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Imperfect Information and the Community Reinvestment Act

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The Community Reinvestment Act has been used as a vehicle to increase lending to low-income neighborhoods. In this article, a conceptual framework is developed to evaluate the effect of CRA on bank portfolios. Results suggest that CRA will boost lending to low-income neighborhoods, with the cost of achieving the social goal of more even lending borne by bank customers and owners. The increase in lending to low-income neighborhoods is reinforced by an information effect: as banks expend greater effort searching for high-quality, low-income borrowers, this increased knowledge about the area reduces risks in that area.

Over the last two decades, community groups and Congress have expressed concern about "inadequate" lending to disadvantaged neighborhoods. These groups have argued that restrictive lending practices have led to decay and blight in some neighborhoods because qualified borrowers who would have made improvements could not get loans.

The arguments have centered around "redlining," a practice whereby a financial institution indiscriminately limits loans for the purchase of property in certain "undesirable" neighborhoods within its market area. According to this practice, lenders are alleged to deny loan applications for purchases in those geographic areas, regardless of the credit worthiness of the individual borrower. A number of statistically-based studies that purported to show evidence of redlining were influential in securing passage of the Community Reinvestment Act (CRA) as part of the Housing and Community Development Act of 1977.

Since 1977, redlining, or the absence of redlining, has occupied much of the attention of those investigating CRA-related issues. In practice, however, protests by community groups based on CRA grounds have delayed or prevented bank mergers and acquisitions even without specific proof that a particular bank has engaged in redlining. Moreover, the implementation of CRA has tended to encourage banks to make more loans in certain neighborhoods, regardless of whether a given bank has been shown to have engaged in redlining. Clearly, then, CRA has implications for banks beyond its anti-redlining provisions. Consequently, this article seeks to evaluate the effects of CRA within this broader context, leaving aside the questions whether CRA is necessary or whether redlining occurs. We develop a model to explain, first, why a bank might have different lending policies for different neighborhoods, and second, how the current approach to CRA's enforcement affects a bank's decisions in this regard.

Differential neighborhood lending patterns can be shown to be a rational response to an environment in which the costs of acquiring information are high and neighborhoods differ widely in their average default risks. The existence of CRA suggests that society views these differential lending patterns as "suboptimal," and CRA enforcement essentially requires financial institutions to bear the social cost of providing low-income borrowers greater access to funding. Specifically, banks are encouraged under CRA to increase lending in low-income neighborhoods. To do so, they may incur higher costs investigating the credit worthiness of potential borrowers in these areas than would be optimal from the perspective of profit maximization. CRA trades off bank profits for the social benefits derived from greater access by borrowers in disadvantaged neighborhoods.

This view of CRA, as a mechanism to induce banks to increase lending in low-income neighborhoods, is consistent with a variety of institutional responses to CRA. These responses can be interpreted as efforts to reduce the costs that kept banks from making loans prior to CRA. Among these responses are pooling agreements by banks and cooperative efforts between banks and community groups.

We present an imperfect information model in Section I to demonstrate conditions under which banks would choose to allocate credit across neighborhoods on the basis of average neighborhood characteristics. The effects of changes in information on the allocation of funds across neighborhoods are explored in Section II. The role of CRA in the lending decision is highlighted in Section III, where it is introduced as an additional constraint on the bank's choice. We discuss institutional arrangements that have emerged to minimize the cost burden of CRA in Section IV, and draw conclusions in Section V.

I. An Imperfect Information Model

The operations of a bank are based on a broad spectrum of factors and motivations, including maintaining the goodwill of customers, serving the needs of the community, and providing returns to investors. A central feature of commercial banks is their role as credit intermediaries. Banks develop expertise in evaluating the credit worthiness of borrowers and enjoy economies of scale in monitoring loans to ensure prudent behavior on the part of borrowers. The extent to which this monitoring activity is not performed easily or as efficiently by other participants in the credit markets determines the market share of banking relative to direct placement activity.[1]

Portfolio diversification is another factor in bank lending decisions. Every loan faces some default risk associated with the particular characteristics of the borrower or the project as well as overall economic conditions. A bank can reduce these risks, however, by diversifying its portfolio since the specific risks of every project are not perfectly correlated, and these risks tend to offset one another. As a result, the total risk of a diversified portfolio is generally less than that of an undiversified one.

Diversification can occur along many different dimensions, such as across industries (agriculture, manufacturing, services, etc.) and size categories (large corporations or single proprietorships), and across general classifications of customers (residential, industrial, commercial, etc.). Diversification also can be accomplished geographically, by lending to similar customers in different markets or neighborhoods.

As commonly expressed, the problem of "socially inadequate" lending to particular neighborhoods may arise because the costs of identifying good loans in certain areas outweigh the advantages that would be gained through greater geographic diversification. This form of credit rationing, sometimes referred to as "rational redlining,"[2] occurs when banks restrict lending or are less aggressive in marketing loan products in certain neighborhoods because the costs of identifying the qualified loans are too high to be profitable. Thus, the lack of readily available, complete information can affect the allocation of credit across neighborhoods.

In this model, we assume a bank operates in a geographic lending market comprising two neighborhoods, which we denote by the subscripts R (for "rich") and P (for "poor"). The bank divides its portfolio of loans between the two neighborhoods, with proportion θ allocated to neighborhood P, and $(1-\theta)$ to neighborhood R.

We define i_P as the contractual interest rate on neighborhood P loans and i_R as the contractual interest rate on loans to residents of neighborhood R.[3] We assume that loan markets are competitive and that interest rates on loans are determined in these markets. Loan interest rates may be *affected* by the underlying risks of projects in the two neighborhoods, although they may not correct for risk differentials exactly. We assume that the risk of a loan project in neighborhood P exceeds that in neighborhood R. Consequently, the loan rate in neighborhood P may be higher than that in neighborhood R.

The limit on banks' ability to tailor rates to reflect fully the differences in neighborhood risks may arise for a variety of reasons, including transaction costs or pressures from social or regulatory groups.[4] Moreover, problems of adverse selection, where higher rates may attract less credit worthy borrowers, can prevent banks from adjusting interest rates to compensate fully for risk.[5,6]

Finally, because much of the attention in the application of CRA is focused on home mortgage lending, the model reflects some of the characteristics of that market. In particular, while lenders can in principle charge differential rates across areas, in practice they tend to have only slight variations in mortgage terms at any given point in time. In large part, this leveling of rates and terms results from the desire of lenders to create homogeneous mortgage contracts that can be resold in secondary markets.

Because of these factors restricting interest rate differentials, we assume that individual banks are price takers and that rates are set exogenously. Thus, in this model, i_P and i_R are not viewed as explicit choice variables by the bank.[7]

In the absence of defaults, total dollar returns for the bank on neighborhood P loans are $i_P \theta L$ where L is the total dollar volume of loans in the bank's portfolio. Similarly, the income on neighborhood R loans is $i_R(1-\theta)L$. To simplify the analysis, we assume that the volume of loans is given. We define units such that $L = 1$ and thus eliminate it from the two expressions above.[8]

Banks are assumed to maximize an objective function that trades off risk and return. The bank's perception of a loan's riskiness depends, first, on the actual distribution of potential rates of return to that loan project. This distribution depends on the interaction between specific characteristics of the project and the realization of future random events. (This distribution likely will change when the interest rate changes.) Even with full information about current conditions, the bank still faces risks from future events.

Although the bank cannot observe this distribution and therefore derive a true measure of the loan's actual riskiness, it can estimate a project's riskiness by obtaining information about the details of the individual project, details that are observable at some cost to the bank. Thus, a bank's estimate of a project's riskiness depends on the amount of information gathered. Essentially, as the bank invests in more information, its ability to distinguish among borrowers and projects rises, allowing it to restrict its portfolio to the lowest risk projects seeking loans at the given contractual interest rate.

Risk can be expected to differ across neighborhoods. We assume that, for a given interest rate, the variance of returns to loans in neighborhood P is higher than in neighborhood R. This effect could be expected if income streams in the poor neighborhood were more volatile. Moreover, if banks operate less in low income areas, as is alleged by CRA advocates, they can be expected to have less information about neighborhood P.

