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An Econometric Model of Building Society Behaviour in Ireland

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Précis: This paper presents a quarterly model of Irish building society behaviour over the period 1973–78. The model attempts to explain the major variables in the incremental balance sheet with special emphasis on the relationships between mortgage supply, interest rates and the growth of building society liabilities. An important implication of the results is that variations in mortgage supply are substantially influenced by the public's desire to accumulate shares and deposits which appears to be more responsive to real income growth than to changes in relative interest rates.

I INTRODUCTION

Building societies are mutual or non-profit-making financial institutions which intermediate between the markets for mortgage loans and saving deposits. In Ireland, as in the United Kingdom, building societies have progressively become the major source of private housing finance and important collectors of private savings. As a consequence building society operations may be assumed to have a significant influence both upon the level of activity in the private residential construction sector and the pattern of aggregate private net saving.

The aggregate Irish building societies' balance sheet for September 1973 and 1978, respectively, is shown in Table 1 below. As can be seen building society assets have grown considerably over this period and this remains true when the figures are deflated by the Consumer Price Index or, more appropriately (since building societies are mainly in the market for housing finance), an index of house prices.

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Table 1: *Assets and liabilities of Irish Building Societies, 1973 and 1978*

	September 1973 (£000s)	*September 1978 (£000s)*
Liabilities		
Shares and Deposits	170,445	582,800
Loans (from banks)	2,580	5,700
Reserves	7,355	31,300
Other liabilities	1,705	10,100
Assets		
Mortgages	149,363	478,700
Bank balances	8,977	33,300
Investments	19,588	103,300
Other assets (including premises)	4,157	14,600

Source: Central Bank of Ireland, Quarterly Bulletin.

This paper presents a quarterly econometric model which attempts to explain the behaviour of Irish building societies over the period 1973–1978. The construction of such a model is justified, not only by the importance of these institutions in the social and economic framework, but also by the exceptionally interesting theoretical and empirical problems which their modelling presents.

The remainder of the paper is divided into three parts. The first describes the theoretical specification of the model employed. The second part discusses the estimation procedure adopted and presents estimates of the stochastic equations. The third and final sections attempt to analyse the results obtained and offer some conclusions. A full description and statement of the data used is appended.

II THE MODEL

The model presented in this section is specified to explain the behaviour of the major variables in the building societies' aggregate balance sheet. The following system of identities and stochastic equations describe the structure of the model:

$$GA_t + \Delta LA_t + \Delta ONA_t \equiv \Delta S_t + \Delta R_t + REP_t \quad (1)$$

$$\Delta R_t \equiv MR_t\,(M_t) + GR_t\,(LA_t) - SR_t\,(S_t) - V_t \quad (2)$$

$$M_t \equiv M_{t-1} + GA_t - REP_t \quad (3)$$

$$SR_t = a_0 + a_1 BR^e_t + U_{it} \qquad a_1 > 0 \tag{4}$$

$$BR^e_t = (1-Z) \sum_{i=0}^{n} Z^i BR_{t-1} \qquad 0 < Z < 1 \tag{5}$$

$$MR_t = b_0 + b_1 SR_t + U_{2t} \qquad b_0, b_1 > 0 \tag{6}$$

$$(\frac{S}{P})_t = k_1 (\frac{S}{P})^*_t + (1-k_1) (\frac{S}{P})_{t-1} \qquad 0 < k_1 < 1 \tag{7}$$

$$(\frac{S}{P})^*_t = c_0 + c_1 Y_t + c_2 SR_t + C_3 BR_t + c_4 I^e_t + U_{3t} \tag{8}$$

$$c_1, c_2 > 0 \quad c_3, c_4 < 0$$

$$I^e_t = (1-x) \sum_{i=0}^{\infty} x^i I_{t-i-1} \qquad 0 < x < 1 \tag{9}$$

$$APP_t = k_2 [M^*_t - M_{t-1}] + k_3 REP_t + U_{4t} \quad k_2, k_3 > 0 \tag{10}$$

