Government Intervention in the Mortgage Market: A Study of Anti-Redlining Regulations

Ronald W. Masulis*

Abstract: This paper addresses the question of whether economic incentives exist for mortgage lenders to avoid or to minimize mortgage originations in neighborhoods inhabited primarily by low-income racial minorities. The Option Pricing Model is utilized to determine what mortgage borrower characteristics affect the market value of the mortgage contracts. It is found that existing laws do not enable mortgage lenders to vary either origination prices or mortgage terms so as to adjust for differences in the market values of mortgages. As a result, incentives are created for both the mortgage lender and the mortgage insurer to avoid originations and underwritings in areas with relatively high default probabilities. Various changes in mortgage lending regulations are suggested to eliminate these incentives, and the effects of alternative programs to subsidize mortgage borrowers with relatively high default probabilities are considered.

Forthcoming: Journal of Monetary Economics, 1982

*University of California, Los Angeles, and the Federal Home Loan Bank Board. I would like to thank George Benston, Henry Cassidy, Michael Jensen, Herbert Johnson, Philip Jones, Thomas King, Susan Wachter, H. Martin Weingartner, the referee of this journal, and the workshop participants at the University of Pennsylvania, the University of Rochester, the University of Southern California, and Vanderbilt University for their comments. This analysis does not necessarily represent the views of the Federal Home Loan Bank Board or the Office of Policy and Economic Research.

1. Introduction

The federal government has in recent years made serious efforts to deter alleged 'redlining' in the origination of mortgage loans, as manifested in the enactment of the Fair Housing Act of 1968, the Equal Credit Opportunity Act of 1974, and the Community Reinvestment Act of 1977.[1] Federal regulations implementing these statutes have broadly interpreted redlining as the practice by which mortgage lenders either refuse to originate mortgages or offer less desirable mortgage contract terms in certain geographic areas usually associated with low incomes, racial minorities, or older dwelling units. In the hearings preceding the passage of these statutes, it was alleged that this refusal to lend is motivated by racial or ethnic bias. This allegation raises an intriguing question from an economic perspective given that mortgage lending is a competitive industry where profit maximizing firms would not be expected to ignore potential customers.[2] Can apparent redlining behavior reflect underlying economic differences among mortgage applicants correlated by geographic area which cause mortgage lending to be unprofitable in specific areas? Answering this question requires a careful examination of the mortgage lending process.

Such an examination involves separating mortgage lending into its major economic activities of (a) mortgage origination and servicing, (b) default-free financing of capital needs and (c) default risk-bearing on the mortgage loan. While these activities can all be undertaken by mortgage lenders, they are frequently handled separately by mortgage bankers specializing in (a), purchasers of Ginnie Mae (GNMA) mortgage pools specializing in (b), and mortgage insurers specializing in (c). In the analysis that follows, differences in mortgage borrower characteristics are found to affect the probability of mortgage default and therefore the market values of mortgage contracts. Consequently, the mortgage lenders and insurers involved in activity (c) have economic incentives to treat potential mortgage borrowers differently.[3] An important related question which this paper addresses is the impact of anti-redlining legislation on the economic incentives for mortgage lenders to originate mortgages in allegedly redlined areas.

This study begins with the development of a valuation equation for a simple mortgage contract based on the Option Pricing Model. This valuation equation is used to analyze the economic attributes of the real estate collateral and the borrower that affect the market value of the mortgage. A summary of the existing regulatory environment within which mortgage lenders operate and the implications for the mortgage origination process follows. This regulatory environment, by restricting lenders' ability to vary mortgage terms, creates incentives for lenders to avoid originating mortgages to relatively risky borrowers. Potential ways for lenders to circumvent some of the effects of these government regulations are considered. It is also shown how government subsidies to mortgage lenders have increased their incentives to originate relatively risky mortgages. The impacts of introducing mortgage insurance are explored by developing a valuation equation for these insurance contracts. It is found that differences in borrower and real estate collateral characteristics affect the market values of mortgage insurance contracts. Government regulations are shown to affect the underwriting decisions of mortgage insurers. The existence of collateral's hazard risk is also shown to affect the mortgage lending decision. Finally, various mortgage subsidy programs aimed at low income minority borrowers are evaluated, followed by a summary of the paper's major conclusions.

