Market Discrimination, Credit Rationing and the Customer Relationship at Commercial Banks

by

John M. Mason*

Working Paper No. 2-77a

RODNEY L. WHITE CENTER
FOR FINANCIAL RESEARCH

University of Pennsylvania

The Wharton School

Philadelphia, Pa. 19104

*Assistant Professor of Finance, The Wharton School, University of Pennsylvania

I. Introduction

Credit rationing at commercial banks has been a concern of economists for a long time. To date the most satisfactory explanation of this type of behavior has been put forward by Jaffee and Modigliani [14] and by Jaffee [15] although some question has been raised by Frost [7] about the empirical specification of the work.

The work completed by Jaffee and Modigliani, together or separately, rests upon the assumption that banks work in imperfect loan markets. Oligopolistic pricing techniques are used by the banks although it is felt that the discriminating monopolist case cannot be applied to the analysis of credit rationing because theory implies that the banks have to be on the demand curves of their loan customers. However, different prices can be charged different customers because of the existence of the several loan classes. Credit rationing takes place when not everyone in a loan class can obtain all the funds they want at the going interest rate. This process of credit rationing is then studied to determine whether this state can exist in equilibrium or not; the answer provided by Jaffee and Modigliani is that credit rationing is not necessarily a transitional occurance, as Samuelson has implied [23], but can exist in dynamic equilibrium.

The Jaffee-Modigliani (J-M) model is subject to several weaknesses. In the first place, the J-M work does not establish a stronger case for many different loan classifications than does the model for the discriminating monopolist. It is obvious that differentiating customers into many loan classifications and charging them different rates raises the amount of profits earned by the bank. This does not, however, support the fact that there are more than one loan classification or how many classifications should exist.

In regard to the latter point, an ad hoc argument is presented that banks, in an effort to maintain themselves close to a collusive optimum, base their classification scheme upon "readily verifiable objective criteria" and, "to make the whole arrangement manageable, the number of different rate classes (is) kept relatively small".[1] In this article, I contend that there is a strong economic reason for choosing several loan classifications based upon amount of information available to the bank; this presents a stronger reason than the banking systems' effort to maintain a collusive optimum, particularly since this type of behavior is illegal.

Secondly, the pricing structure alluded to in Jaffee is also derived in a rather ad hoc fashion depending this time not only on the attempt to reach a collusive optimum but also upon social pressure. For example, Jaffee states that "even aside from usury ceilings, the pressure of legal restrictions and considerations of good will and social mores would make it inadvisable if not impossible for the monopolist banker to charge widely different rates to different customers". Furthermore, "tacit agreement" among banks on the structure of class rates "could be facilitated by tying these rates through fairly rigid differentials to a prime rate set by price leadership"[2]. In this paper, I attempt to get away from such ad hoc pricing schemes and to rely upon pricing schemes actually used in banking practice.

Thirdly, the J-M framework rests on the assumption that rationing occurs within loan classifications. They have, in a sense, assumed a continuum of customers of different riskiness through a given loan class and if rationing must occur due to a constraint on reserve positions, once the rate is set, rationing will occur to those who are riskier within the loan class than would apply to the rate applicable to the loan class as a whole; other borrowers falling below the risk applied to the loan rate for the class would obtain all the funds they desired.

Information, however, is scarce and the reason we have the number of loan classifications we do is because a greater outlay of funds would be needed to achieve a greater number of loan classes; more information is needed to make the greater distinction in borrowers. Thus, a loan class, once decided upon is homogenous with respect to the customers that are placed in it. Consequently, all borrowers within a loan class will be charged the same rate and all will be rationed, if any are rationed. One loan class may be rationed more than another, but each borrower within a class will be given the same treatment.[3]

Fourthly, non-price terms have never been adequately incorporated into the loan relationship in previous studies of credit rationing. Some attempts [28] have been made to talk about the interest rate paid on a loan as adjusted for the non-price terms of the loan, but this does not account for these terms satisfactorily. It is my contention that these terms are very important in the pricing scheme and serve the purpose, within a rigid pricing scheme, of shifting loan demands so as to keep banks on demand schedules rather than at some indeterminant, intermediate point.

Finally, any discussion of bank loans must consider the customer relationship that exists between a bank and its customers.[4] Although the strength of the relationship may vary through different loan classifications, it turns out that the customer relationship is vital to explaining the behavior of the banking industry over the credit cycle. In fact using the model of the discriminating monopolist we cannot explain the possible existence of credit rationing by commercial banks nor the relative use of the non-price terms of different loan classifications unless we introduce the customer relationship.

One additional point should be made. It is assumed in this paper that prime loan customers are never rationed. The reason for this is that they represent the only loan class the bank has enough information on concerning the elasticity of demand. This is due to the competitive position of prime borrowers. There is much less information on other loan classes, hence they are priced relative to the prime rate and not relative to the market.[5] The present paper builds upon this and attempts to show how rationing does occur, given the pricing practices of commercial banks that evolve from this lack of information. The conclusions reached depend heavily upon the relationship that develops between the interest rate charged the prime borrower and competitively determined open-market interest rates.

II. THE ADMINISTRATION OF LOANS

Commercial banks operate in a world that is, of date, rapidly changing and thus subject to incomplete information. Incomplete information pertains to the conditions in the money and credit markets that make a determination of the correct package of price and non-price terms of loans to various customers extremely difficult. Because of this, banks must continually search for the meaning of the credit information which they are supplied but must also search for market clearing terms; as a result they generally must grope their way toward a vector of terms that clears all markets.