$$M^*_t = m_0 + m_1 S_t + m_2 MR_t + m_3 GR_t + U_{5t} \tag{11}$$

$$m_1, m_2 > 0, \quad m_3 < 0$$

$$GA_t = \sum_{i=0}^{n} w_i APP_{t-i} + U_{6t} \tag{12}$$

where
GA = building societies' gross mortgage advances (£m)
LA = building societies' liquid assets, net of bank loans (£m)
S = building societies' stock of shares and deposits (£m)
R = building societies' stock of reserves (£m)
REP = repayments of principal on outstanding mortgages (£m)
M = building societies' stock of mortgages (£m)
V = building societies' advertising and management expenses (£m)
SR = interest rate on building societies' shares and deposits (%)
MR = mortgage interest rate (%)
GR = Government three-year bond rate (%)
BR = interest rate on deposits in the Associated Banks under £5,000 (%)
P = money price index
Y = aggregate real income (£m)
I = actual rate of price inflation (%)
APP = building societies' mortgage approvals (£m)
ONA = buildings societies' other net assets (£m)
* = desired level of a stock variable
e = expected level of a variable
t = time subscript indicating the value of a variable in period t
U_{it} = error term in a stochastic equation.

The identity (1) is the building societies' aggregate incremental balance sheet. For given changes in other net assets (which include premises and are assumed to be exogenous), (1) defines gross additions to building societies' assets as being equal to the total inflow of funds via shares and deposits, reserves and repayments of principal on existing mortgages. Identity (2) defines the change in reserves as net interest revenue minus advertising and management expenses, while (3) defines the mortgage stock as being equal to M_{t-1} plus net advances.

Equations (4), (5) and (6) deal with the determination of building societies' interest rates. The interaction of mortgage demand and supply should, in principle, be sufficient to determine the equilibrium or market-clearing value of the mortgage rate. Consequently, we should be able to write a relationship of the form

$$MR = f(ZD, ZS)$$

where ZD and ZS are vectors of exogenous variables determining demand and supply, respectively. Unfortunately, the determination of MR is somewhat complicated by the well-known tendency of buildings societies to employ credit rationing. That is, in a situation of excess demand for mortgages, building societies typically allocate the available mortgage supply on a non-price basis rather than permit the market to be cleared by an appropriate interest rate adjustment. Conversely, when mortgage demand is relatively weak, building societies may delay reducing the mortgage rate and opt for short-run additions to their liquidity portfolios.

To avoid the considerable econometric difficulties associated with this problem, we employ the much simpler hypothesis that building societies are passive interest rate adjusters, setting the rate on shares and deposits according to their expectations of interest rates offered by competing institutions. Equation (4), therefore, specifies the share/deposit rate as a function of the expected rate on deposit accounts in the Associated Banks, while (5) employs an adaptive expectations model to determine BR^e_t. Substituting for BR^e in (4) and transforming the result via the Koyck transformation yields the following estimating equation:

$$SR_t = a_0 (1-Z) + a_1 (1-Z)BR_t + Z(SR_{t-1}) + (U_{1t} - ZU_{1t-1}) \qquad (4a)$$

As building societies tend to move the mortgage rate simultaneously with share and deposit rates, we assume that MR is a simple "mark-up" on SR as shown by Equation (6).

Equations (7) and (8) assume that the public's holding of building societies' shares and deposits can be explained by the well-known partial adjustment mechanism. The parameter k_1 in Equation (7) indicates the proportion of the desired change in the stock of shares and deposits which is achieved in the current quarter, while Equation (8) defines the public's desired stock as a function of real income,[1] relative interest rates and the expected inflation rate which is used as a measure of the nominal return on wealth held in the form of physical goods.[2] We also assume that the demand for shares and deposits is homogeneous of degree one in the money price level P and that the expected inflation rate can be proxied by the adaptive expectations model as given in Equation (9). This is a standard, though somewhat naive, expectations generating mechanism. For evidence of the applicability of such a mechanism and comparison with direct expectations data, see Turnovsky (1970).

The final set of Equations (10)–(12) deal with the mortgage market. In contrast to several other studies of building society behaviour, mortgage approvals rather than gross advances are treated as the appropriate supply variable on the assumption that loans are not necessarily paid during the quarter in which they are approved.