---

[1] Also see Executive Order 11063 (1962) which covers mortgage insurance.

[2] The competitive nature of the mortgage market can be seen from the number of competing mortgage lenders in a given area. These include individual savings and loan associations, commercial banks, savings banks, mortgage bankers and individual investors.

[3] While there is also evidence that expected servicing costs rise with the probability of mortgage default, this is considered a second-order effect, hereafter to be ignored.

2. Valuation of mortgage contracts

A rigorous analysis of the impacts of borrower attributes on mortgage values requires a mortgage valuation model such as that developed in this section. A mortgage contract has as its basic feature a long-term loan, where the collateral is a risky real estate asset which gives the borrower the right to the service flow of the collateral over the life of the loan. The well-known valuation equation for a simple loan contract with a single payment date and no default costs is based on the Black–Scholes (1973) Option Pricing Model (OPM), extended by Merton (1974a, b) to dividend paying assets and simple debt contracts.[4]

Following Smith (1980), the OPM can be used to value a simple mortgage contract under the following assumptions:

(a) Rational investors operate in a perfect capital market. That is, there are no transaction costs, no transaction related taxes, and all participants have free access to all available information and are price takers.
(b) There are homogeneous expectations about the dynamic behavior of real estate prices.
(c) The distribution of the market value of real estate at the end of any finite period is lognormal where the real estate's rate of return variance σ^2 is stationary. The real estate experiences a known continuous rate of depreciation (or appreciation) which is equal to a constant fraction of the real estate's market value.
(d) There is a known and stationary riskless interest rate.
(e) There are no default costs or costs of foreclosure.[5]

Given these assumptions, the following valuation equation for the mortgage's current market value D can be derived:

$$D = V\,e^{-st}N(d_1) + L\,e^{-rt}N(d_2), \quad \text{where}$$
$$d_1 = \frac{\ln\left(V\,e^{-st}/L\,e^{-rt}\right)}{\sigma\sqrt{t}} + \frac{1}{2}\sigma\sqrt{t} \quad \text{and} \quad d_2 = d_1 - \sigma\sqrt{t}, \tag{1}$$

ln = natural log,
$N(\,)$ = standard cumulative normal distribution function,
V = market value of the risky real estate asset,
L = face value of the mortgage,
t = time to maturity on the mortgage loan,
s = rate of depreciation (appreciation) on the real estate,

[4] The Black–Scholes Option Pricing Model assumes that: there is no interest rate risk, the only collateral on the mortgage is the risky real estate, and payment of interest and principal all occurs in a balloon payment at maturity. (While the last assumption is not completely realistic, it does not affect the qualitative results of this paper.) Default-free interest rate risk is ignored in order to focus on the issue of mortgage default and to keep the mortgage valuation equation relatively simple. Recent formulations of the valuation model for mortgage loan contracts have included more realistic payment schedules for interest and principal [see Asay (1979)] and foreclosure and bankruptcy costs [see Smith (1980)].

[5] While this is often a realistic assumption, it is relaxed in the next section of the paper. This implies that it is rational for the mortgage borrower to default on the mortgage contract at the maturity date when the market value of the risky real estate falls below the principal and interest or face value of the mortgage.

r = riskless (default-free) interest rate,
σ^2 = rate of return variance = real estate's valuation risk.

This mortgage valuation equation has the following properties:[6]

$$1 > \partial D/\partial V, \quad \partial D/\partial L > 0 \quad \text{and} \quad \partial D/\partial r, \quad \partial D/\partial s, \quad \partial D/\partial v, \quad \partial D/\partial t < 0.$$

These comparative statics offer some insights into the economic properties of the mortgage valuation equation. In particular, the mortgage's price is a positive function of the mortgage's principal and interest rate,[7] and a negative function of: (a) the ratio of loan face value to market value of collateral (called the loan to value ratio) L/V, given a fixed mortgage face value (principal plus interest), (b) the valuation risk of the collateral, defined as the collateral's rate of return variance, σ^2, (c) the time to maturity of the mortgage t,[8] (d) the rate of depreciation of the collateral s, and (e) the riskless interest rate.