The bank's estimate of risk to loans in the two neighborhoods can be written as:

$$\mathrm{VAR}(r_P) = \sigma_P^2 + \lambda_P(I_P) \tag{1}$$

$$\mathrm{VAR}(r_R) = \sigma_R^2 + \lambda_R(I_R) \tag{2}$$

where r_P and r_R are actual returns on loans that would be expected at the prevailing interest rates. σ_P^2 and σ_R^2 represent the variances of loan returns in neighborhoods P and R, respectively, that result from unobservable factors. We can think of these measures as the full-information minimum variances of returns of the portfolio the bank would choose if it had all the information available about possible projects. For a given interest rate, these components of the variance are assumed to be fixed. The λ terms in equations (1) and (2) are the result of the component of risk caused by imperfect information, with $\lambda_P > \lambda_R$.[9] These terms are dependent on the information the bank obtains about the two neighborhoods, I_P and I_R. Our assumption that information reduces this component of risk suggests that $\lambda_P' < 0$ and $\lambda_R' < 0$. We assume that λ_P and λ_R are unaffected by information about the other neighborhood. Thus, λ_P is independent of I_R and λ_R is independent of I_P.[10]

Banks, therefore, can reduce loan risk by acquiring more information about projects and borrowers in the two neighborhoods so that they can weed out the higher-risk projects. If information gathering were costless, they would seek information about both neighborhoods until $\lambda_i = 0$.

But information gathering is not costless. Banks typically must set up an on-site branch or loan origination office, conduct local surveys regarding the values of neighborhood properties, and solicit and evaluate loan applications from neighborhood residents—all functions that entail significant expenditures by the bank.

We characterize these information gathering costs by the average cost functions, $C_P(I_P)$ and $C_R(I_R)$. Total information costs are equal to $C_P(I_P)\theta$ for neighborhood P and $C_R(I_R)(1-\theta)$ for neighborhood R. Typically, there are large initial fixed costs associated with the investment in information (such as setting up a branch), which lead to declining average costs over some range. We assume, however, that the marginal cost of obtaining information

Imperfect Information vs. Credit Rationing

The model presented in this paper is explicitly designed to focus on factors other than differential interest rates that can affect neighborhood lending patterns. The model stresses the role of imperfect information and the interaction of CRA restrictions.

Another model that offers complementary insights into the issue is the credit rationing model, of which work by Stiglitz and Weiss (1981) is often taken as a major point of departure. In that framework, it is possible to show why banks might not choose simply to compensate for higher risks in different neighborhoods by charging higher rates in those areas.

Credit rationing is said to exist when lenders refuse to grant credit to a borrower even when that borrower is willing to pay a higher interest rate. Such refusal is predicted when the lender does not expect to obtain its required return at any interest rate. In this context, it is important to understand the difference between the lender's expected rate of return and the interest rate charged on a loan. The expected rate of return is the interest rate charged net of the expected rate of default. At any given interest rate, an increase in the expected default rate means a decrease in the expected return on the loan.

This difference has important links to two ideas that are closely tied to theories of redlining: (1) information asymmetry and (2) adverse selection.

In cases of information asymmetry, lenders and borrowers have access to different sets of information regarding the credit quality of borrowers. While lenders may know that certain borrower characteristics are related to high default rates, they do not know all the characteristics of individual borrowers because borrowers can withhold information. A borrower who has characteristics that lenders associate with high credit risk has an incentive to hide this information. As a result, it is difficult for lenders to distinguish between a loan applicant who will default and one who will not. That is, borrowers who are observationally indistinguishable may be different in fact.

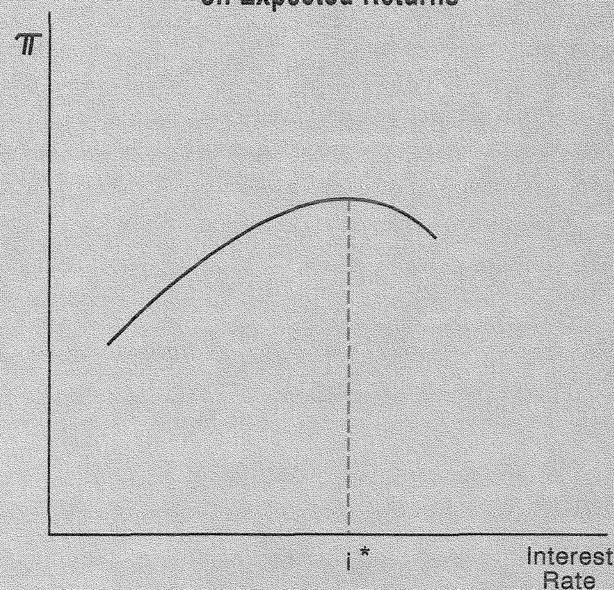
A related concept is the theory of adverse selection. According to this theory, different interest rates imply different pools of loan applicants. A rise in interest rates can induce an adverse change in the mix of applicants. Safe potential borrowers drop out of the market. These borrowers are discouraged by higher interest rates because these rates mean higher payments relative to the value of the loan project. On the other hand, borrowers who know they are unsafe are less concerned about the higher loan payments. They know they have a higher likelihood of default and, thus, a higher probability of not repaying the loan anyway.

Even though individual borrowers may have risk-related characteristics that lenders cannot identify, lenders understand the relationship between interest rates and the potential for adverse selection of borrowers. Lenders realize that beyond a certain point, increasing the interest rate on loans can mean an increase in defaults and thus lower expected returns. Therefore, lenders will not lend at rates above a certain maximum because the expected rate of return on lending falls.

This notion is depicted in Figure B1. The vertical axis represents the bank's expected return on loans (net of losses as a result of defaults), a concept analogous to the variable π in our model. The horizontal axis represents the contractual interest rate on loans. The expected return to the bank rises with the quoted interest rate until it reaches i^*. Below this interest rate, the greater interest income resulting from higher contracted interest rates dominates any increase in default rates resulting from the change in the quality of the pool of applicants. Above i^*, however, so many safe borrowers are discouraged from applying for loans that the expected return to the bank actually falls. At these high rates, there is a larger share of risky borrowers in the pool of applicants, and default rates can rise by more than the increase in interest income to the bank.

Figure B1

Effect of Adverse Selection on Expected Returns



In practice, information asymmetries and adverse selection confront lenders simultaneously. Suppose, for example, that lenders can distinguish between two groups of borrowers, a high-risk group and a low-risk group. Information asymmetries may make it difficult for the lender to differentiate among the members of each group (as in the previous discussion). But there generally is some set of observable characteristics of loan applicants that allows the lender to place some applicants in the low-risk group and the rest in the high-risk group. Suppose, in addition, that lenders know as much about members of the high-risk group as they know about members of the low-risk group.

Figure B2 shows how the existence of observably different groups of applicants can lead to credit rationing. The axes in Figure B2 are the same as in Figure B1. In this figure, the lender must derive a rate of return that is at least as high as its cost of funds, r_d (the rate the bank pays on deposits). At any given interest rate, borrowers in the low-risk group (Group I) provide a higher expected return to the bank than borrowers in the high-risk group (Group II). Moreover, the expected default rate for Group II is so high that no contracted interest rate yields an expected return sufficient to cover the lender's cost of funds. That is, all points on the curve that characterizes Group II are below r_d, the lender's cost of funds. In this case, members of Group II will be rationed out of the credit market. In the sense described by Jaffee and Stiglitz (1990), Group II borrowers are redlined, even though some Group II projects might yield sufficient returns to justify allocating credit.

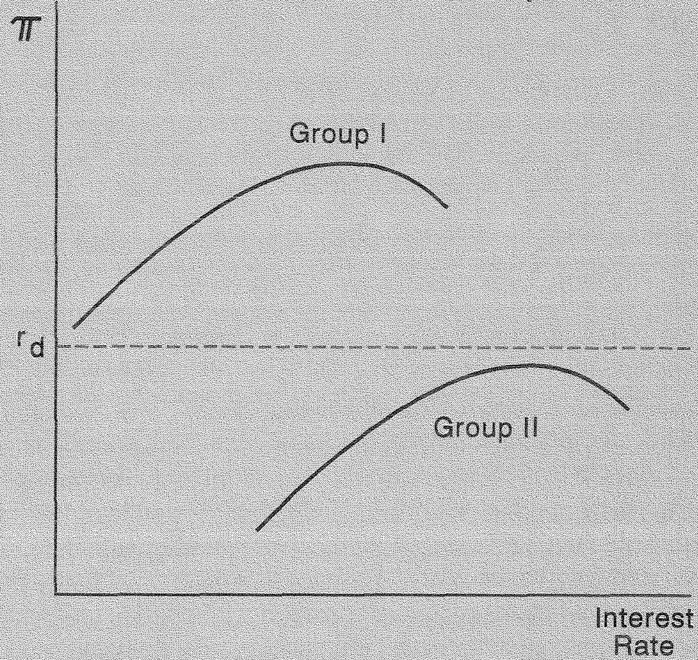
Credit Rationing vs. the Imperfect Information Model

The model in Section I is complementary to the standard credit rationing model. Stiglitz and Weiss (1987) focus on the optimal loan rates to charge different groups and the decision to allocate credit to those groups. In doing so, they assume that the bank cannot affect the expected return/loan rate trade-off through additional information gathering. In terms of our notation, their model assumes that $\lambda(I_i) = 0$.