The supply of mortgage credit as defined in Equations (10) and (11) is assumed to depend upon the discrepancy between the desired mortgage stock and the actual stock, and upon repayments of principal. The desired stock is specified as a function of a scale variable (share and deposit liabilities) and the relative return on mortgage lending. We note that Equation (10) has the steady state property of defining equilibrium supply as a function of repayments only. That is, when the actual mortgage stock achieves its desired level, then

$$APP_t = k_3\ REP_t + U_{4t}$$

Therefore, *a priori,* we would expect the estimate of k_3 to be close to unity. Finally, Equation (12) specifies gross advances per quarter as a function of both current and past mortgage approvals.

The balance sheet variables, REP and ONA, are assumed to be exogenous. An attempt to model REP in terms of current and past values of the mortgage stock was unsuccessful.[3] Substituting for $(\frac{S}{P})^*$, I^e and M^* in (7), (8) and (10) yields a model consisting of five stochastic equations and three identities in the eight endogenous variables, LA, R, M, SR, MR, S, APP and GA. All other variables including advertising and management expenses, V, are assumed to be exogenous.

1. Official Irish data do not provide a quarterly income series. Average weekly earnings in the transportable goods industries are used as a proxy.

2. We have assumed that investors have static expectations concerning interest rates. In part this is an analytical simplification, but some justification is given by the unsatisfactory performance of autoregressive schemes as predictors of interest rate movements.

3. For successful modelling of REP, see Spencer and O'Herlihy (1972).

III ESTIMATION AND RESULTS

The structure of the model presented above permits a relatively straightforward estimation technique to be employed. The stochastic equations of the system are recursive in form and this is clearly apparent when we examine their structural matrix in Table 2.

The matrix is triangular. If we assume in addition that the variance-covariance matrix of structural disturbances is diagonal, ordinary least squares estimates are maximum likelihood under the standard assumptions of zero mean and constant variances of the disturbances. The diagonality assumption, implying the independence of disturbances across structural equations, is a strong assumption which considerably simplifies the estimation of the system.[4]

Table 2: *Coefficients of endogenous variables*

Equation	*SR*	*MR*	*S*	*APP*	*GA*
4a	1	0	0	0	0
6	$-b_1$	1	0	0	0
(7), (8) and (9)	$-k_1c_2$	0	1	0	0
(10) and (11)	0	$-k_2m_2$	$-k_2m_1$	1	0
(12)	0	0	0	$-W_0$	1

The use of an adaptive expectations model to proxy I_t^e in the shares and deposits equation creates the difficulty that the appropriate Koyck transformation procedure yields an estimating equation which is "over-identified" in the sense that the number of estimated coefficients exceeds the number of parameters. To cope with this situation, we employed a maximum-likelihood search procedure to obtain a direct estimate of the adaptive expectations parameter, x.[5] Finally, in an effort to minimise problems caused by collinearity between time series on interest rates, we used the differences (SR – BR) and (MR – GR) in the shares and deposits and mortgage approvals equations, respectively.

The model was estimated using quarterly data for the period 1970 (IV) – 1977 (II). A full description of the data is given in the appendix. The results

4. For a discussion of this technique and a proof of the assertion, see Theil (1971). Note also that the price level, P, has been set equal to unity in the structural matrix.

5. The structural equations are assumed to be serially independent. For a description of a search procedure, see Klein (1958). For a search method when the disturbances are serially correlated, see Dhrymes (1969).

were as follows:

(a) *Share Rate*

$$SR_t = 2.41 + 0.58\,BR_t + 0.16\,SR_{t-1}$$
$$(4.8)\quad(8.63)\quad(1.74)$$

$\bar{R}^2 = 0.85$ DW = 1.47 'h' = 1.53

(b) *Mortgage Rate*

$$MR_t = 3.63 + 1.01\,SR_t$$
$$(4.45)\quad(8.88)$$

$\bar{R}^2 = 0.74$ DW = 1.74

(c) *Shares and Deposits*

$$\left(\frac{S}{P}\right)_t = -0.139 + 0.015Y_t + 0.006\,\frac{(SR_t - BR_t)}{1 - T} - 0.0025(1-x)\sum_0^{\infty} x^i I_{t-i-1} + 0.91\left(\frac{S}{P}\right)_{t-1}$$
$$(2.51)\quad(3.32)\quad(2.17)\quad(5.67)\quad(23.97)$$

