

A Preliminary Study of Credit Rationing in Ireland

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Précis: In their seminal study of credit rationing, Jaffee and Modigliani (1969) hypothesised that an intensification of the extent of credit rationing will manifest itself in a movement in banks' loan portfolios toward prime borrowers. In this paper, the hypothesis is tested in the context of Irish data. The Jaffee-Modigliani approach received moderate support for the larger of two groups of banks for which it was tested. In a small open economy such as Ireland's, with a fixed exchange rate and facing high capital mobility, interest rates are effectively exogenously determined and thus credit rationing may be the most important channel in transmitting monetary policy actions to the real economy.

I INTRODUCTION

In this paper we consider the applicability of a recently developed theory of credit rationing to bank behaviour in Ireland. Since loan rates tend to be sticky, credit rationing is likely to exist from time to time and, for this reason, the discrepancy between the *ex ante* demand for credit and the actual volume of credit extended by banks is likely to be a strategic linking variable between the financial and real sectors of the economy. In an economy as open as Ireland's and with a fixed exchange rate policy, the predominant effect of monetary policy measures is on external reserves. To the extent that monetary policy actions affect domestic economic aggregates, they are likely to do so via reduced credit availability or credit rationing (since loan rates are sticky). If credit rationing does exist, it will have its effect on the expenditure plans of less credit-worthy borrowers. It could be expected that, to the extent that prime borrowers may be affected by rationing, they could arrange alternative financing abroad or from non-bank financial

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intermediaries. For a profit-maximising bank, prime borrowers will not tend to be rationed; any rationing that does occur will be concentrated on non-prime borrowers. In fact, the empirical measure of credit-rationing employed below is the ratio of prime to total loans granted.

The structure of the paper is as follows. In Section II, we outline the theory of credit rationing, as developed in the seminal paper by Jaffee and Modigliani (1969), together with a suggested empirical measure and test of credit rationing. Section III outlines some features of the Irish credit market pertinent to the question of credit rationing. This section also notes the actions of the Central Bank that have impinged on this issue. The results of the empirical analysis are presented in Section IV, while the final section summarises the content of the paper.

II THE THEORY OF CREDIT RATIONING

Credit rationing exists when there is an excess demand for bank loans at the ruling interest rate on bank loans. Jaffee and Modigliani (1969) distinguished two forms of credit rationing. *Equilibrium rationing* is defined as credit rationing which occurs when the loan-rate is at its long run equilibrium level. (The paradoxical nature of this statement will be addressed below.) *Dynamic or disequilibrium rationing* is defined as credit rationing which may occur in the short-run when the loan rate has not adjusted fully to its long-run equilibrium level. Three elements enter into the analysis of both types of rationing: the demand for loans, the supply of loans and the loan rate.

In an analysis of the rationing phenomenon, a loan supply or loan offer curve is first developed. Every economic entity, whether an individual or an enterprise, has an expected value associated with the end of each period for which a contracted loan repayment is due. From the bank's viewpoint, the expected value at the end of each period is derived from a probability density function associated with each possible outcome. This density function reflects the bank's assessment of factors such as the credit-worthiness of the customers based on past experience. If the sum of the actual end-of-period values is less than the full amount of the contracted repayments, the borrower will default on the loan in full or in part. In the case of a firm, it is not necessary for the specific project or purpose for which the borrowing was incurred to generate sufficient funds to remunerate the loan; a firm will endeavour to meet the contracted repayments by utilising funds earned from its other operations if at all possible in order to maintain its credit-worthiness and avoid default.

Corresponding to any loan that a bank may consider offering to a borrower, there is an expected profit for the bank. This expected profit is a

function of the loan size, the loan rate and the density function for the end-of-period value of the agent. An optimal loan to a customer is defined as the loan size which maximises the bank's expected profit from that customer for a given loan interest rate. The bank's loan *offer curve* for that customer is then the set of optimal loans corresponding to different loan rates. The offer curve is given by the first order condition for the maximisation of expected profit and is the implicit solution of this equation for loan size, L , in terms of the loan rate, R . This offer curve is backward bending because as the loan rate becomes larger and larger, the probability of the firm defaulting on the contracted repayment increases; the bank's optimal loan offer will decrease, therefore, as interest rates become ever higher. It can be shown also that expected profits increase along the offer curve at progressively higher interest rates. Such a loan offer or supply curve, $L(R)$, is illustrated in Figure 1, together with a demand curve, $D(R)$. It will be seen that the offer curve is a vertical line segment when the loan rate is equal to the opportunity cost rate; when there is no risk of default, the loan offer curve is this vertical line.

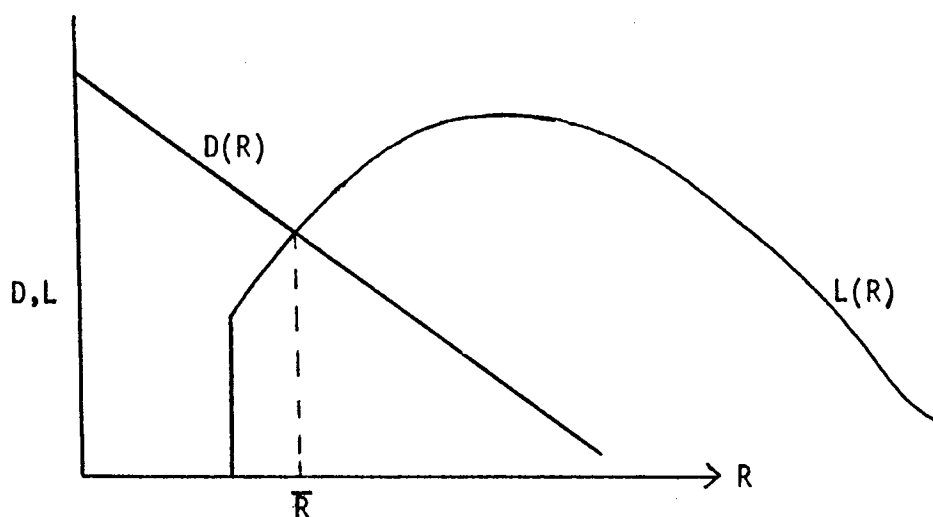


Figure 1: Demand for, and supply of, bank loans.