In contrast, the model presented in Section I examines how banks can affect the expected return/loan rate trade-off through information gathering. To simplify the analysis, we ignore the factors that determine loan rates (the problem investigated by Stiglitz and Weiss). We thus do not provide a simultaneous determination of loan rates, portfolio shares, and information acquisition. We choose instead to focus on the influence of variance-reducing information on the credit allocation decision of the bank, taking contractual interest rates as given. This framework, we believe, provides a useful analytical tool to investigate how CRA affects bank lending decisions.

Figure B2

Credit Rationing with Different Borrower Groups



The presence of obtainable information alters the motivation for the differential treatment of borrowers in our model relative to the typical credit rationing story. In the credit rationing model, there is a fundamental difference in the default risks of the two groups of borrowers. Since one group of borrowers is riskier than another, lenders respond to this difference in default characteristics by curtailing credit to the riskier group. In our framework, the two neighborhoods differ in terms of *perceived* risks of default, with the difference in perceived risks exacerbated by information problems. In the absence of any information investment, the perceived risk in the rich neighborhood is smaller than the perceived risk in the poor neighborhood. Thus, as in the credit rationing model, the rich neighborhood receives more credit. However, since the bank can purchase information that reduces default risk, the cost of information affects the allocation of credit between the two neighborhoods.

To summarize, the model that relies on costly information offers one explanation for differential lending behavior across neighborhoods. When the perceived variance of returns in one neighborhood is significantly larger than in the other, the bank allocates less credit to the area with the higher risk. Thus, apparent redlining simply may be a rational response of banks to the problems raised by imperfect, and costly, information.

eventually rises as the desired type or quality of information becomes more difficult to obtain or evaluate. This produces U-shaped average and marginal cost curves.

We abstract from the deposit-taking activities of the bank, even though this activity may affect the bank's cost of funds and, thus, its profits. In effect, we assume a perfectly elastic supply of deposits at a risk-free rate of return to depositors, r_d.[11] As a result, we separate the bank's deposit-taking function from the business of making loans.

With the components described above, it is possible to state the bank's objective function as

$$\text{Max } \pi = i_P\theta + i_R(1-\theta) - \beta \text{ var}[r_P\theta + r_R(1-\theta)] - C_P(I_P)\theta - C_R(I_R)(1-\theta) - r_d \quad (3)$$

where π is the bank's adjusted return. π must be positive for the bank to operate. The bank chooses values of θ, I_P, and I_R that maximize this expression.

The objective function in (3) asserts that the bank seeks a balance between a portfolio's interest income, information costs, and variance. In this case, we assume that the adjusted return depends negatively on portfolio variance. This effect could arise for a variety of reasons, including risk aversion on the part of banks.[12] In addition, bankruptcy costs resulting from failed projects can be expected to make portfolio risk a negative factor to the bank. The third term, therefore, reflects a reduction in the bank's income from expected loan losses to its portfolio, which for simplicity is assumed to be a constant multiple, β, of the bank's portfolio variance.[13]

This formulation differs from other models of credit allocation. For example, as discussed in the box, "Imperfect Information vs. Credit Rationing," the standard credit rationing model focuses on the effects of asymmetric information on the determination of loan rates and the decision to exclude or ration credit to various borrower groups. The current work, which should be viewed as complementary to this credit rationing model, focuses on the process by which information gathering changes credit allotments. Moreover, the structure of this model is designed explicitly to model the effect of CRA, which is difficult to incorporate directly into the credit rationing framework. Nevertheless, many of the implications of the credit rationing model can be expected to carry over into this analysis as well.

The solution of (3) yields the following optimal conditions for a bank's portfolio allocation and information gathering:

$$\theta^* = \frac{i_P - i_R + C_R - C_P + 2\beta[\text{var}(r_R)]}{2\beta[\text{var}(r_P) + \text{var}(r_R)]} \quad (4)$$

$$C'_P(I_P^*) = -\beta\theta\lambda'_P(I_P^*) \quad (5)$$

$$C'_R(I_R^*) = -\beta(1-\theta)\lambda'_R(I_R^*) \quad (6)$$

Equations (4) to (6) represent equilibrium first-order conditions for the three choice variables, which are simultaneously determined and clearly interdependent. By totally differentiating equations (4) to (6), it is possible to solve for reduced form expressions that calculate the effect of changes in exogenous variables and model parameters on the equilibrium values of the choice variables. We present these comparative statics results in the Appendix.

The solution to the model suggests several factors that influence a bank's allocation of loans across neighborhoods:

- The bank lends a larger proportion of its loan portfolio in the poor neighborhood when the contractual interest rate on neighborhood *P* loans rises relative to that on neighborhood *R* loans.
- When the variance of neighborhood *P* returns falls relative to that in neighborhood *R*, the proportion of loans in neighborhood *P* rises. Assuming that the risk-adjusted return to lending in the rich neighborhood is higher before $\text{Var}(r_P)$ declines, the relative advantage of the wealthier neighborhood is eroded.[14] Similarly, factors that reduce the cost of obtaining information about neighborhood *P* relative to that for neighborhood *R* increase the proportion of loans to neighborhood *P*. Clearly, if information is less costly to obtain in one area, more information is acquired, thereby reducing the relative variance of returns to that neighborhood.
- The effect of an increase in risk aversion (or the expected default rate) is less clear and depends, among other things, on the spread between contractual interest rates and differences in variances of the two neighborhood returns. As β rises, the value of reducing the portfolio's variance rises, pushing the solution toward the minimum variance portfolio. For low initial levels of θ, the effect of an increase in β is to shift the portfolio toward neighborhood *P* loans to capture the advantages of portfolio diversification. At high values of θ, similar diversification incentives shift the loan portfolio toward neighborhood *R* loans.

The solution to the model is depicted graphically in Figure 1. The figure shows how different allocations across neighborhoods affect profits, holding constant the optimal quantities of information, I_P^* and I_R^*. The curve labelled π_P represents the portion of adjusted returns attributable to lending in neighborhood *P*. The π_R curve is the equivalent measure for neighborhood *R* loans. The curve marked π is the vertical sum of the π_P and π_R curves, representing the bank's total profits as a function of θ. At $\theta = 0$, the entire bank portfolio is allocated to neighborhood R loans and the total adjusted return is thus equal to π_R. Conversely, at $\theta = 1$, the bank's portfolio consists entirely of loans to neighborhood P projects and total returns are derived from π_P. The two functions, π_P and π_R are concave in θ.[15] Their curvature creates the total return function that, in the current figure, rises over some portion of values of θ, and then falls. The profit-maximizing bank chooses the highest point on the total return curve, with an optimal credit allocation equal to θ^*.

Factors that raise the marginal profit of neighborhood P loans relative to that of neighborhood R loans will increase θ^*. For example, an increase in i_P relative to i_R, or a decrease in the variance of r_P relative to that of r_R will rotate π_P upward, and tend to move θ^* to the right. An increase in β will increase the concavity of both profit functions, and θ^* will increase if it was very low initially and if the increased concavity raised the marginal profit of neighborhood P loans more than that for neighborhood R loans.

In the solution shown in Figure 1, neighborhood P is not redlined, that is, the optimal credit allocation implies $1>\theta>0$. It is possible, however, to derive a redlined solution in the current framework. Redlining will occur if the marginal profit from lending to the poor neighborhood, represented by the slope of the π_P function, is less than the absolute value of the slope of the π_R function at low levels of θ. In such a case, the total return function slopes downward over its entire length, with a maximum value occurring at $\theta = 0$. In this case, the profit-maximizing bank would allocate all of its loans to neighborhood R projects and would redline neighborhood P.