$\bar{R}^2 = 0.99$ DW = 1.4 'h' = 1.56 x = 0.01 T = marginal tax rate

(d) *Mortgage Approvals*

$$APP_t = 3.538 + 0.492\,S_t + 1.18\,(MR_t - GR_t) - 0.559\,M_{t-1} + 0.89\,REP_t$$
$$(1.41)\quad(4.1)\quad(1.9)\quad(3.47)\quad(2.26)$$

$\bar{R}^2 = 0.79$ DW = 1.85 D = 0.22

(e) *Gross Advances*

	Almon Variables				
	A_1	A_2	A_3	R^2	DW
Regression coefficient	0.189	0.216	0.108	0.98	1.35
t-ratio	(5.95)	(5.42)	(1.50)		

Unscrambled Almon Variables

Lag	*Weight*	*t-statistic*
0	0.135	3.09
1	0.207	8.41
2	0.223	4.80
3	0.188	3.70
4	0.108	1.50

Mean lag = 1.92 Standard error = 0.225

Sum of weights = 0.861 Standard error = 0.022

Figures in parentheses are t-ratios, $\bar{R}^2$ is the value of R^2 adjusted for degrees of freedom, DW is the Durbin Watson statistic (not applicable, though reported, for equations with lagged values of the dependent variable), 'h' is the Durbin 'h' statistic, and D is the autocorrelation coefficient.

IV INTERPRETATION

(a) *The Share and Mortgage Rate Equations*

In both of these equations the coefficients have the expected signs and all are significantly different from zero at the five per cent level. Solving the estimated coefficients of the share rate equation gives $a_0 = 2.87$, $a_1 = 0.69$ and $z = 0.16$ which implies that a one percentage point rise in the expected level of BR causes SR to rise by 0.69 of a percentage point. The estimate of the adaptive expectations parameter z suggests that expectations are extrapolative, rather than regressive, with substantial weight being given to relatively recent changes in BR. The short-run responsiveness of the share rate with respect of BR is 0.58 whereas the long-run responsiveness is 0.69.[6] The relatively low value of the t-ratio for the coefficient of the lagged dependent variable, SR_{t-1}, does, however, cast some doubt on the use of an adaptive expectations mechanism in this case. This can be seen by comparing the simple and partial correlation coefficients between SR_t and SR_{t-1} indicating, respectively, the proportion of the variance in SR_t explained by SR_{t-1} alone and the proportion of the variance in SR_t explained by SR_{t-1} after the influence of BR has been taken into account. The value of the simple correlation coefficient is 0.36 and that of the partial correlation coefficient is 0.116. Hence, once the contribution of BR to the variance of SR has been allowed for, inclusion of the variable SR_{t-1} makes relatively little additional contribution.

The estimated coefficient of the mortgage rate equation, $b_1 = 1.01$, would tend to support the mark-up hypothesis used to generate this equation. A single percentage point rise in the share rate is translated into a very slightly greater increase in the mortgage rate.

(b) *The Mortgage Approvals Equation*

The estimated coefficients of the mortgages equation imply that $k_2 = 0.56$, $k_3 = 0.89$, $m_0 = 6.33$, $m_1 = 0.88$ and $m_2 = -m_3 = 2.11$. The long-run propensities to lend are thus 0.88 from shares and deposits and 0.89 from repayments of principal. Using end-of-sample values, the short-run elasticity of approvals is 5.6 with respect to S_t, but only 0.36 with respect to MR_t, which

6. Bias may, however, be a problem in these results. See footnote 8 below.

suggests that the inflow of funds via shares and deposits is the dominant variable in explaining lending behaviour. Although the desired level of the mortgage stock is not directly observable, it is reasonable to assume that the ratio of S_t to M^*_t would be greater than unity while the ratio of MR_t to M^*_t would be considerably less than unity in any given quarter. Estimates of 0.88 for m_1 and 2.11 for m_2, therefore, suggest that M* is more elastic with respect to S than with respect to MR. For example, using the end-of-sample values of S, MR and GR together with the estimates of m_0, m_1 and m_2 to proxy M* from (11) gives $\ell_{M^*, S} = 0.98$ and $\ell_{M^*, MR} = 0.06$.