The degree of competition between banks is an important determinant of whether or not credit rationing will be profitable for a bank. Reference to Figure 1 indicates that the interest rate $\bar{R}$ clears the market for bank loans. If an interest rate less than $\bar{R}$ were charged by the bank, there would be credit rationing since the demand is greater than the supply at each $R < \bar{R}$. If the bank is a discriminating monopolist (i.e., if it maximises its profit with respect to each customer separately and charges each customer a

different interest rate), credit rationing is not profitable for the bank. The reason for this is that, since expected profits increase along the offer curve at higher interest rates and since the interest rate $\bar{R}$ is feasible, the bank will charge an interest rate at least as high as $\bar{R}$. If it chooses to charge an interest rate higher than $\bar{R}$, the volume of loans extended is constrained by the demand curve; for this case, the most profitable interest rate involves no credit rationing.

If, instead of a discriminating monopolist regime, we consider the case where a bank, for one reason or another, charges a common rate to a set of customers in a broadly similar risk category, it may be profitable for the bank to ration certain customers. Consider two customers, and let R^*_1 and R^*_2 be the optimal rates that a discriminating monopolist banker would charge customers 1 and 2, respectively. It can be shown (Jaffee and Modigliani, *op. cit.*, p. 857) that where a common optimal rate R^* is charged, it will lie in the interval (R^*_1, R^*_2) .

One can readily construct an example where the common optimal rate R^* is less than $\bar{R}_2$, the market-clearing rate for customer 2 (see Figure 2). Then, since $\bar{R}_1 \leq R^* \leq \bar{R}_2$, there will be no rationing of customer 1, but customer 2 will be rationed since the rate charged, R^* , is less than the market-clearing rate, $\bar{R}_2$, for customer 2; there is an excess demand for credit by customer 2 at the interest rate charged to him.

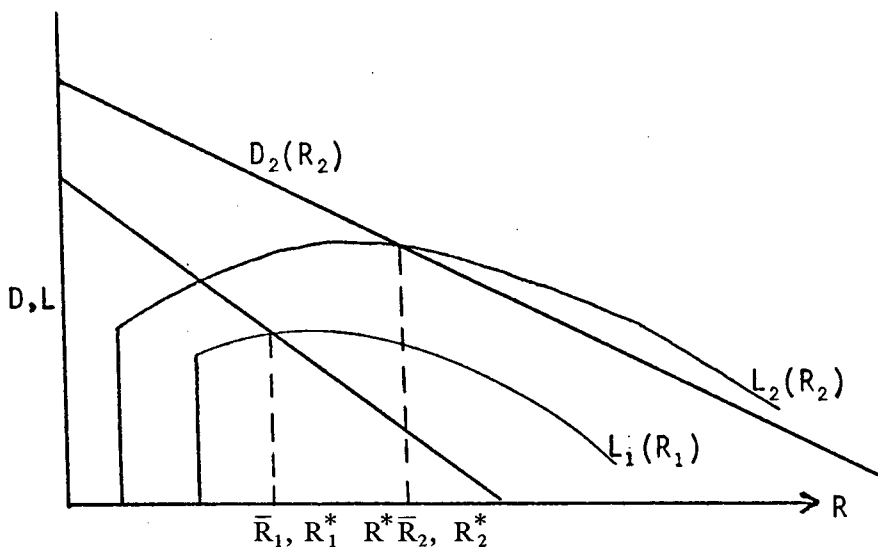


Figure 2: Common interest rate, R^* , charged; customer 2 rationed.

In practice, generalising to more than 2 customers, banks classify their customers into a small number of risk classes, to each of which a uniform loan rate is charged. The reasons for this may derive from legal restrictions,

considerations of goodwill and long-run profit maximisation and, perhaps, a degree of administrative convenience, etc. (see Anderson and Ostas, 1977, p. 27). If the common optimal rate, R^*_j , charged to all customers in the j -th class is such that for certain (more risky) borrowers R^*_j is less than the market-clearing rates for those customers, then it will be profitable for the bank to ration such customers. Such *equilibrium credit-rationing* is more likely to exist the smaller the number of classes of borrowers with an inevitably high degree of heterogeneity of borrowers in each class. Equilibrium credit rationing will be profitable as long as there are differential risks attached to borrowings by different customers and banks do not act as discriminating monopolists, charging a different optimal rate to each customer.

Aggregate equilibrium rationing, E , within a particular class charged a common loan rate can be written as the difference between loan demand and supply for all bank customers experiencing rationing. Thus,

$$E = \sum \max [D_i(R) - L_i(R), 0] \quad (1)$$

Dynamic rationing is defined as the quantity of excess demand for loans that arises due to the sluggish movement of interest rates to new equilibrium levels (for each category of borrower). The equilibrium loan rate can change as a result of shifts in demand schedules or in the supply or loan offer curve; the latter could be the result of a change in the opportunity cost for banks of extending loans or of a changed perceived probability of default as a consequence, for example, of changed economic conditions. Any development that serves to increase the equilibrium loan rate (or set of rates for various classes of borrowers) while the quoted rate remains unchanged implies an increase in credit rationing, assuming as a starting point that the equilibrium rate is not less than the quoted rate. An increase in the opportunity cost of loans, an increased probability of insolvency or an upward shift in demand are all factors that tend to increase the degree of credit rationing, and this will tend to fall most heavily on customers who would be rationed in equilibrium, i.e., the more risky customer, while less risky borrowers will be affected least, if at all. Thus, equilibrium and dynamic rationing tend to be mutually reinforcing.

While the theory of credit rationing outlined above is constructed on the assumption of a single heterogeneous group of borrowers charged a common loan rate, there is normally more than one class of borrower. In the simplest case, for example, we might have prime and non-prime borrowers. In the model, the former are perceived by banks as being risk-free and constituting, therefore, a homogeneous group of borrowers. This implies that, within the prime group, there should be little or no equilibrium credit rationing because the common loan rate charged is the optimal one for each homogeneous

customer. Also, the comparatively risk-free nature of prime borrowers implies that the loan offer curve to such a borrower is a vertical line or very close to being a vertical line. Figure 3 illustrates that, for the case of a risk-less borrower, dynamic credit rationing will not occur. With an interest rate, R , being charged, the customer's demand for loans is satisfied at that rate. When, as the result, say, of an increase in the opportunity cost of loans, the equilibrium loan rate increases to R^1 , there will be no dynamic credit rationing if, for various reasons, the bank is slow to increase the actual loan rate to R^1 ; the reason for this is that the initial loan offer curve is still the operative one until the actual quoted loan rate is increased to R^1 . It is clear, in any event, that loans are demand-determined with the result that there can be no dynamic credit rationing.