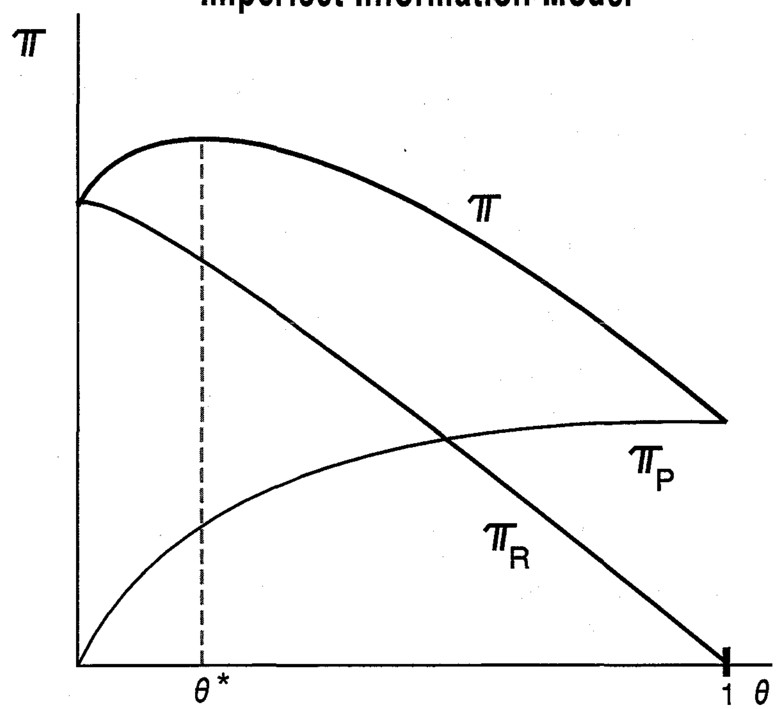
II. The Effect of Information

The equilibrium lending pattern across neighborhoods, shown in Figure 1, is directly affected by the information gathering process. As we demonstrate in this section, the equilibrium values of all three choice variables are highly interdependent, with optimal investment in information about both neighborhoods determined simultaneously with the decision about portfolio shares.

The optimal investment in information about the two neighborhoods is closely related to the portfolio allocation decision. The first-order conditions for I_P and I_R, equations

Figure 1

Optimal Credit Allocation in the Imperfect Information Model



(5) and (6), suggest that the bank should invest in information until the marginal cost of the last units acquired (the left-hand sides) just equals the value of the reduced portfolio risk (the right-hand sides). (Note in equations (5) and (6) that $\lambda_i' < 0$ and $C_i' > 0$).

Comparative statics results for the information choice variables, derived in the Appendix, show several factors that affect the optimal information acquisition:

• The amount of information acquired is positively related to the share of loans allocated to that neighborhood. Thus, θ and I_P move together. Whenever the bank allocates more of its loan portfolio to the poor neighborhood, it also is in the bank's interest to acquire more information about neighborhood P borrowers and projects. Because more of the portfolio is at risk in the neighborhood, the marginal benefit of information about that neighborhood rises. Any factor that raises the optimal value of θ, such as a relative increase in contractual interest rates on neighborhood P loans or a decrease in the risk of neighborhood P projects, also will induce the firm to obtain more information about the poor neighborhood.[16]

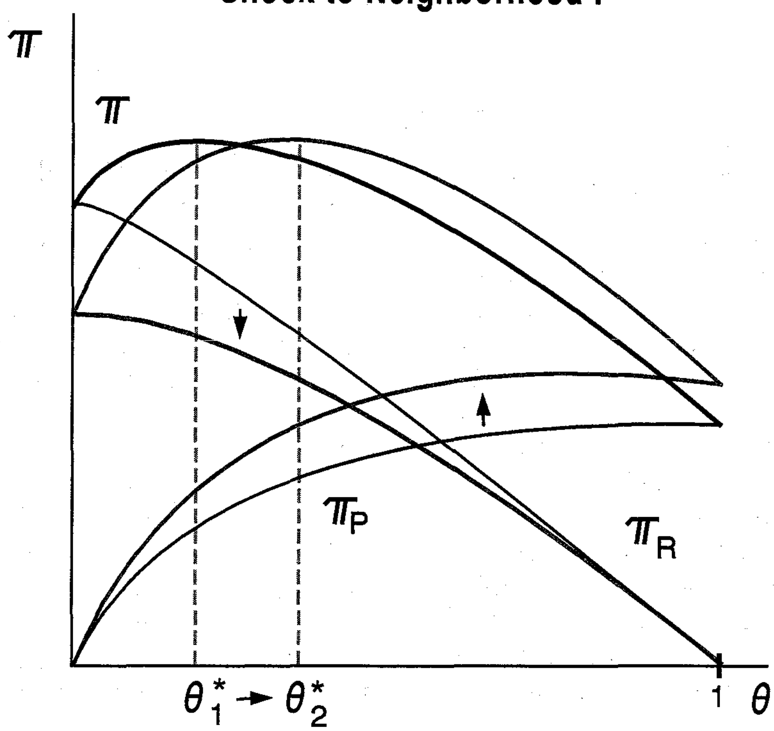
• The amount of information purchased also depends on the degree to which more information reduces portfolio variance. If additional information about neighborhood P becomes less valuable because some exogenous factor negatively affects the bank's perception about the neighborhood's risk, the marginal benefit falls. The bank then reduces the amount of information it obtains about the poor neighborhood, and allocates less of its portfolio to neighborhood P loans. The opposite effect occurs if the marginal benefit of I_R falls; that is, the bank responds by increasing its allocation of loans to the poor neighborhood and purchasing more information about neighborhood P. These results suggest that information investment in the two neighborhoods is a choice between substitutes: factors that raise the value of information in one neighborhood also reduce the relative value of information about the other neighborhood. This result is dependent on our assumption that information about one neighborhood does not affect the variance of projects in the other neighborhood.

• Factors that reduce the marginal cost of information for one neighborhood will increase investment in information in that neighborhood. As discussed in Section IV, pooling arrangements and collaboration with community groups can reduce the marginal cost of information to an individual bank. Banks will then increase information to balance marginal costs and benefits.

• Finally, the solution to the model depends on the relationship between defaults and portfolio variance. Obviously, if there were no defaults, (that is, $\beta = 0$) the bank

Figure 2

Effect of Positive Information Shock to Neighborhood P



would not invest in information at all. Information is only valuable for its variance-reducing content. As the sensitivity of adjusted returns to portfolio variance increases, that is, as β rises, the value of information rises, and the bank invests in more information about *both* neighborhoods.

The role of information gathering in our model can be seen in Figure 2. The black curves represent the initial equilibrium depicted in Figure 1. We suppose that a positive shock occurs to neighborhood P that raises the return to information. For example, a firm announces its intention to build a manufacturing plant in neighborhood P, with plans to hire many local workers. This announcement should lead to better income prospects for neighborhood P residents, and raise the credit quality of the pool of applicants in that neighborhood. The assumed shock to neighborhood P increases the bank's perception of the marginal benefits of additional information. (This implies that λ_P' increases in absolute value as a result of the announcement.)

The higher marginal benefit of information about neighborhood P induces more investment in that information. As a result, π_P shifts upward. The higher profit schedule, therefore, boosts the optimal θ. The rise in θ also boosts the marginal benefit of information in neighborhood P, while reducing the marginal benefit of information in neighborhood R, thereby reinforcing the initial information shock. The bank responds by increasing the information investment in the poor neighborhood even more, further shifting the π_P curve in Figure 2 up to the green line. At the same time, the marginal benefit to neighborhood R information falls relative to its marginal cost. The bank reduces its information investment in the rich neighborhood, resulting in a downward shift of the π_R curve in Figure 2. The new equilibrium implies that the bank responds to the positive shock in the poor neighborhood by raising the portion of its portfolio allocated to neighborhood P loans, increasing the amount of information purchased about neighborhood P, and reducing the information investment in neighborhood R.[17]

This imperfect information framework may shed light on empirical studies claiming to find evidence of neighborhood redlining. Given the cost of obtaining information, it would not be surprising to observe banks using general neighborhood characteristics to evaluate return functions, as well as to assess information costs. This type of information is widely available at relatively low cost. To the extent that racial and other social characteristics are correlated with overall economic variability, returns can appear to be a direct function of these characteristics. Moreover, as the costs of finding the lowest risk loans rise, the potential for credit rationing increases in neighborhoods with characteristics correlated with higher risks. Use of these characteristics as a screening device may therefore represent a first guess by lenders as to default risk in different neighborhoods. Once banks choose (or are induced) to make more substantial investments in information, however, the relevance of general neighborhood characteristics may give way to more costly borrower- or project-specific data that carry more information content. In the context of our model, CRA represents one such inducement.

III. The Role of CRA

CRA can be considered an additional regulatory constraint imposed on banks, thereby affecting their optimal portfolio allocation across neighborhoods. As we show in this section, the basic model presented in Section I can be easily modified to capture the essential features of CRA.

Congress passed the Community Reinvestment Act partially in response to community groups' claims that previous anti-discrimination laws had failed to keep banks from redlining. A financial institution is said to redline if it indiscriminately denies loans for the purchase of property in certain "undesirable" neighborhoods within its market area. In hearings prior to the drafting of what became the CRA, statistically-based studies were presented (New York Public Interest Research Group, 1977; National Peoples Action, 1976) that claimed to confirm the existence of redlining, despite the earlier passage of the Equal Credit Opportunity Act (1974) and the Home Mortgage Disclosure Act (1975).