A. Risk

Bank loan classifications are based on many factors, just one of them is risk. Since we will be dealing with risk adjusted rates, however, it is necessary to deal with the adjustment for this factor right at the beginning. Assuming that the demand for loans in any loan class can be represented functionally as

$$L_i = f(\hat{r}_i) \quad f'(\hat{r}_i) < 0 \tag{1}$$

where $\hat{r}_i$ is the contract rate of interest for the i<u>th</u> loan classification and L_i is the demand for loans in the i<u>th</u> category. Assuming that all borrowers in the i<u>th</u> loan class are homogenous they are assumed to be subject to default risk σ_i, which generally would be denominated in terms of basis points. The default risk can be taken as exogenous to the bank, based either on past history or industry experience. Thus we can adjust the contract rate for the default risk leaving

$$L_i = h(r_i) \quad h'(r_i) < 0 \tag{2}$$

where r_i is the risk adjusted rate of interest charged borrowers in the i<u>th</u> loan class.

A question of concern at this point is whether risk has been eliminated from the model. The answer is no, because riskier borrowers will have demand curves that are more inelastic with respect to interest rates than the less risky borrowers.[6] Aside from risk, riskier borrowers will generally have fewer alternative sources of funds. And, if all banks follow similar credit analysis techniques, which they generally tend to do, then this will support the separation of the markets.

B. The Loan Classification Scheme

The general model used in this paper is that of the discriminating monopolist. The rationale for this is drawn from the industrial organization literature.[7] Whereas, the commercial banking industry is relatively competitive each firm acts similar to the others in the market. The reason for this is that banks are in close "proximity" to one another. Proximity does not necessarily imply geographical closeness, although many banks that operate in the same market are close together physically.

People in industrial organization also refer to proximity in terms of buying and selling in the same market, dealing with the same customers, and serving on the same industry committees. Banks and bankers certainly fit into this pattern, buying and selling Federal Funds to each other, participating or syndicating loans together, and serving on governing boards such as within the Federal Reserve System. Being close, in this sense, causes firms to act like one another and, hence, the industry tends to act as a firm. Thus, the industry is assumed to have some control over rates and quantities and, as we shall see, some control over the division of customers into differing loan classes.

It is readily shown in intermediate microeconomic textbooks that the total revenue of an organization is increased if the organization can separate its customers into different categories and price each category differently. In terms of the commercial bank we label these different categories loan classes.

There are many ways a bank or banks may decide to divide up the total market for loans. For example, we may distinguish high-risk loans from low-risk loans on the basis of several objective criteria that may be obtained from balance sheet information or we may differentiate due to a borrower's access to different markets. It is easy to separate commercial loans from consumer loans and these two from mortgage loans; also race or sex may be used as a criterion for dividing up loan classes.[8]

The ability to distinguish loan classifications is one of information availability. Some divisions require very little information, i.e., sex, race, asset size, access to national markets. However, we can imagine that as loan classes are added, the cost of adding an additional class may rise. We would expect a bank to continue adding loan classes until the marginal revenue achieved from an additional loan class is equal to the marginal cost associated with the ability to differentiate that additional loan class.

I would like to emphasize a point now in terms of the makeup of these loan classes. To achieve a finer distinction, as J-M does, within a given classification would require more information which would cost more money. The bank has stopped short of obtaining this information because it is not economically reasonable to do so. Thus, the bank will treat all customers within a given category exactly the same, because as far as it is concerned they all are the same.

The mathematics follow directly. If the balance sheet of the bank is as follows

$$\sum_{i=1}^{m} L_i = \sum_{h=1}^{n} D_h + K \qquad (3)$$

where L_i is the i^{th} loan and investment category of the bank, D_h is the h^{th} liability of the bank and K stands for the capital accounts an amount we will hold constant for this paper. Profits (π) are determined as revenues less expenses.

$$\pi = \sum_{i=1}^{m} r_i^a L_i - \sum_{h=1}^{n} r_h^d D_h - C_I(m) \quad i = 1, 2, \ldots, m. \tag{4}$$

In this case the interest rates, r, are adjusted for risk and for administrative costs. The $C_I(m)$ is the cost of obtaining information for i asset categories.

Before going into firm optimization we establish the conditions for the number of loan classes. If $R_m = \Sigma_{i=1}^{m} r_i^a L_i$ and the liability side of the balance sheet is not affected by a change in the number of loan classes[9] then

$$\pi = R_i - \sum_{h=1}^{n} r_h D_h - C_I(m) \quad i = 1, 2, \ldots, m. \tag{5}$$

and

$$\frac{d\pi}{dm} = \frac{dR_m}{dm} - \frac{d\, C_I(m)}{dm} = 0$$

or

$$\frac{dR_m}{dm} = \frac{dC_I(m)}{dm} .$$

That is, in equilibrium the marginal revenue from adding one more loan class is equal to the marginal cost of obtaining the additional loan class.[10]

C. Pricing

Commercial banks will generally operate to obtain a target yield on a given loan class, say Y_i, that is determined by historical experience or the profit planning of the bank. This yield will be achieved by a combination of fees and other non-price terms, NP_{ij}, and can be shown as

$$Y_i = Y(r_{ij}, NP_{ij}) \tag{7}$$

where r_{ij} is the contract rate charged to the $j^{\underline{th}}$ customer of the $i^{\underline{th}}$ loan classification. Banks have to assess neither the same contract rate, nor the same non-price terms to each borrower of a given loan category, although