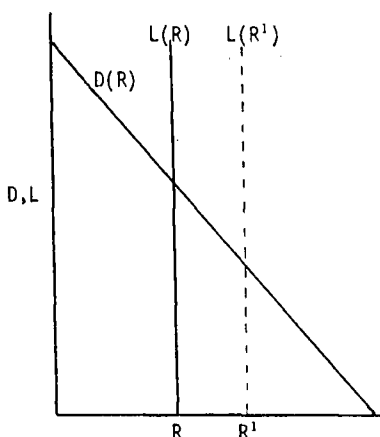


Figure 3: Case of risk-free borrower.

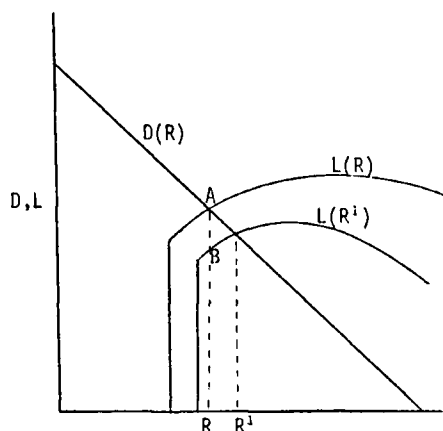


Figure 4: Case of risky borrower.

If we consider the non-prime category of borrower, on the other hand, a wide range of customers with different riskiness is encompassed within this group. A common rate charged, therefore, must result in some degree of equilibrium credit rationing. In addition, since a non-vertical offer curve faces these borrowers, dynamic rationing is likely to exist from time to time. In Figure 4, for example, we illustrate the case of such a bank customer who, when the bank continues to quote the loan rate, R , although the loan offer curve has shifted down as a result of an increase in the opportunity cost, is rationed to the extent of AB . As the quoted loan rate is adjusted to the market-clearing or equilibrium rate, dynamic credit rationing is reduced *pari passu* and is eliminated entirely when the quoted rate is set equal to the new market-clearing rate.

These considerations imply that when two or more groups of borrowers are considered together, any credit rationing will affect the non-prime group(s). Since direct measures of *ex ante* customer demand and bank loan

supply are unavailable and, consequently, direct measures of the degree of credit rationing cannot be obtained, an operational measure of rationing is suggested by the proposition that an increase in aggregate credit rationing (which is the consequence of an increased positive divergence between the equilibrium and quoted loan rate) is associated with an increased share of risk-free or prime loans in the total loan portfolio of banks. Thus, the Jaffee-Modigliani (J-M) theory of credit rationing points to the employment of the prime to total loans ratio (H) as an index of credit rationing. A test of the theory consists, therefore, in testing the hypothesis that there is a statistically significant and positive relation between H and the difference between the equilibrium loan rate and the actual loan rate -- that is,

$$H = a_0 + a_1 (R^*_L - R_L) + \epsilon \quad (2)$$

where H is the ratio of prime to total loans,

R^*_L is the equilibrium loan rate, and

R_L is the observed loan rate.

Before interpreting any empirical evidence based on equation (2), it is worth noting that there exists a relationship between the dependent variable, H , and the ideal index of credit rationing, $\hat{H}$, which measures the discrepancy between the supply of loans to, and the *ex ante* demand of, non-prime borrowers. This relationship is given by

$$H = \frac{1}{1 + B(1 - \hat{H})} \quad (3)$$

where B is the ratio of non-prime to prime *ex ante* demands. Clearly, the measure of credit rationing proposed by J-M is monotonically related to the ideal measure $\hat{H}$ if B is a constant.

If equation (2) above is a statistically insignificant relationship, the hypothesis proposed by the J-M theory is rejected. In essence, since $\hat{H}$ by definition is *fully* explained by such a relationship, rejection means that H and $\hat{H}$ are not significantly correlated. This rejection of the J-M theory further implies that it is primarily variation in relative *ex ante* demands, B , which is the dominant source of variation in H . (The obverse of the argument applies if a significant relationship is established.)

Contrary to the J-M argument, it is not possible to interpret the intercept term in equation (2) as a measure of equilibrium credit rationing because when R^*_L is equal to R_L , the intercept term comprises a component measuring equilibrium rationing, as well as a component for the average value of H in the absence of equilibrium credit rationing. It is not possible to obtain estimates of these separate components.

III INSTITUTIONAL ASPECTS OF THE IRISH CREDIT MARKET

We have seen above that a sufficient condition for equilibrium credit rationing is that there be less than perfect price discrimination on the part of banks, and a sufficient condition for dynamic rationing is that there be less than perfect flexibility of interest rate movements. In Ireland, both of these conditions are fulfilled. Since April 1972, borrowers have been aggregated into three categories (AAA, AA and A), while, prior to that date, a single loan rate was levied on all borrowers. (For a short period before April 1972, there were two overdraft rates in existence.)

Loan rates in Ireland are intimately related to UK lending rates and, consequently, are largely insensitive to local credit market conditions (see Browne and O'Connell, 1978); both Irish and UK loan rates change rather infrequently and in discrete steps. Apart from the virtual exogeneity of loan rates, there is an added reason why credit rationing might be important. From time to time, the Central Bank has urged ceilings on certain components of bank lending, as well as requesting that bank resources be channelled into "productive", rather than "non-productive", lending; at the same time, loan rates were normally left unchanged. Since "non-productive" borrowers fall predominantly into the high-risk, single A category of borrower, to the extent that the Central Bank measures have been effective there would have been an increase in credit rationing with its effects concentrated on non-prime borrowers. In this way, restrictive Central Bank measures could have enlarged the degree of credit rationing and increased the proportion of prime lending to total lending. (A more detailed account of monetary policy actions taken by the Central Bank is given in Armstrong and O'Connell, 1978.)

IV EMPIRICAL MODELS OF CREDIT RATIONING AND RESULTS

The Irish commercial banks comprise two main groups of banks, the Associated Banks and the non-Associated Banks; the former group concentrates on retail banking for the most part, while the latter specialises mainly in wholesale banking and instalment credit. We propose to test the Jaffee-Modigliani hypothesis for both groups of banks.