It is true that those earlier laws may not provide effective sanctions against redlining. While the Equal Credit Opportunity Act prohibits discrimination in credit transactions on the basis of race, color, religion, national origin, sex, marital status, and age, it does not outlaw geographic discrimination. The Home Mortgage Disclosure Act requires financial institutions to disclose data on the volume of mortgage loans by census tract or zip code, but does not proscribe geographically discriminatory loan policies.

CRA requires federal regulators to motivate commercial banks and thrift institutions to meet community credit needs by considering a financial institution's record of community lending when they evaluate its applications for mergers or acquisitions. Members of the public also may formally protest an application if they think that the institution's record with regard to lending in certain neighborhoods is unsatisfactory.

The primary purpose of CRA, which is expressed in purposefully vague language, is subject to debate. An often-used, narrow interpretation is that CRA is an anti-redlining bill. In this view, the critical issue becomes one of identifying clear evidence that banks engage in irrational redlining. Otherwise, enforcement of CRA is not needed.

The evidence in redlining studies is inconclusive. Several studies have found average neighborhood racial and other social characteristics to be significantly correlated with lending activity even after controlling for a variety of other influences. However, these studies have been criticized for excluding important variables or using incorrect data—factors that can lead to overestimates of the importance of race or other social factors in neighborhood lending. (For a discussion of empirical studies of redlining, see the box entitled "Evidence of Redlining.")

CRA is viewed more broadly in this study, however. Rather than an anti-redlining law, CRA is viewed here as a mechanism to increase disadvantaged neighborhoods' access to credit whether or not redlining was actually occurring. This broader view of CRA is consistent with two recent developments. In February 1989, the Federal Reserve Board denied on CRA grounds an application by Continental Illinois to acquire another institution, even though Continental Illinois was not believed to be engaged in redlining *per se.*

Also, in 1989, the federal regulatory agencies[18] revised the guidelines for compliance with the CRA, and established more stringent and specific standards. However, because CRA requires that lending be consistent with "safety and soundness" considerations, even the new guidelines do not delineate an acceptable geographic pattern of lending. In the initial statement of the CRA, twelve criteria were to be used in evaluating a lender's record of compliance. One of the criteria states that regulators are to consider "the geographic distribution of the bank's credit extensions, credit applications, and credit denials." The 1989 amendment refers to "unwarranted geographic differences in lending patterns," and to "disparities in lending that do not appear to be attributable to safety and soundness considerations or to factors beyond an institution's control." What would make these geographic differences unwarranted or unattributable to safety and soundness considerations is not stated.

In light of this broader perspective on CRA, two alternative interpretations of the application of CRA have emerged. The regulatory mandate requires that financial institutions search harder for good loans in disadvantaged neighborhoods, but does not outlaw the rationing of credit or require banks to make riskier loans. The law imposes on banks and thrifts the costs associated with expending the effort to seek out high-quality borrowers in areas that are perceived as riskier.

In this "effort-oriented" approach, a bank is penalized for noncompliance with CRA if it demonstrates insufficient efforts to meet the credit needs of the community it serves. The penalties take the form of delays in processing, or even denial of, applications for mergers and acquisitions. CRA examination ratings consider the extent to which the bank conducts outreach programs, educates the public on its policies, and aggressively markets its products in low-income neighborhoods.

Effort, however, may not translate into a greater amount of funds lent to poorer neighborhoods. Recent CRA protests, therefore, have focused more on results than on effort. Challenges to bank mergers and acquisitions on CRA grounds have been raised when community groups have claimed that those institutions failed to meet a "socially acceptable" minimum level of lending in lower-income neighborhoods. In order to avoid the CRA "penalty," banks have responded with specific commitments of loan funds to those neighborhoods.

Modelling CRA

In modelling the effect of CRA, it is necessary to choose between the regulatory interpretation and the more recent results-oriented application of CRA. An "effort-oriented" approach would focus on the amount of information the bank acquires. In contrast, a "results-oriented" approach emphasizes θ, the proportion of the portfolio allocated to the low-income neighborhood. We have chosen to model the latter interpretation.

In the context of our imperfect information model, CRA has the effect of establishing a minimum proportion of the bank loan portfolio allocated to the poor neighborhood. The value of this minimum allotment is determined by a social welfare function that is exogenous to our model. We refer to the socially acceptable minimum level of credit allocated to the poor neighborhood as $\overline{\theta}$. We assume that CRA imposes a penalty on the bank (delays in processing applications, negative publicity, etc.) if it fails to allocate at least this proportion of its loan portfolio to neighborhood P loans. We characterize this penalty by the function:

$$d(\overline{\theta} - \theta) \tag{7}$$

where $d(.) > 0$ when $\theta < \overline{\theta}$, and $d(.) = 0$ when $\theta \geq \overline{\theta}$.

Evidence of Redlining

Concerns over social responsibility in lending complicate the issue of redlining because the characteristics of a neighborhood in which a loan is made affect the likelihood of default. Barth, Cordes, and Yezer (1979) find that even after taking into consideration the effects of intercity differences in per capita income, foreclosure rates are higher in blighted neighborhoods, on properties in poor condition, and, among other things, on houses constructed of wood siding.

When financial institutions cannot vary mortgage rates among borrowers sufficiently to accommodate differences in the likelihood of default, it should not be surprising to see them lend in neighborhoods where the likelihood of default is low and avoid areas where default is more probable. That is, a competitive financial system can be expected to equalize expected rates of return on loans, after adjustment for probabilities of default. Thus, high denial rates in the high-risk neighborhood need not reflect redlining in the normally accepted sense of the term.

The empirical literature that attempts to identify redlining is subject to controversy. A common criticism (Benston, 1981; Sullivan and Pozdena, 1982; Jones and MacLennan, 1987) leveled at such research is that it often ignores factors that would motivate reasonable differences in mortgage lending activity among neighborhoods. That is, such literature is often said to give insufficient consideration to default-related factors such as those identified by Barth, Cordes, and Yezer (1979).

Moreover, reports that purport to confirm the existence of redlining and that were presented at the 1977 Hearings on Community Credit Needs that preceded enactment of the CRA are among those claimed (Benston, 1981) to be particularly susceptible to such criticisms.

In addition, a number of studies that do consider loan-risk factors as determinants of differentials in neighborhood lending patterns (Richardson and Gordon, 1979; Hutchinson, Ostas, and Reed, 1977; Ostas, Reed, and Hutchinson, 1979) fail to find evidence consistent with redlining as defined above.[1] In such studies, even though measures of mortgage extensions vary among neighborhoods, the variance can be explained chiefly by factors that would generate differential perceptions of loan risk among the neighborhoods.

Nevertheless, some recent research does point to the possible existence of redlining in the sense noted here. Bradbury, Case, and Dunham (1989) find that even after accounting for neighborhood differences in wealth, income, housing values, vacancy rates, the percentage of properties that are commercial and industrial, the presence of depository institution offices, and a number of other neighborhood characteristics, loan activity per number of Boston-area housing units is still negatively associated with the percentage of neighborhood resident population that is black.[2] Jones and MacLennan (1987) argue that they find evidence of redlining in Glasgow, Scotland, but they suggest that the process occurs through loan officer guidance of potential borrowers toward some neighborhoods and away from others. However, neither study identifies neighborhoods in which no mortgage lending took place, and a number of structure-specific default-related characteristics noted in other studies, such as Barth, Cordes, and Yezer (1979) are not considered.

In sum, redlining may or may not exist in a narrowly defined sense, but some geographic differentials in mortgage lending most certainly do arise. Moreover, the Community Reinvestment Act discourages such differentiation unless extremely compelling reasons dictate it, and imposes penalties when there is evidence to suggest that lending patterns differ significantly across geographic regions.

NOTES

1. Hutchinson, Ostas, and Reed (1977) note that their results "are consistent with the hypothesis that redlining takes place on the basis of risk aversion . . . [rather than] on a taste for discrimination." Richardson and Gordon (1979) find study areas in predominantly black West Oakland, California not to be "mortgage deficient" relative to surrounding areas.

2. However, it should also be noted that Barth, Cordes, and Yezer (1979) found that the likelihood of a mortgage default was significantly higher if the borrower was black. It is possible that both the Bradbury, Case, and Dunham (1989) results and the Barth, Cordes and Yezer (1979) results are linked to other characteristics, such as income stability, that are correlated with, but not caused by, race. Moreover, in discussing his own work in the field, Canner (1981, p. 68) notes that "[i]t must be emphasized that evidence of racial discrimination in institutional mortgage lending found in this study, as well as others, should be properly viewed outside the redlining process per se. While racial minorities tend to congregate geographically, the redlining process cuts across racial lines."

