted quite well. Forecasts of net receipts and net advances are, however, less reliable. Indeed, errors in the forecasts of net receipts in certain quarters are disturbingly large.[1] There is, however, no significant bias in the forecasts of receipts and advances.

120 These results illustrate the recursive structure of the building society model (share rate → net receipts → net advances). Consider column 3 of Table E. This reveals a general tendency for the equations of the model to overpredict. This occurred because the model failed to predict a reduction in building society rates in 1975Q2. Building societies were therefore forecast to be more competitive than they actually were, and, as a consequence, net receipts and net advances were overpredicted. Also, because the equation for changes in share rate is in first differences, and because this equation implies that the differential between share rate and competing rates is not wholly eliminated by a change in share rate, this overprediction of share rate, and hence of other variables, persisted for much of the period simulated. This highlights how forecasts of net receipts and net advances depend on forecasts of building society share rate.

[1] These RPMSEs are larger than those of many real variables in the Bank's econometric model, but are smaller than those of most financial variables.

The effects of a loss of competitiveness

121 This section describes the results of an exercise to use the building society model to simulate the effects on net receipts, advances, and share and mortgage rate of a 1% loss of competitiveness. In this exercise, the model was solved dynamically for the eight quarters 1977Q1 - 1978Q4. This period was chosen as it is the most recent cycle in levels of short-term interest rates - in 1977 market rates fell, leaving societies very competitive, despite consequent reductions in share rate; in 1978, however, market rates rose and this eroded societies' competitiveness.

122 The model was initially solved using actual levels for the three-month LA rate. It was then solved for a second time assuming that this rate was one percentage point higher. The differences between the two solutions were then computed. These are shown in Table F. They measure the impact of a 1% loss of competitiveness on building society receipts and advances.

Table F

Effects on building societies of a 1% loss of competitiveness

	Three-month LA rate (RLAE)	Gross share rate (RSGE)	Competi-tiveness (RSGE - RLAE)	Net receipts (NREC)	Net advances (NADV)	Liquidity ratio (LIQ)
	per cent	per cent	per cent	£millions	£millions	per cent
1977 Q1	+ 1.0	-	- 1.0	- 77	- 14	- 0.2
Q2	+ 1.0	+ 0.3	- 0.7	-129	- 44	- 0.4
Q3	+ 1.0	+ 0.5	- 0.5	- 85	- 62	- 0.5
Q4	+ 1.0	+ 0.7	- 0.3	- 56	- 63	- 0.3
1978 Q1	+ 1.0	+ 0.7	- 0.3	- 33	- 54	- 0.3
Q2	+ 1.0	+ 0.7	- 0.3	- 27	- 38	- 0.2
Q3	+ 1.0	+ 0.8	- 0.2	- 22	- 30	- 0.2
Q4	+ 1.0	+ 0.9	- 0.1	- 6	- 24	- 0.1

123 A loss of competitiveness has an immediate impact on societies' net receipts. Receipts are reduced by £77 million in the first quarter

of the simulation, by £129 million in the second quarter, but by progressively smaller amounts thereafter as societies increase their rates to restore their competitiveness.

124 The drop in net receipts causes a reduction in net advances, although this is more gradual, as societies, to some extent, maintain lending levels by cutting their liquidity.

125 A loss of competitiveness also increases the pressure for a change in share rate. How quickly share rate is changed in this model (if at all) depends not only on the extent of any loss of competitiveness, but also on the degree of pressure which already exists for a change in share rate. At the start of 1977, the beginning of this simulation, both share and mortgage rates were at record levels. Market rates were, however, falling. There was thus considerable existing pressure for reductions in building society rates. In this simulation, therefore, building society rates are predicted to change more quickly following a loss of competitiveness than would be the case in simulations with different starting conditions. Even so, societies had eliminated only 70% of the initial loss of competitiveness after twelve months and 90% after twenty-four months. This illustrates their well-known slowness to change their rates.

Conclusions

126 There are two conclusions. First, recent changes in building society rates were predicted quite well, even when the model was solved dynamically. Forecasts of levels of net receipts and net advances were, however, less reliable, although there was no general bias.

127 Second, linkages within the building society model seem sensible: a loss of competitiveness would be restored only gradually; in the meantime net receipts would be lower; net advances would also fall, although, to some extent, lending levels would be maintained by a running down of liquidity.

Appendix 1

The estimated model

Net advances

$$NADV = \underset{(2.4)}{1695.77551}\Delta PNH + \underset{(4.6)}{0.56125}.\left(\frac{1}{4}\sum_{i=0}^{3} NREC_{-i} + GOVL\right).\left(1-\frac{LIQ^*}{100}\right)$$

$$+\underset{(2.6)}{0.11621}\left[\left(\frac{LIQ - LIQ^*}{100}\right)\right]DEP_{-1} + \underset{(3.4)}{0.02122}\ HDI$$

$$-\underset{(1.6)}{57.84054}\Delta\left[RM\left(1-\frac{TYR}{100}\right)PNH\right] + \underset{(1.0)}{5.62342}\Delta\left\{\left[\left(\frac{PHN}{PC}\right)/\left(\frac{PNH}{PC}\right)_{-2} -1\right].PNH\right\}$$

$$+0.47148\ U_{-1}$$

$\bar{R}^2 = 0.97$ se = 55.6

Estimation period 1966 Q1 - 1978 Q2

Mortgages outstanding at end-quarter

$$MORT = MORT_{-1} + NADV$$

Proxy for societies' liquidity ratio (end-quarter)

$$LIQ = \left(1-\frac{MORT}{DEP}\right).100$$

Desired liquidity

LIQ* =12.5 % to 1973 Q4; 15.5 % from 1974 QI onwards

Mortgage rate (end-quarter)

$$(RME-RSE^*)(1-PLIQ)+(RLAE-RSE^*)PLIQ = \underset{(25.9)}{1.12935} - \underset{(2.0)}{0.47078}\ D73^*$$