There are some practical difficulties encountered in the actual measurement of the rationing index, that is, the ratio of prime to non-prime loans (or, alternatively, prime to total loans). Exact data on lending under the three priority headings, AAA, AA and A, are available on an annual basis only from the annual term-lending survey. However, it is possible to consider, as an alternative, quarterly data on bank advances as compiled by the Central Bank. These data disaggregate advances into 22 categories. Although it is not possible to obtain from these categories aggregate lending to AAA borrowers

owing to the lack of correspondence between categories of borrowers in the AAA group and in the analysis of advances, by suitable aggregation of categories of borrowers in the analysis of advances it may be possible to obtain reasonably satisfactory substitutes for the operational measure of credit rationing. The dependent variable used in equation (2) is the ratio of all loans issued under categories AAA and AA together to total loans issued. This variable is denoted by H ; it should be stated that the numerator of the ratio can be obtained from the data on advances, although the two categories combined, AAA and AA, are somewhat more heterogeneous than one would like a prime category of borrowers to be. A second measure of the dependent variable used as the numerator of the ratio is total loans granted to certain subgroups in the AAA category which are set out individually in the analysis of advances. This narrower index was not successful in preliminary empirical work, perhaps because the magnitude of the loan amount extended to this more narrowly defined prime class of borrowers (the numerator) is very small.

The exogeneity of the Irish prime lending rate has already been adverted to (see Browne and O'Connell, 1978). In order to obtain an estimate of the market clearing rate, R^*_L , we employ the procedure suggested by Jaffee and Modigliani. Applying this approach to the Irish context gives the following equation for R^*_L :

$$R^*_L = a_0 + a_1(R_T + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3) \quad (4)$$

The underlying rationale is that, for profit-maximising banks, the marginal return from an additional loan, after adjustment for risk, liquidity and maturity, should equal the opportunity cost represented by the return on other assets, including those with a freely fluctuating market rate. The variable, R_T , is the Treasury Bill (Exchequer Bill) rate and the other terms reflect the liquidity value of Treasury (Exchequer) Bills. The second component, X_1 , is defined as the ratio of total deposits to holdings of Exchequer and Treasury Bills *less* unity (i.e., $DEP/ETB - 1$). The basic premise is that the liquidity yield of 90-day Government paper should decrease as holdings increase relative to deposit liabilities. In the limit, the liquidity yield goes to zero when all deposits are invested in 90-day Government paper and becomes infinite as Bill holdings approach zero. We expect β_1 to be positive.

The third component, X_2 , is the ratio of loans to non-loans in the portfolio. The rationale for this (see Jaffee, 1971) is that the opportunity cost of funds for loans is likely to rise when the share of the bank's assets in loans increases. However, this argument is not tenable in the Irish context because market interest rates, in effect, are determined exogenously. The inclusion of X_2 can be rationalised as follows: it can be considered as an adjustment to the required rate on loans arising from their relative illiquidity *vis-à-vis* short-term

Government paper. This illiquidity should increase as the ratio of loans to assets grows, and this effect is measured by $L/(A - L)$ where L is total loans and A is total assets in the portfolio. The illiquidity cost approaches zero as the loan portfolio approaches zero and becomes infinite as loans approach total assets. We expect the coefficient, β_2 , to be positive. Finally, the last term, X_3 , in the R^*_L equation is the change in X_2 and is designed to reflect additional liquidity costs arising from a short-run increase in loans as a result of a change in unutilised overdraft permissions that is beyond the immediate control of the banks. (See Whitaker, 1970, p. 5, for a more general discussion of this problem in the Irish context.)

Substituting equation (4) into equation (2) yields

$$H = a_0 + a_1 \{a_0 + a_1 (R_T + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3) - R_L\} + \epsilon \quad (5)$$

$$\text{i.e., } H = (a_0 + a_1 a_0) + a_1 a_1 R_T + a_1 a_1 \beta_1 X_1 + a_1 a_1 \beta_2 X_2 + a_1 a_1 \beta_3 X_3 \\ - a_1 R_L + \epsilon$$

It is possible to derive estimates of all the structural parameters from this reduced form equation, except for a_0 and a_0 .

Estimation of equation (5) as it stands imposes the equilibrium assumption that the actual prime to total loans ratio in bank portfolios is, in fact, that desired on the basis of the values of the independent variables. It is better to admit the possibility of a disequilibrium for the reason that the banks cannot readily adjust the composition of their loan portfolios within a very short-time period, if only because not all loans can be called in at will. A standard approach is the partial adjustment model from which can be derived a reduced form equation for estimation. In the present case, this yields the following reduced form equation:

$$H = \lambda(a_0 + a_1 a_0) + \lambda a_1 a_1 R_T + \lambda a_1 a_1 \beta_1 X_1 + \lambda a_1 a_1 \beta_2 X_2 + \lambda a_1 a_1 \beta_3 X_3 \\ - \lambda a_1 R_L + (1 - \lambda) H_{-1} + \lambda \epsilon \quad (6)$$

There are seven reduced form and eight structural coefficients; as in the case of equation (5), all the latter coefficients can be obtained, except for a_0 and a_0 . Finally, as an alternative to the linear relationship postulated between the credit rationing proxy, H , and the composite variable, $(R^*_L - R_L)$, we hypothesise that the relation is of a logistic kind. Such a specification recognises that the H ratio lies in the $(0, 1)$ interval. The formulation is as follows, where, for convenience, only one argument is included:

$$H = a/(1 + \exp(b + cx)) \quad (7)$$

In the present case, the numerator can be replaced by unity (the upper bound for the H ratio). Application of the logit transformation then leads to the following equation for estimation:

$$\ln (1/H - 1) = a_0 + a_1 R_T + a_2 X_1 + a_3 X_2 + a_4 X_3 + a_5 R_L \quad (8)$$

In summary, the equations for estimation are numbered (5), (6) and (8).

In the empirical work we regard bank portfolios, both within and without the state, as being managed as a single unit. Consequently, the independent variables in the above specifications that refer to bank balance sheet concepts (e.g., total deposits and total assets) comprise aggregates that are the sums of items "within the state" and "elsewhere".

The equilibrium version of the Jaffee-Modigliani credit rationing hypothesis, equation (5), is only moderately supported by the data for the Associated Banks. The empirical estimate of this model is

$$\begin{aligned} H = & 0.92 + 0.01 R_T - 0.00001 X_1 + 0.04 X_2 - 0.22 X_3 & (5a) \\ & (12.2) \quad (2.1) \quad (-0.1) \quad (0.8) \quad (-2.9) \\ & - 0.02 R_L - 0.08 DV & R^2 = 0.68; D W = 0.41 \\ & (-2.6) \quad (-3.8) \end{aligned}$$

The results indicate that, notwithstanding the reduction in efficiency deriving from first-order autocorrelation of residuals, variation in the H ratio is positively and significantly related to variation in the discrepancy between the equilibrium loan rate, as measured here, and the observed market rate. (See the coefficient on R_L .)