The post-CRA net return function for the bank, therefore, becomes:

$$\pi = i_P\theta + i_R(1-\theta) - \beta\text{var}[r_P\theta + r_R(1-\theta)] - C_P(I_P)\theta - C_R(I_R)(1-\theta) - d(\bar{\theta}-\theta) - r_d \quad (8)$$

and the optimal portfolio share in neighborhood P loans becomes:

$$\theta_{CRA} = \frac{i_P - i_R + C_R - C_P + 2\beta[\text{var}(r_R)] + d}{2\beta[\text{var}(r_P) + \text{var}(r_R)]} \quad (9)$$

The only difference between (4) and (9) is that d now appears as an argument in the numerator. As the penalty for allocating too little credit to neighborhood P increases, the bank's optimal share of lending to P rises accordingly.

With the imposition of the CRA penalty, where binding, the post-CRA value of θ exceeds the value obtained in Section I by the ratio of the penalty to the weighted sum of the return variances, thus increasing the bank's lending in the poor neighborhood. The bank now treats the CRA penalty as an additional cost of doing business and, in effect, chooses the optimal penalty.

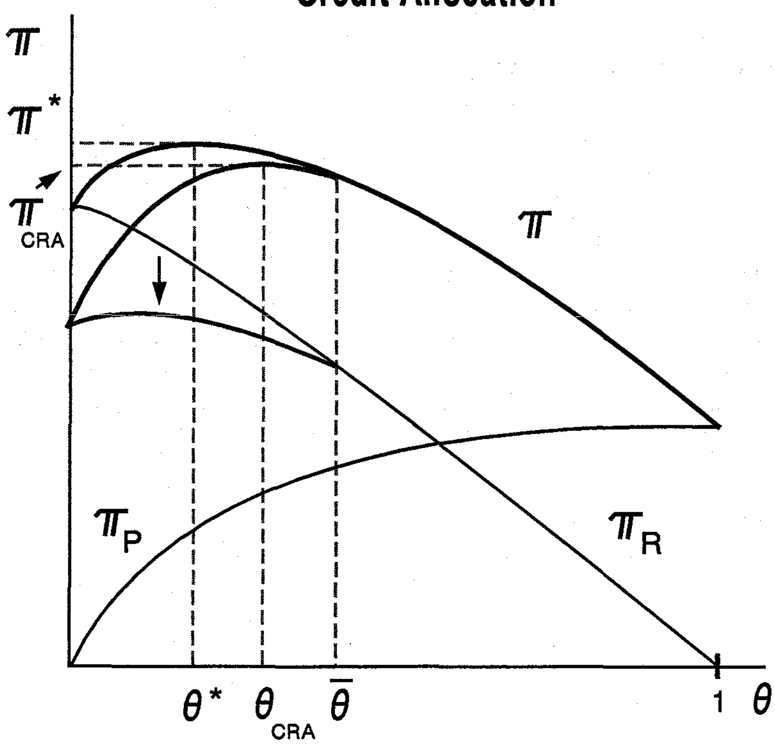
The influence of CRA on the model's solution is depicted graphically in Figure 3. Again, the solid curves represent an initial equilibrium, with θ^* the pre-CRA optimal portfolio allocation. In the presence of the CRA penalty, the returns to neighborhood R loans are reduced for all portfolio allocations below $\bar{\theta}$. The bank must pay the CRA penalty for not allocating a sufficient amount of its portfolio to neighborhood P loans. This is shown in Figure 3 by the downward shift of the π_R function for all values of θ less than $\bar{\theta}$. Our assumption that the penalty increases the further θ^* is from the social optimum is presented by the increasing distance between the black and green curves as θ approaches zero.

As the CRA penalty shifts down a portion of the π_R function, it also shifts the total return function for all values of θ less than $\bar{\theta}$. The profit-maximizing bank chooses the highest point on the total return function, in this case corresponding to the value θ_{CRA}. This portfolio allocation is closer to the socially optimal value of θ than the original solution. CRA thus has the desired impact of raising the proportion of the bank's portfolio allocated to neighborhood P loans. Moreover, the larger the penalty, the larger is the resulting shift in the portfolio allocation.

The achievement of this goal, however, comes at a cost. Total returns for the bank are smaller after the imposition of CRA (as long as the CRA constraint is binding and the actual, as opposed to perceived, risks of lending in neighborhood P are higher than those in neighborhood R). CRA imposes an additional cost on the bank and induces it to increase its lending to the neighborhood with the higher expected return variance. Total returns decline because this

Figure 3

Effect of CRA on Optimal Credit Allocation



higher variance is associated with a greater probability of default. From the bank's standpoint, CRA has an undesirable impact. In essence, CRA forces the bank to pay the social cost of increased lending to the poor neighborhood.[19]

One beneficial side-effect of CRA is its impact on information gathering. Figure 3 does not show the separate information effects that augment the impact of the penalty. Banks seek to reduce the penalty by raising θ, which in turn raises the marginal benefit of information in neighborhood P. Banks, therefore, invest more in I_P and less in I_R. The change in information investment shifts the π_P and π_R curves as in Figure 2, reinforcing the increase in θ_{CRA}, and moving it closer to $\bar{\theta}$. Thus, the ability to invest in information moves the equilibrium credit allocation even closer to the socially desired value than is shown in Figure 3.

This informational effect of CRA potentially can mitigate some of the cost of complying with the law. If the bank's initial perception of the low-income neighborhood's risk was too high, CRA's incentive to gather more information can lead the bank to discover that there are far more high-quality loans that can be made in the area than it initially believed. Of course, the increased information also may confirm the bank's initial characterization of the neighborhood's risk. And, in fact, if credit quality is too low, the bank may choose to redline and pay the regulatory penalty.

CRA's effect on information, as modeled here, also achieves the "effort-oriented" enforcement of CRA. Banks are encouraged to aggressively seek loans to boost their portfolio of low-income neighborhood loans, thus satisfying the regulatory interpretation of the law.

IV. Implications and Institutional Developments

One particularly attractive feature of the imperfect information model is its potential to explain the emergence of post-CRA institutional arrangements. The model suggests that socially suboptimal lending occurs in part because the costs of finding good loans are too high, not necessarily because good loans cannot be made in a particular neighborhood.

A predictable response of banks to this new regulatory constraint is to seek ways to minimize the cost and risks of complying with CRA regulations. Several arrangements have emerged in the financial community to reduce the cost of CRA compliance. First, as an explicit response to CRA, financial institutions in a number of states have formed multi-institution consortia[20] which not only lower the per-institution cost of information, but allow participants to share credit risks. A prime example is the California Community Reinvestment Corporation, in which major lenders in the state have pooled funds in a separate entity whose sole directive is to find and make loans in disadvantaged neighborhoods. Since these same individual institutions perform many other types of loan functions in-house, it is clear (and is sometimes explicitly stated) that the establishment of such consortia serves the purposes of lowering per-institution costs of information and of spreading risk in a lending process where such costs and risks are relatively high.

Second, some banks allow non-profit community groups to perform the initial applicant screening for CRA-related loans.[21] This approach lowers the costs of information for the lending institution by shifting part of the search and monitoring costs to the community groups. This approach also may reduce default risks since the community group, by placing its "reputational capital" on the line, has an interest in encouraging the borrower to follow the terms of the loan. It also increases community group sensitivity to the credit-risk problems faced by institutions when lending in certain areas.

Third, some banks form separate corporations for CRA activity which allow banks to take equity positions in the borrower as well as debt positions.[22] Joint loan-equity positions, when they are possible, have been shown to increase the monitoring and information gathering capability of the lender.[23,24]

Two points are particularly interesting with regard to all of these arrangements. First, these strategies are explicitly targeted at CRA and are not widely applied to other lending problems. Second, all of these strategies are aimed at reducing the costs of obtaining neighborhood information and possibly at spreading risk.