The estimated value of $k_2 = 0.56$ indicates a relatively fast speed of adjustment of the actual mortgage stock to its desired level. Building societies require less than four quarters to eliminate 95 per cent of the discrepancy between the desired and actual mortgage stocks.

Finally, since the influence of excluded variables upon the level of mortgage approvals is highly likely to extend over many quarters there is, *a priori,* a reasonable likelihood that serial correlation will be a problem with an approvals equation of the form employed in this model. To cope with this problem, the approvals equation was estimated using the Cochrane-Orcutt iterative technique. This procedure yields an estimate of 0.22 for the first-order coefficient of correlation between the residuals.

(c) *The Gross Advances Equation*

Equation (12) specifies gross advances as a function of lagged mortgage approvals. Experimentation with different lag structures revealed that the "best" results were obtained when the lag profile is assumed to extend over four quarters. The equation was estimated using the Almon distributed lag on the assumption that the weights on lagged approvals follow a third-order polynomial with the constant term suppressed. The lag profile suggests that the rate at which approvals are disbursed rises to a peak after two quarters and declines thereafter. Note that the weights, W_i, would sum to unity only if all approvals were actually paid out by building societies. In practice, some mortgage approvals will not be taken up by the borrower which explains why the W_i sum to less than one.

(d) *The Shares and Deposits Equation*

Building societies pay interest after income tax has been deducted and interest earned on Associated Bank deposits is either wholly or partially exempt from income tax. In such circumstances it is plausible that investors respond to grossed up interest rates. To allow for this, both SR and BR were grossed up using a marginal tax rate of 35 per cent throughout the sample period, except for the third quarter of 1975 when 38.5 per cent was used.

The value of $k_1 = 0.09$ indicates that investors adjust their actual stock position towards their desired stock relatively slowly with only nine per cent of the adjustment to a change in a determining variable taking place in the first quarter. This implies that the public require approximately eight years to eliminate 95 per cent of the discrepancy.[7] In contrast to this restrained stock adjustment process, the estimated value of $x = 0.1$ implies that expectations of inflation are highly extrapolative with the weights assigned to lagged inflation terms declining to 0.009 after only three quarters.[8]

A clear implication of the approvals equation is that mortgage lending may be substantially influenced by the public's desire to accumulate building societies' shares and deposits. Estimates of the shares and deposits equation are, therefore, of considerable interest. Using the share rate equation, the total short-run impact of a one percentage point change in BR is given by

$$\frac{d(S/P)_t}{dBR_t} = \frac{0.006\ (0.58-1)}{1-T}$$

which equals -0.0039 for $T = 0.35$. A one percentage point increase in BR will, therefore, reduce share and deposit demand by £4,000 ("real" pounds) in the current quarter. The impact upon the flow of mortgage approvals is given by

$$\frac{dAPP_t}{dBR_t} = \left(\frac{\partial APP_T}{\partial S_t}\right)\left(\frac{\partial (S/P)_t}{\partial BR_t}\right) P_t + \left(\frac{\partial APP_t}{\partial MR_t}\right)\left(\frac{\partial MR_t}{\partial SR_t}\right)\left(\frac{\partial SR_t}{\partial BR_t}\right)$$

$$= -0.0019\ P_t + 0.6912 \text{ for } T = 0.35$$

Using the end-of-sample value for P (285.7), $dAPP_t/dBR_t$ is equal to 0.142 – that is, given P at 285.7, a one percentage point increase in BR leads to a rise in mortgage approvals of £142,000 in the current quarter. Computing the respective short-run elasticities for end-of-sample values gives

$$E_{S/P},\ BR = -0.013$$

$$E_{APP},\ BR = 0.021$$

7. Hewitt and Thom (1978) report an estimate of 0.19 for k_1 using Northern Ireland data.

8. The presence of lagged values of the dependent variable in both the share rate and shares and deposits equations leads to the estimated coefficients being biased downwards in small samples under OLS estimation. Various corrections have been suggested in the literature, but Monte Carlo studies tend to suggest that ordinary least squares has the lowest mean squared error among the commoner techniques (see Copas, 1966). We have assumed the absence of serially correlated errors in both these equations. If this is not the case, then the bias will depend directly upon the sign of the autocorrelation coefficient (see Griliches, 1961). Malinvaud (1966) has, however, shown that the bias in these cases decreases with the addition of exogenous explanatory variables, though not to insignificant levels.