A dummy variable DV is included in the equation in order to take account of the discontinuity in the classification of borrowers from 1968 onwards. (A full explanation is given in the Appendix.) Some negative features of equation (5a) are the incorrect sign on X_3 , (i.e., $\Delta L/(A - L)$), the statistically insignificant coefficients on X_1 and X_2 (i.e., $DEP/ETB - 1$ and $L/(A - L)$, respectively), and the low value of the Durbin-Watson statistic. Adjustment of equation (5a) for first-order autocorrelation of the residuals (the estimated value of ρ is .8) results surprisingly in increases in the estimated standard errors of some of the coefficients.

The partial adjustment version of the Jaffee-Modigliani hypothesis performs reasonably well when tested with Associated Bank data. Specification (6) furnishes the following result¹:

1. Since a lagged dependent variable appears in equation (6a), the Durbin-Watson test statistic is biased towards acceptance of the null hypothesis of no first-order autocorrelation. Accordingly, the D-W statistic is not quoted in equation (6a).

$$\begin{aligned}
 H = & 0.19 + 0.008 R_T + 0.0001 X_1 + 0.05 X_2 - 0.2 X_3 & (6a) \\
 & (2.4) \quad (2.3) \quad (1.3) \quad (1.8) \quad (-4.5) \\
 & - 0.007 R_L - 0.04 DV + 0.72 H_1 (-1) \quad \bar{R}^2 = .89 \\
 & (-1.6) \quad (-3.1) \quad (10.6)
 \end{aligned}$$

The estimated coefficients of all of the variables, except X_3 , have the correct expected signs and are significantly different from zero at the five per cent level, with the exception of X_1 which is significantly different from zero at the 10 per cent level. The incorporation of the partial adjustment mechanism has altered the value of the coefficients somewhat and particularly the estimated value of the intercept term. Although undoubtedly equilibrium credit rationing is an important phenomenon, we cannot obtain a direct measure of it from the reduced form intercept term in equation (8a). Durbin's large sample h-test leads to rejection of the zero first order autocorrelation hypothesis at the conventional Type I error size. Consequently, we have applied a maximum likelihood estimation procedure to the partial adjustment specification, incorporating an adjustment for first order autocorrelation. This yielded the following equation:

$$\begin{aligned}
 H = & 0.11 + .005 R_T + .0001 X_1 + 0.04 X_2 - 0.17 X_3 - 0.004 R_L & (6b) \\
 & (1.7) \quad (2.1) \quad (0.9) \quad (2.1) \quad (-4.4) \quad (-1.3) \\
 & - 0.02 DV + 0.83 H_{-1} \quad \bar{R}^2 = .95 \quad DW = 2.1 \quad \rho = -0.38 \\
 & (-2.9) \quad (16.8)
 \end{aligned}$$

Most of the estimated coefficients and t-values are altered only slightly, while the explanatory power of the equation is similarly only marginally enhanced. The important features of equations (6a) and (6b) from the viewpoint of the present exercise is that the relationship between the H-ratio and the discrepancy between the equilibrium and market loan rates is preserved, although the statistical significance of the key coefficient associated with R_L is reduced somewhat. A plot of fitted against actual values of the dependent variable used in equation (6b), that is, $H - \rho H_{-1}$, is given in Figure 5. All of the major turning points and the almost monotonic downward trend in the actual value after 1968 Q1 are tracked quite well with a slight tendency to pick up non-existent variability after this date.

The logistic specification (equation (8) above) for the H ratio gives the following result:

$$\begin{aligned}
 \ln \left[\frac{1}{H} - 1 \right] = & -2.82 - 0.12 R_T - 0.001 X_1 + 0.12 X_2 & (8a) \\
 & (-3.55) \quad (-2.1) \quad (-0.6) \quad (0.3) \\
 & + 2.25 X_3 + 0.15 R_L + 1.02 DV \quad \bar{R}^2 = 0.61 \quad DW = 0.58 \\
 & (2.8) \quad (1.9) \quad (4.75)
 \end{aligned}$$