The model provides an explanation for these arrangements and an interpretation of their effects on lending to disadvantaged neighborhoods. Consider, first, a post-CRA arrangement in which a number of banks pool their resources to obtain and share information about the poor neighborhood. If we assume that N banks participate in the consortium (each as an equal partner), then for each unit of information the individual bank purchases, it receives $N-1$ units through the consortium sharing agreement. In effect, for a given quantity of information, the cost to the individual bank is split among N institutions. The neighborhood P cost function thus becomes $C_P(I_P)/N$. Maximizing the modified adjusted return function yields the following solution for θ:[25]

$$\theta_{POOL} = \frac{i_P - i_R + C_r - \frac{C_P}{N} + 2\beta[\mathrm{var}(r_R)] + d}{2\beta[\mathrm{var}(r_P) + \mathrm{var}(r_R)]} \qquad (10)$$

For a given quantity of I_P, θ is unambiguously larger than in the previous case where each bank obtains neighborhood P information on its own. Clearly, if information costs are lower, the optimal perceived return function for the bank is higher. (In fact, if N becomes so large that per-institution costs become very small, the return function may approach the full-information returns function, and problems caused by imperfect information may be fully mitigated.)

Referring back to the diagrammatic treatment, a decline in information costs acts the same way as that portrayed in Figure 2. Because the marginal cost of a given amount of information falls with pooling, the optimal amount of information gathered rises and the marginal profit function for neighborhood P loans shifts outward, generating an increase in lending to that neighborhood.

Pooling arrangements increase the total amount of information gathered. To see this, consider the first-order condition for neighborhood P information and the resulting partial equilibrium solution for marginal cost:

$$\frac{C'_P(I^*_P)}{N} = -\beta\theta\lambda'_P(I^*_P) \qquad (11)$$

For a given value of neighborhood P information, the marginal cost is lower than in the previous case, and probably lower than the marginal benefit of investing in information. Each bank in the consortium faces a private incentive to invest in more information since they share the costs. The net result is a quantity of I_P that is greater than the case without the consortium. The cost-pooling arrangement thus yields a greater investment in information than the case where all banks operate alone. Such pooled arrangements appear to be particularly cost-effective mechanisms for overcoming problems of imperfect information in lending markets.

Although such methods may minimize the costs of CRA compliance, it is important to emphasize that participating banks still can be expected to be worse off compared to the no-CRA case. If pooling arrangements yielded profits similar to those in the wealthier areas, banks would have had an incentive to form joint ventures before CRA was adopted.

That consortia form under CRA and not without CRA suggests several properties of the cost function. There are economies of scale in information that were not exploited previously. Thus, a bank's costs can be reduced by sharing information, increasing total information while cutting individual information gathering. Moreover, the minimum efficient scale of lending necessary to satisfy CRA may be too high for one bank to enter separately and make normal profits. The consortium, in contrast, may be able to attain a scale of lending activity sufficient to make CRA-related lending profitable. Finally, the costs of forming and maintaining a lending consortium may have prevented pre-CRA arrangements of this type. The benefits of reducing the CRA penalty, however, act to offset these costs.

This result suggests that even with pooling arrangements, profits are lower under CRA. Otherwise, (a) it would not be necessary to form consortia, or (b) if the expected return to lending in the neighborhood is sufficiently high, such consortia would have formed without CRA.

The other arrangements, that is, the involvement of community groups and the use of greater equity control, offer similar advantages in reducing information costs. Community groups may have lower costs of finding good borrowers because of their familiarity with the neighborhood and the potential borrowers. Greater equity control offers lower monitoring costs to the bank, although it does not reduce the initial information cost of finding the loans.

The two most prominent methods, the use of community groups and bank-pooling arrangements differ in their distribution of costs. The use of community groups is attractive to banks since the information costs are passed along to the community and not borne directly by the bank. However, to the extent that banks have a comparative advantage in identifying good loans, that approach may be less efficient. The costs of bank pooling operations are directly borne by the stockholders or customers of the banks, but they have greater control over the lending process.

Other potential arrangements also can be envisioned within this framework. If the costs of complying with social goals put banks at a competitive disadvantage, it might be appropriate to use government funds to subsidize the cost of gathering information, rather than effectively taxing banks as occurs at present. Government agencies could assist community group efforts in screening, or they could subsidize information costs or risks through tax credits. In such ways, the costs of social policy can be directly transferred to society, rather than indirectly through the effect on bank costs, which are borne by bank customers and owners.

V. Summary and Conclusions

In this article, we incorporate CRA policies explicitly in a microeconomic model of bank behavior. We demonstrate that CRA can be viewed as an additional cost or tax on banks when they fail to achieve some socially desirable balance of lending across neighborhoods. Moreover, part of the effectiveness of CRA derives from its inducements to banks to increase lending in disadvantaged neighborhoods—costs that it would not otherwise undertake if CRA were not imposed.

Previous studies have not explicitly modeled the linkage between bank behavior and CRA. Instead, for the most part, they have dealt with the empirical question whether neighborhoods are rationed on the basis of non-economic factors. These studies have been concerned not with *how* CRA affects lending activity, but with *whether* CRA was needed to correct some systematic bias in lending patterns.

In the context of our model, differences in neighborhood lending patterns arise in response to differences in the perceived risks of lending in certain areas. Thus, given the costs involved in obtaining information about neighborhoods, these lending patterns may be optimal from the standpoint of a private, profit-maximizing bank. However, our interpretation of the CRA suggests that it has been invoked to overcome what is viewed as *socially suboptimal* lending in disadvantaged neighborhoods.

The current study provides a better understanding of the relationship between bank behavior and the application of the CRA. Results from this study lead to several conclusions. First, CRA places the social cost of more geographically even lending directly on banks. Banks are, in effect, taxed in such a way as to force them to achieve social goals, with bank customers or shareholders paying the cost of the policy.

Second, by imposing a penalty, CRA will increase lending to disadvantaged neighborhoods—an effect that is reinforced in the model by the assumption of imperfect information. When banks are induced by CRA to increase lending in the poor neighborhood, the value of information about that area rises. The induced investment in information increases the bank's knowledge about the poor neighborhood and may reveal additional low-risk loan projects. Information effects thus raise the proportion of the portfolio allocated to poor neighborhood loans over and above the direct effect of the CRA penalty.

An important policy question arises: if lending patterns are suboptimal from society's standpoint, is it efficient and equitable to place the cost of that social policy on banks? Other mechanisms can be found to lower the cost of information about some neighborhoods, and banks could be subsidized in their information costs rather than taxed.

The policy question raised by this article is whether CRA is the most efficient way to achieve this social goal. Future researchers may wish to shift their focus from whether lending to various neighborhoods is sufficient, to comparing the relative advantages of other mechanisms that can remove the informational inefficiencies that inhibit the desired investing activity.

Moreover, the "penalty function" implicit in CRA offers only one incentive structure for banks to increase their search activity. This approach, which offers vague regulatory penalties on mergers and acquisitions, may not offer the most efficient incentives to banks to increase their lending to disadvantaged neighborhoods. By starting from a clear understanding of the cause of the suboptimal lending—namely, differential risks, exacerbated by costly information—the incentive structure to achieve that goal can be crafted more efficiently.

NOTES

1. See, for example, James (1987).

2. Sullivan and Pozdena (1982) make the distinction between rational redlining, where differential lending occurs as a result of differences in future prospects of borrowers or projects, and irrational redlining. The latter is arbitrary and discriminatory. In our model, only rational redlining occurs.

3. This return includes the explicit interest charged on loans as well as other fees and payments that may be required by the lender. These fees include such items as closing costs, origination fees, prepaid interest, etc. Booth (1990) finds that loan fees play an important role in the pricing of bank commercial loans and that loan fees assume an extensive variety of forms.

4. Although banks have considerable latitude to vary interest rates, collateral requirements, and various fees, some flexibility may be sacrificed to gain advantages of scale through standardization. Moreover, recent work by Jaffee and Russell (1990) suggests that lenders may be limited in their ability to differentiate loan terms because of social pressures regarding "fairness," as well as legal limits associated with discrimination.

5. According to the notion of adverse selection, increases in interest rates may discourage safer borrowers and attract riskier ones who have a lower probability of repaying the loan. The increase in interest rates has an adverse effect on the quality of loan applicants and may actually lead to lower expected returns for lenders (after accounting for defaults). This adverse selection effect limits the extent to which interest rates can reflect loan risk. See the box on Imperfect Information vs. Credit Rationing.

6. In the credit rationing literature, Stiglitz and Weiss (1987) implicitly argue that banks choose to allocate credit sequentially to different borrower classes. The bank chooses a loan rate to each class that maximizes the expected utility (return) from loans to that group, taking into account the adverse selection problem. Consequently, rates differ to different groups, but the differences in rates are not necessarily constructed to yield the same expected return.

7. Although this assumption may appear quite restrictive, relaxing it does not affect the general nature of the results. As long as rates do not fully reflect underlying risks, changes in risk will affect expected returns to the bank. In the model discussed here, changes in variance induced by information do not affect loan rates. This can be generalized easily by making loan rates a direct function of risk, in which case there would be some partially offsetting effect on loan rates. This would reduce the magnitude of the effect on portfolio allocation resulting from a change in risk, but it would not change the direction of the effect.