The contract rate on prime loans, say r_p, will be set relative to open-market rates of interest due to competition that exists between banks and other suppliers of funds for prime borrowers. That is, banks have a good idea of the elasticity of demand for prime loans. However, they do not have sufficient information on other loan classes to determine either the exact position of loan demand or the elasticity of demand at any one point on the demand curve. Since the pricing structure derived from the model of the discriminating monopolist depends heavily upon the elasticities of the various demanders, knowledge of these elasticities are crucial for bankers to determine correct relative prices. Because banks do not know with certainty the numerical value of the different elasticities they must attempt to determine relative prices on some semi-rational basis. Again, we can draw upon the work of those who study industrial organizations. We observe that one rule of thumb that maximizes pricing decisions relative to the cost of information necessary to exactly determine prices is some type of a mark-up scheme over costs, or in this case, over the prime rate.[12] Mathematically, we can express one such scheme as,[13]

$$r_i = r_p + x_i. \tag{8}$$

This problem also carries over to periods in which interest rates are changing. Unless demand curves are of unitary elasticity, changes in elasticity must take place when demand curves shift or marginal costs shift. Again there is the question of the optimal pricing response on the part of the bank. The bank may or may not change the mark-up it charges. This will depend upon whether the marginal cost of gathering information as to the correct movement is greater than, equal to, or less than the marginal revenue acheived by changing the mark-up. If the marginal cost -

marginal revenue situation is such as to require mark-ups in the first place is it extremely likely that the marginal cost of obtaining information about the correct change in mark-ups will be large relative to any additional revenue achieved by the change. Thus, we will assume that banks will not change their mark-ups during periods of changing market conditions.[14]

Furthermore, mark-ups are highly visible representations of the loan class a customer falls into. Thus customers do not like banks to change their mark-ups. These borrowers are much more willing for banks to change the less visible terms of the loans such as maturities, fees or compensating balances. Banks generally comply.[15]

The problem then becomes one of judging the appropriate non-price terms a bank administers to the i^{th} loan class to, first, attempt to obtain the yield it desires and, secondly, to clear the market. Banks in general will attempt to hit the yield, Y_i, determined <u>ex ante</u>. Presumably, the world will not work out exactly as conceived. As a consequence, either actual yields will not live up to expectations[16] or loan demands will be deficient or in excess of that expected. If either situation occurs, the bank will need to make adjustments to achieve yields or to bring the market into equilibrium. In general practice the bank will eventually adjust non-price terms to achieve these results.

Thus, in the short-run, we shall assume that

$$Y_i = Y(r_p; \bar{x}_i, \overline{NP}_i), \qquad (9)$$

where the bars over the variables indicate the variables are constant, and

$$\frac{dr_i}{dr_z} = \frac{dr_p}{dr_z} \qquad (10)$$

where r_z is the market rate of interest. Furthermore, since changes in yields only come about at this time, due to changes in contract rates we shall specify the model in terms of contract rates and not yields.

III. BANK OPTIMIZATION

Firm optimization procedes from equation four, holding the number of loan classes constant, and constraining the optimization by the balance sheet expressed in equation three. Doing this we derive the following conditions where V is the quantity maximized and λ is the Lagrangian Multiplier.

$$\frac{dV}{dL_i} = \frac{\partial r_i^a}{\partial L_i} L_i + r_i^a - \lambda = 0 \quad \text{for } i = 1,2,\ldots,m. \qquad (11)$$

$$\frac{dV}{dD_h} = - \frac{\partial r_h^d}{\partial D_h} D_h - r_h^d - \lambda = 0 \quad \text{for } h = 1,2,\ldots,n.$$

$$\frac{dV}{d\lambda} = \sum_{i=1}^{m} L_i - \sum_{h=1}^{n} D_h - K = 0$$

This leads to the equilibrium conditons (for all i and h)

$$\frac{\partial r_i^a}{\partial L_i} L_i + r_i^a = \frac{\partial r_h^d}{\partial D_h} D_h + r_h^d ,$$

i.e., the marginal revenue of each loan and investment type and the marginal cost of each liability type must be equal.

We must now introduce some institutional factors into our model to make it more relevant to the markets faced by commercial banks. At a minimum, commercial banks face at least one market in which the supply of securities or the supply of funds is perfectly elastic to the bank. In an asset management world this market is the Government securities market. In general, we can assume that there doesn't exist a bank that can alter the price of Government securities by its buying or selling activities. Thus, using G to stand for Government securities we find for these banks the following equilibrium condition;

$$(13) \qquad r_G^a = r_i^a + \frac{\partial r_i^a}{\partial L_i} L_i = r_h^d + \frac{\partial r_h^d}{\partial D_h} D_h \text{; for all h and all i except i = G.}$$

In this case we can interpret the return on Government securities as representing the marginal opportunity cost of not investing in loans, rather than the marginal return on these securities.

Many banks today can purchase funds in markets where, at least over the range of transactions they operate in, they cannot affect the price at which the funds are purchased. We can readily think of the Federal Funds market and/or the market for Certificates of Deposit (CD's). If banks are dealing in these markets, i.e., engaging in liability management, they will not, in general, be using the Government securities market as the marginal market; they will only purchase Government securities to satisfy such requirements as pledging requirements. The reason for this is that the risk adjusted rate on, say, CD's should be equal to the Government rate. Banks will not borrow to invest at the same rate. Thus, we are dealing, in this case, with a true marginal cost of funds and not an opportunity cost. Assuming that mc represents the market that provides funds at the market rate, the equilibrium condition now becomes

$$\partial r_i^a \qquad \partial r_h^d$$

To make the argument that follows the most general possible, it will be assumed that there exists such a market where either securities or funds are supplied elastically, at the rate r_c, but it will not be specified whether the relevant market is an asset market or a liability market. Furthermore, the subscripts i and h will be inclusive of all markets except the one designated c.