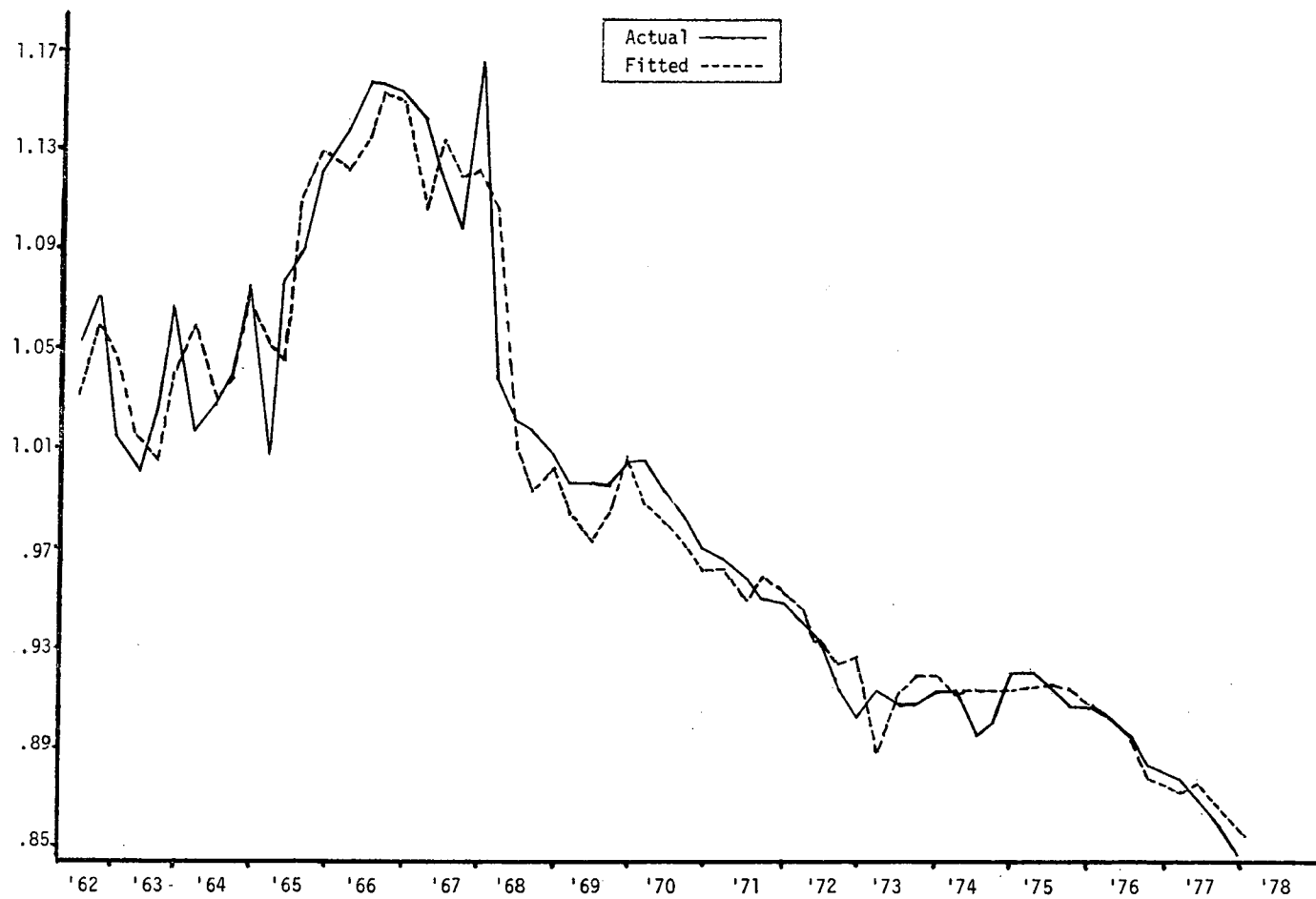


Figure 5: Actual and fitted values — equation (5a).

We expect all the coefficients on the independent variables to have signs opposite to those expected from the equilibrium specification, (5). Thus, X_2 and X_3 have incorrect signs. The adjustment of equation (8a) for an estimated coefficient of first-order autocorrelation of 0.7 leads to no significant improvement in the efficiency of the estimates of the coefficients.

In summary, the application of the Jaffee-Modigliani credit rationing hypothesis has been reasonably successful when applied to data for the Associated Banks. (This was not the case with the non-Associated Banks data to which the methodology was also applied, a result attributable, perhaps, to the very large structural changes experienced by these banks in recent years.) Generally, we found that an increase in the proportion of prime to total loans was associated with an increase in the discrepancy between the equilibrium and the market loan rates, a result predicted by the Jaffee-Modigliani theory of credit rationing.

V SUMMARY AND CONCLUSIONS

In this paper, we have tested on Irish bank lending data a hypothesis derived from the theory of credit rationing, that is, the process of clearing the bank credit market other than by interest rate changes, as suggested by Jaffee and Modigliani (1969). Credit rationing can result from profit-maximising behaviour by commercial banks acting either entirely autonomously or within constraints such as quantitative guidelines imposed by the monetary authorities or exogenously determined interest rates. If credit rationing in any particular instance is affected by Central Bank restraints, this may be an important channel of monetary policy via its effect on actual expenditures. If, in fact, credit rationing effects of monetary policy exist along with interest rate effects, it would be desirable to calibrate monetary policy by measures which take rationing effects into account.

For a bank that can act (or is permitted to act) as a discriminating monopolist, credit rationing will not be practised if profits are to be maximised, since each customer can be charged the specific market-clearing rate. For one reason or another, banks do not act as discriminating monopolists; in practice, they charge a common loan rate to heterogeneous categories of borrowers. Where this common rate is less than the market-clearing rate for specific customers, the latter are rationed. Such customers will be high-risk (non-prime) borrowers; their market-clearing rate will be higher than the common rate charged because the bank's loan offer curve to them will contain a risk premium. This type of rationing Jaffee and Modigliani term equilibrium rationing. A second type of rationing, dynamic rationing, may be evident if

interest rates generally are slow to increase in response to changes in market conditions that make for higher interest rates.

It was argued that, in Ireland, circumstances suggest that credit rationing is a significant empirical phenomenon. Firstly, common loan rates are charged to very broad categories of borrowers encompassing a wide range of bank customers, and, secondly, loan rates do not fluctuate freely in response to market forces, but rather change in discrete steps. These features of the Irish credit market suggest the existence of equilibrium and dynamic credit rationing, respectively. An intensification of either type of rationing might be expected to fall most heavily on high-risk, non-prime borrowers. These borrowers should also be those most affected by credit ceilings imposed on the commercial banks by the Central Bank.

Since direct measures of credit rationing are not available (the *ex ante* demand for credit is unobserved), the theory would point to the proportion of prime loans in total loans as an operational measure for the degree of credit rationing. We have seen that when credit rationing increases, non-prime borrowers are most affected and consequently the proportion of loans accounted for by prime borrowers should tend to increase. This hypothesis can be tested by relating this ratio to the difference between the equilibrium (i.e., the unobserved, freely fluctuating) loan rate and the actual loan rate where the regression coefficient is expected to be positive.

We applied this model to the Associated and non-Associated Banks, using data on the analysis of advances, with moderately satisfactory results being obtained for the Associated Banks. In particular, a partial adjustment adaptation of the Jaffee-Modigliani hypothesis which recognises that banks are "locked into" loans and consequently cannot alter their loan portfolio at will proved to be reasonably well-supported by the data. In the case of the non-Associated Banks, however, this model was not supported by the data.

The results of this study indicate that the ratio of prime to total loans (for the Associated Banks) is a reasonably good measure of credit rationing. This suggests that, along with the conventional textbook interest rate effects on real expenditures, the institutional features of the Irish credit market are such that credit rationing effects may be an important supplementary channel whereby disturbances in the monetary sector are transmitted to the real economy. This particular channel may take on added significance in periods of restrictive credit policy; however, over the longer run, the restrictive effects would probably be largely neutralised by offsetting capital flows given the high degree of financial integration between Ireland and the UK. While the prime to total loans ratio, therefore, is a reasonably good index of credit rationing in Ireland, a more precise measure of rationing must await a more comprehensive study of the Irish credit market — perhaps, using methods of disequilibrium econometrics.

APPENDIX: SOURCES AND METHODS

Data on the analysis of advances, as given in the Statistical Appendix of the Quarterly Bulletins of the Central Bank, are used for obtaining various estimates of the ratio, prime loans/total loans. These data were compiled on the basis of occupation of borrower for the bank return dates in January, April, July and October prior to 1968. From the end of 1967, the basis of compilation was altered so that borrowers are now classified according to the purpose for which a loan is granted; in addition, the month for which the data were collected is brought forward by one month. These discontinuities necessitate the inclusion of a shift dummy variable in the regression analysis. In the case of the Associated banks, the H ratio (i.e., the ratio, prime loans/total loans, in which the numerator is a subset of categories of borrowers in the AAA group) is available from 1967 only (no data being available on advances to local authorities prior to this date). In the case of the non-Associated Banks, data on the analysis of advances are available only from the last quarter of 1972. Acceptance credits, which have taken on increasing importance in recent years as an alternative to the conventional overdraft for prime borrowers, are added on to all advances as well as the various definitions of prime advances. Data on acceptances are obtained from the aggregate balance sheets of the two groups of banks as given in the Statistical Appendix of Central Bank Quarterly Bulletins. (This and all other series are collected for dates which conform exactly, or as closely as possible, to the dates on which the analysis of advances data are now compiled.)