8. In practice, the volume of loans is an endogenous variable that may be at least partially determined by the bank's deposit-taking activities in the two neighborhoods. For purposes of this discussion, however, the assumption of an exogenous total loan volume is not crucial.

9. Information problems may be more acute in the poor neighborhood if banks have fewer branches in those areas. A smaller deposit base makes branching in poor neighborhoods less profitable. In this way, deposit-taking activity can exacerbate information asymmetries across neighborhoods and impinge on the lending decisions.

10. Although this assumption simplifies the ensuing analysis, it is somewhat restrictive. At the very least, we believe that any covariance between these errors is likely to be positive, a relationship that mitigates somewhat, but does not change, the predictions of the model presented below. Negative cross correlations between neighborhood information sets seem unlikely.

11. This assumption is not unreasonable given that deposit insurance in U.S. banking markets has covered virtually 100 percent of deposits.

12. An alternative reason for the negative relationship between returns and variance has to do with the nature of the debt contract. The probability of default rises with variance, as does the probability of a high payoff to the project owner or borrower. Since lenders cannot receive more than the loan rate when favorable outcomes occur, they are not compensated for the increased probability of default. Thus, lenders' returns have a truncated distribution, the mean of which falls as the variance of returns to project owners rises. This is true even if the rising variance is mean preserving.

13. Clearly, the expected loss parameter β could be an increasing function of the portfolio's variance. In that case, the loss associated with having greater variance would be higher than in the case derived here, further encouraging the movement away from the riskier neighborhood.

14. The share of loans made in neighborhood P also increases as the full-information variance of returns in R rises: as $\sigma_R^2 \to \infty$, $\theta \to 1$. An interesting case arises when the two neighborhoods are identical. In this case, variances of returns in the two areas are the same, as are the information cost functions and the interest rates on loans. In this setting, the bank allocates half of its loan portfolio to each neighborhood. Since there are neither greater loan risks in one neighborhood relative to the other nor greater costs of obtaining information, the bank treats both areas the same in its lending activity.

15. The concavity of these return functions can be shown using the full solution to the model presented in the Appendix. We assume, for simplicity, that the two functions are monotonic. Thus, π_P rises continuously as θ increases while π_R falls as θ rises. It is possible that these two functions might be sufficiently concave to slope downward at their ends, a possibility that only reinforces the results presented here.

16. We assume that the economies of scale in information gathering drop off rapidly, in the sense that the negatively sloped portion of the marginal cost schedule occurs only at very low levels of I_P. In practice, banks would tend to operate on the positively sloped portion of the marginal cost curve, such that an increase in θ increases the amount of information acquired.

17. As long as the marginal benefit of information regarding a particular neighborhood exceeds its marginal cost, additional information will shift the return function from that neighborhood upward. Once information investment reaches the optimum, however, any additional investment in information will reduce returns and the π function will shift downward.

18. These regulators include the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Office of the Comptroller of the Currency, and the Office of Thrift Supervision (formerly the Federal Home Loan Bank Board).

19. Banks may be able to pass some of these costs on to their customers in the form of reduced services, higher fees, etc. If costs are too high, in fact, a bank may choose to drop the neighborhood as part of its market area, thus passing the costs on to the community.

20. See Mannion and Faber (1989) p. 26.

21. See *U.S. News & World Report* (1989), pp. 26-27.

22. See Mannion and Faber (1989), p. 26.

23. See Kim (1989).

24. An alternative strategic response of banks could be to close branches and limit their service area. Some evidence of this effect is presented for the Phoenix metropolitan area by Booth and Smith (1984), where CRA had a negative impact on branching. Limits are imposed on this ability, however, with community groups seeking regulatory prohibitions to such closures.

25. To the extent that pooling also spreads risks and reduces the variance of low-income neighborhood loans to pool participants, $\mathrm{Var}(r_P)$ also may fall in expression (10), further increasing θ.

APPENDIX

The three first-order conditions from the model yield a system of three equations in three variables, θ, I_P, and I_R. We can totally differentiate this 3-equation system and then solve it in terms of the exogenous variables and parameters of the model. The results of this exercise represent the "complete" solutions to the model in that they take account of all interactions among the variables. In matrix notation, the system of three equations can be represented (after total differentiation) as:

$$Ax = y$$

where

$$A = \begin{bmatrix} \{-2\beta[\mathrm{var}(r_R) + \mathrm{var}(r_P)] + d''\} & (-C'_P - 2\beta\theta\lambda'_P) & [C'_R + 2\beta(1-\theta)\lambda'_R] \\ (-\beta\lambda'_P) & (-\beta\theta\lambda''_P - C''_P) & (0) \\ (\beta\lambda'_R) & (0) & [-\beta(1-\theta)\lambda''_R - C''_R] \end{bmatrix}$$

$$x = \begin{bmatrix} d\theta \\ dI_P \\ dI_R \end{bmatrix}$$

$$y = \begin{bmatrix} di_P + di_R - 2\{\mathrm{var}(r_R) - \theta[\mathrm{var}(r_R) + \mathrm{var}(r_P)]\}\, d\beta + 2\beta\theta d\sigma_P^2 + 2\beta\,(1-\theta)d\sigma_R^2 \\ \theta\lambda'_P d\beta \\ (1-\theta)\lambda'_R d\beta \end{bmatrix}$$

The solution for the vector, x, requires inverting matrix A, i.e.,

$$x = A^{-1}y.$$

The inversion process includes evaluating the determinant of A. In order to ascertain the sign of this determinant, it is necessary to place certain restrictions on the magnitudes of the second order derivatives of the $C(\bullet)$ and $\lambda(\bullet)$ functions in the model. These restrictions entail requiring the second-order own derivatives of these functions (with respect to each neighborhood) to dominate second-order cross effects (i.e., *between* neighborhoods). In addition, we assume that first-order effects generally dominate second-order effects. These restrictions are reasonable and not likely to be violated.

With the above-imposed restrictions, we obtain the following general form:

$$x = A^{-1}y = \begin{bmatrix} (-) & (-) & (+) \\ (-) & (-) & (-) \\ (+) & (-) & (-) \end{bmatrix} [y].$$

This equation system leads to the following set of results:

$$\frac{\partial\theta}{\partial i_P} > 0 \qquad \frac{\partial I_P}{\partial i_P} > 0 \qquad \frac{\partial I_R}{\partial i_P} < 0$$

$$\frac{\partial\theta}{\partial i_R} < 0 \qquad \frac{\partial I_P}{\partial i_R} < 0 \qquad \frac{\partial I_R}{\partial i_R} > 0$$

$$\frac{\partial\theta}{\partial\beta}\ ?\ 0 \qquad \frac{\partial I_P}{\partial\beta} > 0 \qquad \frac{\partial I_R}{\partial\beta} > 0$$

$$\frac{\partial\theta}{\partial\sigma_P^2} < 0 \qquad \frac{\partial I_P}{\partial\sigma_P^2} < 0 \qquad \frac{\partial I_R}{\partial\sigma_P^2} > 0$$

$$\frac{\partial\theta}{\partial\sigma_R^2} > 0 \qquad \frac{\partial I_P}{\partial\sigma_R^2} > 0 \qquad \frac{\partial I_R}{\partial\sigma_R^2} < 0$$

We have also considered the impact of parameters that shift the costs entailed in gathering information (α_i), the underlying return variance (γ_i), and the CRA penalty function (δ).

$$\frac{\partial\theta}{\partial\alpha_P} < 0 \qquad \frac{\partial I_P}{\partial\alpha_P} < 0 \qquad \frac{\partial I_R}{\partial\alpha_P} > 0$$

$$\frac{\partial\theta}{\partial\alpha_R} > 0 \qquad \frac{\partial I_P}{\partial\alpha_R} > 0 \qquad \frac{\partial I_R}{\partial\alpha_R} < 0$$

$$\frac{\partial\theta}{\partial\gamma_P} < 0 \qquad \frac{\partial I_P}{\partial\gamma_P} < 0 \qquad \frac{\partial I_R}{\partial\gamma_P} > 0$$

$$\frac{\partial\theta}{\partial\gamma_R} > 0 \qquad \frac{\partial I_P}{\partial\gamma_R} > 0 \qquad \frac{\partial I_R}{\partial\gamma_R} < 0$$

$$\frac{\partial\theta}{\partial\delta} > 0 \qquad \frac{\partial I_P}{\partial\delta} > 0 \qquad \frac{\partial I_R}{\partial\delta} < 0$$

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