We now want to consider whether this model and the pricing scheme set forward earlier can explain rationing behavior or not. Let us, therefore, assume the pricing scheme presented in Section II is a realistic description of the pricing process used by banks and assume that the prime rate class is class 1 of loans and j represents all the other classes of loans and investments, other than class 1. Then, if we substitute in r_c in either equation (13) or (14), and rearrange the terms of the equations into elasticities, assuming, for simplicity, that all demand curves are of constant elasticity, we find the pricing conditions to be:

$$r_c = r_1^a \left(\frac{e_1 - 1}{e_1}\right) = r_j^a \left(\frac{e_j - 1}{e_j}\right) \qquad (15)$$

where $e_i = -(r_i^a/L_i)(\partial L_i/\partial r_i^a)$.

Assuming, therefore, that the demand curve for the prime loan class is the most elastic loan class excluding, of course, the government loan class $|e_1|>|e_j|$, and, thus, $r_j^a > r_1^a$. According to our pricing scheme, using $\bar{r}_j^a$ as the bank charge, and knowing that $r_j^a > r_1^a$, and assuming a special, initial equilibrium where, given all other terms of the loan, the x_j are such that there exists no excess demand or supply for any loans in any of the banks' markets, we get equation (16). This equation defines the equilibrium in which the administered prices of the bank, the $\bar{r}_j^a$, are the same as would be determined by the market if the bank allowed the market to determine pricing equilibrium in which the administered prices of the bank, the $\bar{r}_j^a$, are the same as would be determined by the market if the bank allowed the market to determine pricing alternatives.

$$\bar{r}_j^a = r_1^a + x_j = r_c \frac{e_1}{e_1-1} + x_j = r_c \frac{e_j}{e_j-1} \tag{16}$$

The relevant question for credit rationing now becomes, what happens to this equilibrium position once interest rates are shocked. As was explained above (see equation 10), we assume that banks do not alter the x_j's so that

$$\frac{dr_1^a}{d\alpha} = \frac{d\bar{r}_j^a}{d\alpha} \tag{17}$$

where $d\alpha$ represents a shock to the level of interest rates. However, according to (15)

$$\frac{dr_1^a}{d\alpha} = \frac{dr_c}{d\alpha} \frac{e_1}{e_1-1} , \tag{18}$$

and, thus, using equation (16),

$$\frac{d\bar{r}_j^a}{d\alpha} = \frac{dr_c}{d\alpha} \frac{e_1}{e_1-1} . \tag{19}$$

This results because the x_j do not change. To clear market j, however, equation (15) tells us that

$$\frac{dr_j^a}{d\alpha} = \frac{dr_c}{d\alpha} \frac{e_j}{e_j-1} , \tag{20}$$

Credit rationing will occur in the non-prime loan classes if the interest rate actually charged to the <u>jth</u> loan class rises less than the interest rate that would be charged in firm optimization, i.e., if

$$\frac{dr_j^{a}}{d\alpha} > \frac{dr_j^{\bar{a}}}{d\alpha} \tag{21}$$

This reduces to the following inequality.

$$\frac{1 - \frac{1}{e_j}}{1 - \frac{1}{e_1}} < 1 \tag{22}$$

which, since $|e_1|>|e_j|$, equation (21) cannot hold. The conclusion that can be drawn from this is that if the pricing scheme based on non-rationed prime rate customers postulated in Section II is realistic and is followed by the commercial banking industry, we must look elsewhere for the existence of credit rationing, because the model to date gives us no rationale for believing that credit rationing would exist under such a regime.

IV. THE CUSTOMER RELATIONSHIP

One of the long-standing arrangements assumed to exist in the world of commercial banking is the customer relationship. Put simply, the customer relationship implies to the bank that a borrower will bring his business back to the bank at some time in the future because of the consideration and terms he is receiving currently or has received in the past. The current terms may include a commitment by the bank for a line of credit; it may mean a concession on rate or maturity; it may mean just making money available when it is needed.[17] Whatever the reason, there is an implied future tie between the borrower and the lender. This arrangement, in the bank's eyes, raises future loan demand for the bank, and, hopefully provides for steadier revenues over time.[18]

This arrangement has been thoroughly described by Hodgeman [13]. The very essence of the relationship, however, is an intertemporal one and Hodgeman, I believe, has failed to catch this in his model. John Wood [29], on the other the model developed in equations (3) and (4) is added the argument that cash flows are received over time; these future flows must be discounted to the present; and that loan demands are dependent not only on the current rate of interest and current economic activity but also upon the past loan experience a borrower has had with the bank. Specifically,

$$\pi^* = \sum_{t=1}^{T} \beta^{(t-1)} \left(\sum_{i=1}^{m} r^a_{it} L_{it} - \sum_{h=I}^{n} r^d_{ht} D_{ht} - C_{I_t} \quad (i) \right) \tag{23}$$

where π^* represents the discounted cash flow to the bank, the variable to be maximized, and β is the discount factor used to discount the future cash flows. The demand and supply of assets and liabilities are as follows:

$$r^a_{it} = r_{it} \left(r_{yt}, Z_t, L_{it}, L_{it-1}, \ldots \right) \tag{24}$$