The loan rate, R_L , for the Associated Banks is the simple average of the AAA, AA and A rates for overdraft and term loans up to one year. It is not possible to construct a weighted average due to the lack of quarterly data on loans by category; it is considered adequate to take the one-year term loan rate only in the light of the consistently rigid one-to-one relationship between the absolute changes in the one-year and other term loan rates. The source for the series required is the Banking Department of the Central Bank.

Total deposits at the Associated Banks is the sum of within-the-state current accounts (adjusted for cheques in the course of collection), deposit accounts, excluding Government current and deposit accounts (offsets are included for the whole period), and current and deposit accounts elsewhere. The source for these data is the Banking Department of the Central Bank. Data on Associated Bank holdings of Exchequer and Treasury Bills are obtained from the same source. Total assets within and without the state were obtained from the main assets table of the Associated Banks as given in the Quarterly Bulletins; offsets are included after April 1971. Total loans of the Associated Banks used in the variable, Loans/(Assets—Loans), are the sum of Bills, Loans, Advances(adj.) and Investments to non-Government

borrowers within the state and elsewhere. Offsets are included to preserve continuity in the series; holdings of Agricultural Commodities Intervention Bills are excluded from total loans. The Exchequer Bill rate and the previous series were obtained from the Banking Department of the Central Bank.

Series for the non-Associated Banks are obtained in an exactly analogous way to the Associated Banks; the analysis can be done only for the period after 1972 when the data on the categorisation of advances became available. The deposits series comprises current, deposit and other accounts within and without the state, *less* all inter-bank balances within the state. The loan rate used in the case of the non-Associated Banks is the mid-point of the range of rates charged on overdrafts by different banks within the non-Associated group. Although overdrafts constitute only a small portion of non-Associated Bank lending, the rigidity of the interest rate structure should ensure that movements in the overdraft rate mirror movements in rates generally. Where possible, all data were obtained from Central Bank Quarterly Bulletins, supplemented, when necessary, by material from the Banking Department of the Central Bank.

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Data For Associated Banks

		<i>Loan rate</i>	<i>Total deposits</i>	<i>Holdings of 90-day govt. paper</i>	<i>Ex- chequer bill rate</i>	<i>Total loan port- folio</i>	<i>Total assets</i>	<i>Advances to AAA and AA borrowers</i>	<i>Advances to specific AAA borrowers</i>	<i>All advances</i>
		<i>per cent</i>	<i>£m.</i>	<i>£m.</i>	<i>per cent</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>
1962	Q1	6.75	497.4	23.02	5.39	307.6	558.7	191.8	1.0	208.1
	Q2	6.00	508.5	17.00	4.20	309.3	568.9	184.4	1.0	214.5
	Q3	6.00	519.0	9.93	3.92	321.0	578.8	199.9	1.0	225.3
	Q4	6.00	543.0	11.29	3.89	330.6	612.0	209.6	1.0	232.6
1963	Q1	5.75	536.0	11.24	3.66	337.0	600.5	197.2	1.0	233.8
	Q2	5.75	541.0	10.55	3.80	342.4	605.9	192.6	1.0	231.4
	Q3	5.75	557.8	9.50	3.86	354.6	621.4	215.9	1.0	249.1
	Q4	5.75	568.0	11.50	3.92	358.8	634.7	233.6	1.0	259.4
1964	Q1	5.75	567.4	10.73	3.97	369.6	639.6	216.8	1.0	257.3
	Q2	6.25	570.3	8.23	4.55	375.9	647.8	232.3	1.0	269.4
	Q3	6.25	589.5	7.49	4.83	387.0	659.3	246.6	1.0	281.9
	Q4	6.25	609.9	7.60	6.69	399.6	683.5	267.2	1.0	295.5
1965	Q1	7.25	603.3	10.91	6.67	420.8	676.2	247.3	1.0	297.0
	Q2	7.25	611.3	9.62	6.45	423.8	690.4	283.4	1.0	310.1
	Q3	7.25	630.7	13.20	5.72	423.2	705.4	293.3	1.0	322.9
	Q4	7.25	643.1	11.32	5.67	408.6	720.1	301.1	1.0	320.1
1966	Q1	7.25	648.4	11.74	5.81	411.3	727.9	303.2	1.0	319.3
	Q2	7.25	652.4	11.03	5.84	408.8	736.4	308.6	1.0	319.1
	Q3	8.00	656.4	11.24	6.87	406.3	745.0	319.1	1.0	331.2
	Q4	8.00	660.4	10.29	6.83	403.8	753.5	329.6	1.0	343.1
1967	Q1	7.62	653.2	10.27	6.20	414.1	739.8	326.6	1.0	342.5
	Q2	7.62	661.5	5.29	5.39	411.4	751.5	306.3	1.0	329.6
	Q3	7.25	690.3	5.25	5.47	420.4	778.0	314.0	1.0	342.3
	Q4	8.50	724.1	6.31	7.69	423.3	822.5	350.8	1.0	357.7
1968	Q1	8.50	737.4	7.31	7.59	438.9	831.3	320.7	91.9	377.7
	Q2	8.50	756.0	7.03	7.30	453.3	853.1	337.8	96.5	394.7
	Q3	8.50	799.1	7.84	7.21	480.9	898.8	353.5	103.6	414.9
	Q4	8.00	837.1	6.56	6.94	501.7	944.9	349.0	81.0	413.8
1969	Q1	8.00	834.3	6.66	7.17	519.8	947.0	364.1	87.5	435.8
	Q2	9.00	851.4	7.90	8.36	550.8	968.0	382.3	88.1	457.5
	Q3	9.00	879.1	7.87	8.31	564.2	995.0	398.2	102.9	477.7
	Q4	9.50	907.0	7.81	8.25	557.8	1030.9	400.6	102.2	474.8

(continued)

Data For Associated Banks (continued)