$\bar{R}^2 = 0.05$ se = 0.33 dw = 0.9

Estimation period 1964Q1 - 1978Q2

where: $PLIQ = \dfrac{LIQ+LIQ^*}{200}$

Share and mortgage rates

Pressure for a change in share rate

$$P = \underset{(3.9)}{0.12281}\ QUARTER - \underset{(2.4)}{0.62250}\ DELC + \underset{(4.6)}{0.08389}\ ABS(RSGE_{-1} - RLAE)$$

$$- \underset{(2.0)}{0.53196}\ DLOAN + 0.1325\ NCHANGE$$

$\bar{R}^2 = 0.27$ se = 0.43 dw = 1.7

Estimation period 1972Q1 - 1979Q2

Note: ABS = absolute value

Decision rule

If $P_t > 0.53$ P = 1; else P = 0

If P = 1 change rates

Net share rate (end-quarter)

$$\Delta RSNE = \underset{(4.4)}{0.19428} - \underset{(10.8)}{0.27324}[RSN_{-1} - RLAE(1 - \frac{T\ R}{100})]$$

$\bar{R}^2 = 0.60$ se = 0.21 dw = 1.8

Estimation period 1958Q1 - 1979Q2

(only for quarters when share rate was changed)

$$RSGE = \frac{RSNE}{1-TYR/100}$$

Cost of deposits to societies

$$RSE^* = \frac{RSNE}{1-TCR/100}$$

If P = 0 no changes to rates

$$RSNE = RSNE_{-1}$$

$$RME = RME_{-1}$$

Number of changes in rates in last year

$$NCHANGE = \sum_{i=1}^{4} P_{-i}$$

Time since last change in rates

$$\text{If } P_{-1} = 1 \text{ QUARTER} = 0$$

$$\text{If } P_{-1} = 0 \text{ QUARTER} = \text{Min}(\text{QUARTER}_{-1}+1,3)$$

Share rate - average quarter

$$RSN = \frac{RSNE + RSNE_{-1}}{2}$$

$$RSG = RSN/(1-TYR)$$

$$RM = \frac{RME+RME_{-1}}{2}$$

Net inflows of shares and deposits

$$\frac{NIFL}{PC} = \underset{(10.6)}{-1512.458} + \underset{(14.4)}{0.15439}\frac{HDI-ICA}{PC} + \underset{(19.7)}{120.07654}(RSG-RLA)$$

$$+ \underset{(4.0)}{161.79181}\, DNSC(RSG-RNSC) + \underset{(2.1)}{31.46308}\Delta(RSG-RUKG).$$

$\bar{R}^2 = 0.90$ se = 76.1 dw = 1.75

Estimation period 1965Q1 - 1978Q4

Interest credited to accounts

$$ICA = \underset{(14.0)}{10.247} + \underset{(256.0)}{0.71247}\ SI.$$

$\bar{R}^2 = 0.99$ se = 3.1 dw = 0.50

Estimation period 1965Q1 - 1978Q2

Net interest earned on building society shares and deposits

$$SI = 0.97.\frac{RSN}{400}.\left(\frac{DEP+DEP_{-1}}{2}\right)$$

Net receipts of shares and deposits

$$NREC = NIFL+ICA.$$

Shares and deposits at end-quarter

$$DEP = DEP_{-1}+NREC.$$

Appendix 2

List of variables

DECL = dummy to take account of the fact that societies are reluctant to change their rates in the period before a general election [= 1 in quarter before an election].

DEP = shares and deposits outstanding at end-quarter (£ millions).

DLOAN = dummy variable to take account of the government loan to societies in 1974 in return for not raising their rates.

DNSC = dummy variable = 1 in the three months following the issue of a national savings certificate.

GOVL = net receipt/repayment of government loan to societies in 1974/75. See DLOAN (£ millions).

HDI = estimate of households' disposable income (£ millions) = personal disposable income less current grants; net saving by life assurance companies and pension funds; personal sector stock appreciation; and imputed rent of owner occupiers; plus households' gross interest payments.

ICA = interest credited to accounts (£ millions).

k = threshold for a change in building society rates.

LIQ = proxy for societies' liquidity ratio (per cent).

LIQ* = estimate of societies' desired liquidity ratio (per cent).

MORT = mortgages outstanding at end-quarter (£ millions).

NADV = net advances of mortgage principal (£ millions).

NCHANGE = number of times in which societies' rates have changed in the last twelve months.

NIFL = net inflows of shares and deposits (£ millions).

NREC = net receipts of shares and deposits (£ millions).

P = estimate of pressure for a change in building society rates (O>P>1).

PC = consumer price deflator (1975 = 1).

PLIQ = planned liquidity (per cent).

PNH = index of new house prices (1975 = 1).

QUARTER = number of quarters since last change in building society rates.

RLA, RLAE = three-month local authority deposit rate - average and end-quarter (per cent).

RM, RME = mortgage rate - average and end-quarter (per cent).

RSE* = cost to societies of shares and deposits (per cent).

RSG, RSGE = share rate grossed up at basic tax rate - average and end-quarter (per cent).

RSN, RSNE = net share rate - average and end-quarter (per cent).

RSNC = gross return on national savings certificates (per cent).

RUKG = yield on 20-year gilt-edged stocks (per cent).

SI = interest paid to building society shareholders and depositors (£ millions).

TCR = composite tax rate (per cent).

TYR = basic rate of income tax (per cent).

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