, and,

$$r^d_{ht} = r_{ht} \left(r_{yt}, Z_t \; r^d_{gt}, \ldots \right)$$

where g represents all liability categories except h

All that is really necessary for the understanding of banking behavior is the two period case. Commercial bankers, as well as other profit maximizers, don't have a long time horizon[19] and in most cases the current period and the future is all that is necessary. Thus, assuming only that t=1 and t=2 and maximizing (23) subject to a budget constraint for each period we obtain the following equilibrium conditions. Note, that the subscript 1 refers to the current period and 2 refers to the future.

$$r^a_{i1} + L_{i1} \frac{\partial r^a_{i1}}{\partial L_{i1}} - \beta L_{i2} \frac{\partial r^a_{i2}}{\partial L_{i2}} \frac{\partial L_{i2}}{\partial L_{i1}} = r^d_{kL} + d_{k1} \frac{\partial r^d_{k1}}{\partial d_{k1}} = r_{c1} \tag{25}$$

$$r_{i2} + L_{i2} \frac{\partial r^a_{i2}}{} = r_{k2} + d_{k2} \frac{\partial r^d_{k2}}{} = r$$

where r_{c1} and r_{c2} are the marginal cost or marginal opportunity cost of funds, as assumed earlier, in periods 1 and 2.

The effect of the customer relationship should be noted at this point. First of all, all contract rates involving customers will be lower relative to the marginal cost of funds r_c, than in the earlier model. Secondly, the relative pricing of loan customers, i.e., the determination of x_j, will depend not only on the elasticity of the demand curve for loans, but also upon the strength of the customer relationship, i.e., upon how far the demand for loans shifts out in the second period due to an increase in loans in the first period, $\partial L_{i2}/\partial L_{i1}$. Since, this term is positive, a loan class with a weak customer relationship will be priced higher to the market relative to other loan classes that exhibit a stronger customer relationship. Thus, some industries that do not have strong customer relationships with banks may feel that they are priced too high for the amount of risk inherent in the loan: they may be victims not only of market imperfections but of weak intertemporal bargaining power.[20] Thus, we still see that $\overline{r_{i1}^{a}} = r_{11}^{a} + x_i$ where i is all assets other than prime loans but that now, in our special, initial, equilibrium where no excess demand or supply exists, given all other terms of the loan,

$$(27) \qquad \overline{r_j^a} = r_{c1}\left(\frac{e_1}{e_1-1}\right) - \beta\ \frac{r_{12}}{e_1-1.}\ \frac{\partial L_{12}}{\partial L_{11}} + x_i = r_{c1}\left(\frac{e_i}{e_i-1}\right) - \beta\ \frac{r_{i2}}{e_i-1}\ \frac{\partial L_{i2}}{\partial L_{i1}}$$

As shown earlier, the relevant question for credit rationing is what happens to the equilibrium position once interest rate levels are disturbed. We again find the implied change in the market rate and compare this with the markup, x_i, assuming that prime loans are not rationed, i.e., $dr_1^a/d\alpha = d\overline{r_j^a}/d\alpha$. From equation (27) we see that

$$(28) \qquad \frac{dr_1}{d\alpha} = \frac{dr_{c1}}{d\alpha}\left(\frac{e_1}{e_1-1}\right) - \beta\left(\frac{e_1}{(e_1-1)^2}\right)\frac{\partial L_{12}}{\partial L_{11}}\ \frac{dr_{c2}}{d\alpha} = \frac{d\overline{r_i^a}}{d\alpha}$$

To clear market i, however,

$$\frac{dr_i^a}{d\alpha} = \frac{dr_{c1}}{d\alpha}\left(\frac{e_i}{e_i-1}\right) - \beta\left(\frac{e_i}{(e_i-1)^2}\right)\frac{\partial L_{i2}}{\partial L_{i1}} \quad \frac{dr_{c2}}{d\alpha} \tag{29}$$

If credit rationing is to occur $dr_i^a/d\alpha > dr_i^a/d\alpha$ which reduces from equations (28) and (29) to

$$0 > \frac{dr_{c1}}{d\alpha}\left(\frac{e_1}{e_1-1} - \frac{e_i}{e_i-1}\right) - \beta \ \frac{dr_{c2}}{d\alpha}\left(\frac{e_1}{(e_1-1)^2}\ \frac{\partial L_{12}}{\partial L_{11}} - \frac{e_i}{(e_i-1)^2}\ \frac{\partial L_{i2}}{\partial L_{i1}}\right) \tag{30}$$

In order to simplify, let us assume that $dr_{c2}/d\alpha = drc_1/d\alpha$. Since $drc_2/d\alpha \neq 0$ what remains must be negative. Using this knowledge and our earlier assumption that $|e_1|>|e_i|$, it is obvious that the first term in brackets is positive. It is therefore necessary that the second term in brackets be sufficiently positive to offset the positive value of the first set of brackets. Of course, a high discount factor, β, helps to offset the first term too. The condition that satisfies the second term in brackets being positive is

$$\frac{\partial L_{i2}}{\partial L_{i1}} \Big/ \frac{\partial L_{12}}{\partial L_{11}} < \frac{(1-\frac{1}{e_i})}{(1-\frac{1}{e_1})} \cdot \frac{(e_i-1)}{(e_1-1)} \ . \tag{31}$$