		<i>Loan</i>	<i>Total</i>	<i>Holdings</i>	<i>Ex-</i>	<i>Total</i>	<i>Total</i>	<i>Advances</i>	<i>Advances</i>	
		<i>rate</i>	<i>deposits</i>	<i>of 90-day</i>	<i>chequer</i>	<i>loan</i>	<i>assets</i>	<i>to AAA</i>	<i>to specific</i>	<i>All</i>
		<i>per cent</i>	<i>£m.</i>	<i>govt. paper</i>	<i>bill rate</i>	<i>port-folio</i>	<i>£m.</i>	<i>and AA borrowers</i>	<i>AAA borrowers</i>	<i>advances</i>
				<i>£m.</i>	<i>per cent</i>	<i>£m.</i>		<i>£m.</i>	<i>£m.</i>	<i>£m.</i>
1970	Q1	9.50	921.8	7.71	8.13	581.1	1065.3	415.0	111.7	492.5
	Q2	9.50	955.2	6.87	7.25	604.7	1099.7	428.4	116.3	513.2
	Q3	9.50	988.6	6.87	7.28	628.3	1134.2	441.8	120.8	533.9
	Q4	9.50	1021.9	6.87	7.27	651.8	1168.6	455.3	125.5	554.7
1971	Q1	9.50	1055.3	6.82	7.21	675.4	1203.0	468.7	130.0	575.4
	Q2	9.00	1088.7	5.67	6.01	699.0	1237.4	482.1	134.6	596.1
	Q3	9.00	1131.8	5.76	6.09	704.5	1283.6	491.3	156.1	613.3
	Q4	8.50	1170.9	4.55	4.83	703.7	1333.9	429.7	144.1	535.9
1972	Q1	8.50	1195.0	4.39	4.63	728.0	1387.9	449.8	151.5	557.6
	Q2	8.50	1189.2	4.30	4.51	766.3	1474.2	456.9	144.8	577.0
	Q3	7.25	1230.6	5.79	6.14	815.8	1524.2	469.9	149.7	611.7
	Q4	8.25	1297.5	6.93	7.32	840.3	1613.0	499.0	145.8	652.6
1973	Q1	9.25	1313.0	8.19	8.62	925.6	1662.5	549.8	147.8	714.7
	Q2	10.00	1376.0	7.47	7.54	963.2	1755.1	560.3	145.9	732.6
	Q3	11.00	1430.3	12.19	11.11	1015.8	1902.6	577.7	163.3	753.2
	Q4	11.75	1552.4	12.77	12.43	1084.3	2060.6	613.5	163.6	797.8
1974	Q1	13.25	1598.6	12.30	12.15	1139.5	2139.4	650.3	167.5	842.3
	Q2	13.25	1668.0	11.77	11.63	1209.7	2307.9	691.7	172.9	903.6
	Q3	12.75	1745.1	11.50	11.39	1233.9	2432.5	683.7	180.1	882.7
	Q4	12.75	1857.6	11.24	11.19	1255.7	2547.6	717.2	188.2	910.1
1975	Q1	12.33	1921.1	10.10	10.27	1296.7	2660.2	730.6	200.3	925.5
	Q2	11.92	1994.5	12.93	9.67	1336.4	2780.4	735.6	204.2	940.0
	Q3	11.92	2101.2	16.43	10.67	1380.2	2911.4	727.8	218.8	946.8
	Q4	11.92	2273.1	30.36	11.47	1428.9	3088.9	767.7	229.8	998.2
1976	Q1	11.17	2326.3	18.50	9.02	1445.4	3153.6	750.1	202.7	989.8
	Q2	11.17	2404.1	11.70	10.19	1555.8	3285.4	801.3	212.4	1069.5
	Q3	11.17	2485.6	13.13	11.07	1712.2	3434.2	863.0	209.3	1155.8
	Q4	14.42	2567.0	17.12	14.56	1878.6	3583.0	924.5	206.2	1242.0
1977	Q1	14.42	2565.4	33.97	11.47	1896.8	3606.9	954.1	210.7	1282.4
	Q2	10.67	2701.2	20.54	7.66	1990.8	3841.3	996.9	221.5	1358.9
	Q3	10.67	2793.2	18.60	7.06	2092.2	4077.6	999.5	231.0	1387.2
	Q4	8.67	3065.8	17.49	4.73	2180.0	4360.4	1016.2	217.4	1445.9

Data For The Non-Associated Banks

		<i>Loan rate</i>	<i>Total deposits</i>	<i>Holdings of 90-day govt. paper</i>	<i>Total loans</i>	<i>Total assets</i>	<i>Advances to AAA and AA borrowers</i>	<i>All advances</i>
		<i>per cent</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>	<i>£m.</i>
1972	Q1							
	Q2							
	Q3							
	Q4	9.25	469.3	0.80	387.2	622.8	168.2	233.3
1973	Q1	11.25	524.9	3.30	428.3	685.8	166.7	263.9
	Q2	11.25	564.9	1.30	431.5	740.6	163.3	260.3
	Q3	13.50	656.7	2.20	470.5	856.9	176.4	283.6
	Q4	15.00	728.0	4.20	512.1	966.1	188.2	310.6
1974	Q1	15.75	814.7	4.20	545.2	1050.5	198.7	325.4
	Q2	15.25	891.2	3.00	608.5	1166.6	210.1	345.5
	Q3	15.88	920.9	2.30	622.7	1214.1	235.4	361.8
	Q4	15.88	978.0	11.80	680.0	1272.2	269.9	392.3
1975	Q1	15.00	978.0	6.20	688.9	1295.8	277.1	401.1
	Q2	14.75	953.4	1.90	680.1	1285.8	288.7	407.7
	Q3	14.50	965.1	11.70	712.6	1303.8	322.6	437.5
	Q4	15.00	1015.9	10.10	697.7	1370.4	340.7	462.6
1976	Q1	13.75	1085.1	16.40	694.2	1433.1	345.6	466.0
	Q2	13.75	1072.3	19.00	710.1	1476.2	361.1	483.5
	Q3	14.88	1128.7	21.20	758.7	1714.1	394.0	508.4
	Q4	16.00	1222.2	14.70	811.4	1632.2	417.7	538.8
1977	Q1	16.00	1361.5	13.50	896.1	1855.4	437.8	565.6
	Q2	11.25	1411.0	12.70	951.4	1895.4	481.3	613.2
	Q3	10.75	1462.7	8.30	1025.4	2001.7	523.8	653.0
	Q4	10.13	1542.7	11.80	1046.7	2131.8	559.8	593.6