The corresponding real income elasticities are

$$E_{S/P}, Y = 0.217$$

$$E_{APP}, Y = 1.20$$

where

$$E_{APP}, Y = \left(\frac{\partial APP}{\partial S}\right) \left(\frac{\partial (S/P)}{\partial Y}\right) \left(\frac{Y}{APP}\right) P$$

An interesting feature of these results is that mortgage approvals respond positively to both interest rate and real income changes. The finding of a positive relationship between mortgage lending and interest rates may be thought surprising in view of the negative correlation between BR and shares and deposits. A rise in BR leads to a rise in the mortgage rate via the mark-up on the share rate which, given the yield on government securities, induces building societies to substitute mortgage lending for other assets. The net effect is, however, very small with a one percentage change in BR leading to a change in the nominal value of approvals of only 0.021 per cent. The relative elasticity of approvals with respect to income, on the other hand, is a reflection of the dominance of inflows via shares and deposits in explaining the level of mortgage approvals.

V CONCLUSION

The model presented above appears to be reasonably satisfactory in explaining the major variables in the incremental balance sheet. The model does, however, exhibit a number of defects. One problem is that it approaches the mortgage market from the supply side and neglects mortgage demand. This may be justified on the assumption that building societies have operated in conditions of excess demand for housing finance during the period under consideration and that, consequently, only the supply constraint is binding. More generally, however, it would have been desirable to estimate a mortgage demand equation which would have interacted with the demand for shares and deposits. The latter will depend, in part, upon present and future mortgage demand because of rationing rules such as consistent saving behaviour and minimum deposit requirements. We were, however, unable to estimate a satisfactory mortgage demand equation with the available data which precluded this approach.

A further criticism of the model is its *ad hoc* nature in the sense that the behavioural equations are not derived from explicit choice theoretic foundations. The reason for pursuing an institutional approach is that there is no obvious or commonly agreed objective function which adequately describes building society behaviour. Building societies do not have proprietors apart from those who hold shares and accumulated surpluses are typically added to reserves rather than distributed to a distinct group of people. Consequently, it would be erroneous to treat them as profit-maximising bodies. In addition, there is comparatively little evidence that the societies seek to maximise in terms of growth or any other single objective. There is a case for viewing these institutions as satisficers in a quasi-monopolistic framework, but the state of the art is insufficiently advanced to yield quantitatively testable hypotheses at this stage.

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APPENDIX

Variable	*Description*	*Mean*	*Range*
Mortgages (M)	Stock outstanding at end of each quarter	176.23	66.72/355.58
Shares and deposits (S)	Stock outstanding at end of each quarter	208.69	79.84/427.9
Gross advances (GA)	Value of loans paid per quarter	14.24	5.65/30.79
Repayment of principal (REP)	$GA_t - (M_t - M_{t-1})$	Computer Generated	
Share and deposit rate (SR)	Quarterly average of monthly BS share rate	10.93	8.46/14.63
Mortgage rate (MR)	Quarterly average of monthly BS mortgage rate	6.84	5.85/8.57

Bank deposit rate (BR)	Quarterly average of monthly data on the Associated Banks's rate on deposits under £5,000	9.311	4.62/13.82
General price level (P)	Consumer Price Index (1968 = 100)	181.0	118.4/285.7
Real income (Y)	Average earnings in the transportable goods industries, at 1968 prices	19.09	16.10/21.99
Approvals (APP)	Value of loans approved per quarter	18.16	6.7/41.43

Sources: GA and APP, Quarterly Bulletin of Housing Statistics (Department of the Environment); all others, Central Bank of Ireland, Quarterly Bulletin.