Since the terms on the left-hand-side of the equation show the relative strengths of the customer relationship of the prime loans and the i^{th} loan classification, the whole possibility of credit rationing, in the model under review, reduces to the relative strengths of the customer relationship amongst the different loan classifications. For credit rationing to occur $\partial L_{11}/\partial L_{12}$ must be sufficiently greater than $\partial L_{i2}/\partial L_{i1}$ for the second term in brackets in equation (30) to be positive and for the discount factor times this amount to be larger than the first term in bracket of equation (30) for the inequality in equation (30) to hold. Furthermore, since riskier borrowers tend to have demand curves that are less elastic with respect to interest rates than less risky borrowers, and since riskier borrowers do not tend to have strong customer relationships with banks, as interest rates rise there will be a movement within the bank to a portfolio of loans that is less risky than the one held before the rise.[21]

The case is entirely symmetrical. As interest rates decline, the prime rate will decline, but not by as much as market rates decline. If we start from the special, initial, equilibrium position described above, $|dr_i^a/dx| > |\overline{dr_i^a}/dx|$, in some cases, which will place the bank off of some of the borrower's demand curve again. In this case, the bank will desire to lend more than the customer wants. This will continue unless the bank alters other terms of the loan as described in the next section.

One additional point should be noted. The spread between the prime rate and the relevant open-market interest rate will vary over the credit cycle. As open-market interest rates rise, the spread will narrow, whereas the spread will increase as these interest rates fall. This behavior has been noted by Wood [28] and has been observed in more recent movements in interest rates.

V. Non-price Terms

If conditions of rationing persist implying that the shock to interest rates is permanent rather than temporary, commercial banks will attempt to bring the market back into equilibrium, i.e., shift the market demand curve. They can do this by altering non-price terms. The possibility of changes in non-price terms requires us to be careful in our definition of credit rationing and gives rise to the need to subdivide credit rationing into two distinct subsets. The first we shall designate as 'pure' credit rationing. In this case we find that the quantity of loans given at the stated contract rate of interest is less than the amount demanded, i.e., we are off borrower's demand curves. The second type of rationing, non-price rationing results from a change in the non-price terms offered to a borrower that has the effect of shifting the demand curve of the borrower. Harris [10] has shown that over the credit cycle the non-price terms of loans have moved in the same direction as explicit prices, i.e., as contract interest rates moved upwards, non-price terms became more restrictive. This is as one would expect and represents a reason why the interest rates on all classifications of loans do not rise to the full extent necessary to choak off loan demand. Thus, commercial banks would be able to maintain their markup spreads between loans but by changing non-price terms they would be capable of causing a shift in demand schedules; in this way they hope to maintain zero excess demand or supply for loans in each loan classification. Thus, not explicitly taking into account non-price terms in empirical work (see Jaffee [15] , and Jaffee and Modigliani [14]) leaves out a very important factor in estimating demand curves. Expanding equation (24) the demand curves for loans,we get

$$r_{it}^{a} = r_{it} \quad (r_{yt}, Z_t, L_{it}, L_{it-1}, NP_{it}, \ldots) \tag{32}$$

whre NP_t represents a vector of the non-price terms of a loan in period t. We assume that all non-price terms are negatively related to r_{it}^{a} so that the contract rate, for a given quantity of loans, all other things constant, will be lower the greater the non-price terms of the loan. Equation (33) shows the optimum conditions, after taking total differentials, for the loan, given the possibility that the bank will alter non-price terms. Now, examining the conditions for credit rationing it is easy to

$$\frac{\partial r^a_{i1}}{\partial \alpha} d\alpha = \left(\frac{e_i}{e_i - 1}\right)\left(\frac{\partial r_{c1}}{\partial \alpha}\right) - \beta\left(\frac{e_i}{(e_i-1)^2}\right)\left(\frac{\partial L_{i2}}{\partial L_{i1}}\right)\left(\frac{\partial r_{c2}}{\partial \alpha}\right) d\alpha + \left(\frac{\partial r^a_{i1}}{\partial NP_{it}}\right) dNP_{it} \tag{33}$$

see that an elimination of rationing can be achieved in the face of a rise in interest rates, by an increase in non-price terms. The crucial results are shown in equation (34)

$$0 = \frac{\partial r_{c1}}{\partial \alpha}\left[\frac{e_1}{e_1 - 1} - \frac{e_i}{e_i - 1}\right] - \beta \frac{\partial r_{c2}}{\partial \alpha}\left[\frac{e_1}{(e_1-1)^2} \frac{\partial L_{12}}{\partial L_{11}} - \frac{e_i}{(e_i-1)^2} \frac{\partial L_{i2}}{\partial L_{i1}}\right] + \frac{\partial r^a_{11}}{\partial NP_{1t}} \frac{dNP^a_{1t}}{d\alpha} - \frac{\partial r^a_{i1}}{\partial NP_{it}} \frac{dNP_{it}}{d\alpha} \tag{34}$$

These results can be explained as follows. The first two terms on the right are exactly as shown above in equation (30). Thus, if non-price terms are not changed, the equation reduces to that presented earlier. However, the use of non-price terms allows us to substitute an equality sign in equation (34) where an inequality was needed in equation (30). This assumes that the non-price terms will be used to achieve equilibrium in all loan markets. If we further assume that non-price terms on prime loans do not change we have just the last term to examine. From equation (33) we see that the rise in r_{i1} will have to be less than it would be other wise if non-price terms are changed, i.e., the demand curve shifts downward because $\partial r^a_{it}/\partial NP_{it} < 0$. As a result if the movement of market rates forces an increase in non-price terms of loan, equation (34) shows us that in the event that short-run credit rationing occurred (conditon achieved in equation (31)) the non-price terms can eliminate any excess demand that was caused by the failure of interest rates to rise fully.

It can be noted that in the new equilibrium described by equation (33) the loan quantity will be less than the amount that was observed in the case of rationing. This is because the shift in the demand curve also lowers the marginal revenue curve so that the intersection of the marginal revenue curve and the marginal cost curve must be at a lower quantity of loans. This result would contribute to the wide swings in the proportion of total loans taken up by customers over the credit cycle.

It is perhaps relevant to say at this time that except for discontinuities, because non-price terms tend only to move in discrete amounts, the model presented in this paper does not allow for equilibrium rationing except in the sense that non-price terms of loans may be different for some loan classes in alternate positions of stationary equilibrium. Continued pure rationing, i.e., being off demand curves, cannot exist in the model discussed in this paper. Transitional states will show movements of both price and non-price terms to close the gap created by movements in market interest rates. Empirical work, particularilly that of Harris, [9] and [10], seems to support this result.

VI CONCLUSION

In this paper, I have attempted to show five things.

1. Commercial banks divide borrowers into loan classifications based upon reasonable means of differentiation. Objective criteria such as size, and certain values of accounting ratios are relevant means of differentiation. However, due to information costs, only a given number of classifications will be used and banks will treat each class as homogenous.

2. It is assumed in this paper that commercial banks do not ration prime customers. Furthermore, it was assumed that the contract rate of interest for each non-prime loan classification is marked up a certain number of basis points over the prime rate of interest. Given this type of pricing scheme, it was shown that the single-period model of the banking firm cannot explain credit rationing.

3. Introducing the customer relationship, defined as an intertemporal relationship between the borrower and the lender, allows for the existence of credit rationing of those borrowers whose relationship with the bank, over time, is relatively weak. However, it will not be the case that the same borrowers will get rationed all the time: this is something that can vary in each credit cycle.

4. Non-price terms will be used by banks to bring the markets for different loan classifications into equilibrium. Alterations in terms will vary due to the amount of pure credit rationing a loan class is subject to. Thus, except for discontinuities, equilibrium credit rationing will not exist.

5. It should finally be noted that the model developed in this paper can account for the fact that whole classes of loans may be completely rationed out of the market, either by pure rationing or by the use of non-price terms. This is consistent with actual experience. The possibility that a class can be completely rationed out of the market does not exist in some other models, such as the J-M model.

FOOTNOTES

[1] [15], p. 48.

[2] [15], p. 48.

[3] In the J-M effort a higher priority loan class could be rationed more in the aggregate than one with a lower priority. This can result from the rigid price structure of the bank and the relative distribution of risk throughout the loan class. The higher priority loan class, for the same aggregate demand for funds, could have more customers above the class loan rate than the lower priority class.

[4] For earlier work on the customer relationship, see particularly the work by Hodgeman [13] and Wood [29] .

[5] See [21] for a more complete description of the problem.

[6] Blackwell's [2] discussion of risk can be used to support this contention. Basically, his work shows that for a given contract rate of interest a riskier customer must have a less elastic demand for loans.

[7] See in particular the work of Joskow, [16] .

[8] A rule used in the past by many banks was that only one-half of a womans' income counted for a loan approval. This was a general rule usually assessed across the board and had the affect of placing a woman in a higher risk class than a man with the same income. Because it was applied to all women or family's applying for a loan the practice could be continued indefinitely.

[9] R_j is used because we can't explicitly specify what happens to the revenues from each loan classification. We just know, in general, that total revenue will increase. In the textbook case the marginal cost of dividing customers is assumed to be zero. Thus, it would be profitable for the firm to continue dividing its customers into different loan classes until the added revenue from obtaining one more loan class is zero. This would be where all customers in all loan classes <u>are</u> exactly the same.

[10] Due to the reliability of the data and the uncertainty as to what credit analysis actually means, a bank would not have too many loan classifications. The model can be adjusted to account for this and has been elsewhere (See Mason [21]) but since only the certainty model is treated in this article, the factor of uncertain demand has not been introduced. It should be noted that if very distinct differences appear, due to type of customer (such as the consumer) or type of financing (accounts receivable or inventory) banks very readily use the distinction.

[11] For further discussion of how these terms fit into the pricing scheme see Hodgeman [13] and Severson [25].

[12] The following discussion depends heavily upon the research presented in Mason [21] . Please refer to this paper for a more complete explanation of the use of rules of thumb in bank pricing schemes.

[13] A more modern mark-up formula is a percentage mark-up, i.e., $r_i = r_p(1+x_i)$. This type of mark-up system reduces the problem presented in this paper, although it does not eliminate it.

[14] There is empirical evidence that they do not. For an example see Cohen, Gilmore and Singer [5] . Also, see Hester [11] , p. 203. Hester's results show that "if many loans are made at rates above prime and the differentials are independent of prime" the elasticity of the interest rate charged on a loan with respect to the prime rate is "less than unity."

[15] There is no discussion in this paper about the possibility of "unbundling" all the items included in this part. See [3] for a complete discussion of more explicit pricing in the customer relationship.

[16] Commercial banks have recently worked on more sophisticated means of analyzing customers, ex post. See, for example, [18].

[17] At times, banks may only lend to people who have previous experience at the bank, regardless of the use of the money. For an example of this in the construction loan field see Leaffer [19].

[18] Although the variance of loan demand is not treated here, it has been treated in [21]. It should be noted, however, that these are independent reasons why a customer relationship might exist. An example of their independence can be gleaned from the banking experience of 1974 and 1975. Once banks had given many "insurance" lines of credit that were taken down in a period of severe credit restraint although little had been borrowed before. Future borrowing had increased, but, the banks woefully realized, the variance of the borrowings had also increased.

[19] For an empirical study giving some indication of the time horizon bankers work in see [20].

[20] The construction industry, for example, has considered itself subject to high rates relative to the experience of defaults (see Schulkin [24]).

[21] This result conforms to the responses the author received in the many interviews he had with senior bank loan officers on the subject of loan administration. Question: Who do you loan to as money gets tight? Answer: We loan to customers. Question: How do you manage the riskiness of your loan portfolio? Answer: We loan to customers.

REFERENCES

1. Azzi, C.F., and Cox J.C., "A Theory and Test of Credit Rationing" The American Economic Review, December, 1976.

2. Blackwell, N. R., "An Investigation of the Theory of Credit Rationing," Unpublished Ph.D Thesis, University of Pennsylvania, 1976.

3. Bryan, L. L., and Clark, S. G. Unbindling Full Service Banking, Harcomm Associates, 1973.

4. Chase, S. B. Jr., "Comment" The Quarterly Journal of Economics, May, 1961.

5. Cohen, K. J., Gilmore, T. C., and Singer, F. A., "Bank Procedures for Analyzing Business Loan Applications," in K. J. Cohen and F. S. Hammer, eds., Analytical Methods in Banking, Homewood, Ill.: Richard D. Irwin, Inc., 1966.

6. Friedman, B. M., "Credit Rationing: A Review," Staff Economic Studies, No. 72, Board of Governors of the Federal Reserve System, 1972.

7. Frost, P. A., "Review of Jaffee's Credit Rationing and the Commercial Loan Market," Journal of Political Economy, November/December 1973.

8. Guttentag, J. M., and Davis, R. G., "Compensating Balances," Essays in Money and Credit, Federal Reserve Bank of New York, 1964.

9. Harris, D. G. "Some Evidence on Differential Lending Practices at Commercial Banks," Journal of Finance, December, 1973.

10. Harris, D. G., "Credit Rationing at Commercial Banks: Some Empirical Evidence," The Journal of Money, Credit and Banking, May, 1974.

11. Hester, D. D., "An Empirical Examination of a Commercial Bank Loan Offer Function" in K. J. Cohen and F. S. Hammer, eds., Analytical Methods in Banking, Homewood, Ill.: Richard D. Irwin, Inc., 1966.

12. Hodgeman, D., "Credit Risk and Credit Rationing" The Quarterly Journal of Economics, May, 1960.

13. Hodgeman, D., Commercial Bank Loan and Investment Policy. Champaign: University of Illinois Press, 1963.

14. Jaffee, D. M. and Modigliani, F., "A Theory and Test of Credit Rationing," American Economic Review, December, 1969.

15. Jaffee, D. M., Credit Rationing and The Commercial Loan Market, John Wiley and Sons, Inc., 1971.

16. Joskow, P. L., "Firm Decision-making Processes and Oligopoly Theory," The American Economic Review, May, 1976.

17. Klein, M., "A Theory of the Banking Firm" The Journal of Money, Credit and Banking, May, 1971.

18. Knight, R. E., "Customer Profitability Analysis: Parts I and II" Monthly Review, Federal Reserve Bank of Kansas City, April 1975 and September-October 1975.

19. Leaffer, R. H., Construction and Permanent Mortgage Lending on Multi-Unit Residential and Commercial Income Properties, Unpublished Masters Thesis, The University of Pennsylvania, 1975.

20. Mason, J. M., Vinso, J. D., and Rogalski, R. J., "Expectations, Commercial Bank Adjustment and the Performance of the Monetary Aggregates," mimeo.

21. Mason, J.M. "Commercial Bank Management: A Model with Uncertain Demand and Supply of Funds", forthcoming.

22. Miller, M. H., "Further Comment" The Quarterly Journal of Economics, August, 1972.

23. Samuelson, P. A., Testimony on 'Monetary Policy and the Management of the Public Debt', Hearings before the Subcommittee on General Credit Control and Debt Management of the Joint Committee on the Economic Report, 82nd Congress, 2nd Session, 1952, pages 691-698.

24. Schulkin, P. A., Commercial Bank Construction Lending, Research Report No. 47, Federal Reserve Bank of Boston, September, 1970.

25. Severson, "Determining Pricing Alternatives," The Journal of Commercial Bank Lending, November, 1974.

26. Shull, B., "Commercial Banks as Multi-Product, Price-Discriminating Firms," in D. Carson, ed., Banking and Monetary Studies, Homewood, Ill., 1963.

27. Smith, V., "A Theory and Test of Credit Rationing: Some Generalizations" American Economic Review, June, 1972.

28. Wojnilower, A. M. and Speagle, R. E., "The Prime Rate," Essays in Money and Credit, Federal Reserve Bank of New York, 1964.

29. Wood, J., "A Model of Commercial Bank Loan and Investment Behavior" in H. G. Johnson and A. R. Nobay, eds., Issues in Monetary Economics, Oxford University Press, 1974.