One significant property of the mortgage valuation equation indicated by the comparative statics is that a larger real estate depreciation rate yields a lower mortgage market value, holding the market value of the real estate fixed. This follows because the market value of the depreciated collateral is smaller at maturity, increasing the probability to default and the expected loss conditional on default.[9]

A second important property uncovered by the comparative statics is that higher real estate valuation risk causes a lower market value for the mortgage, even after taking account of the market value of the real estate.[10] Furthermore, it can be shown that the probability of default is a

---

[6] This model implicitly assumes that the appraised market value, depreciation rate and valuation risk of the real estate are certain values which can costlessly be observed by market participants. In practice, appraisal of a real estate's market value is largely determined by recent sales prices of comparable housing units in the same geographic area. The valuation risk of the real estate can generally be estimated by the historical rate of return variance of comparable housing units in the same or similar geographic areas, assuming the real estate is insured against hazards such as floods, fires, etc. However, if recent changes or revisions in expectations of future changes occur in a neighborhood, a historical rate of return variance estimate should be adjusted for this new information. An estimate of the real estates' depreciation (or appreciation) rate can be obtained from the mean price change of a time series of recent sales of comparable housing units deflated for inflation. This estimate may need to be adjusted if there has been a recent change of significance in the neighborhood character such as an increase in the number of abandoned buildings or a change in the level or type of business activity in the neighborhood or if the particular real estate unit exhibits an atypical maintenance level and/or age.

[7] The risky mortgage interest rate R obviously exceeds the riskless interest rate r. This mortgage interest rate on a single payment loan is calculated by realizing that $D = Le^{-Rt}$, so that $R = 1n(L/D)/t$, and when the mortgage's origination price equals its market value, the total interest paid on the mortgage loan equals $L - D$.

[8] Note that the borrower generally has no incentive to pay back the loan early since $\partial D/\partial t < 0$, and since the borrower is obtaining the service flow from the real estate over the life of the mortgage. Further, because there is no interest rate risk, there is no incentive to pay off the loan early for the purpose of refinancing the loan at a lower interest rate.

[9] There is also the possibility that the borrower could have some control of the real estate depreciation rate through the discretionary maintenance expense decision, though this can be partially controlled by lender mandated maintenance requirements included in mortgage loan covenants, an issue explored by Smith (1980). Implicit in the above problem is the more general issue of uncertainty about the depreciation rate and the adverse selection problem caused by asymmetric information about the depreciation rate between the lender and the borrower (the latter being assumed to be better informed). These issues will not be pursued in this paper.

[10] That is to say, even though the market value of the collateral is affected by the risk characteristics of the collateral, the total risk of the collateral still directly affects the market value of the *mortgage.* For example, the Capital Asset

positive function of the real estate's valuation risk, given the legal requirement applying to all major mortgage lenders that the loan to value ratio not exceed 95 percent at the time of origination.[11] Further, the market value of the mortgage can also be shown to be a negative function of the probability of default. This follows from the fact that the value of a mortgage at maturity is the minimum of the mortgage's face value and the market value of the depreciated risky real estate, $D^* = \min (L, V^*)$, where L is greater than V^* under default, given the previous assumptions. Thus, it follows that higher real estate valuation risk implies a higher probability of default and therefore a lower market value for the mortgage.[12]

3. The valuation effects of default costs and attachable assets

Under the previous assumptions, the probability of default on the mortgage is independent of the borrower's financial condition or credit rating. Smith (1980) shows that with the addition of borrower borne default costs X to the model, the probability of default will be lower.[13] If these default costs are positively related to the borrower's credit rating, the market value of the mortgage will be dependent on the borrower's credit rating. If lenders are allowed to attach a portion of the borrower's other assets under mortgage default, the relevant collateral is not simply the real estate but also the attachable assets. As a result, the borrower decision to default is determined by whether the market value of the real estate plus attachable assets, W^* exceeds $L - X$ or not. With this additional collateral, the probability of default is again decreased. Further, while the market value of the mortgage increases, it also becomes dependent on the market value of the attachable assets.[14]

Pricing Model (CAPM) implies that the collateral's price is affected only by the non-diversifiable risk of the collateral, not the total risk of the collateral which affects the loan's price. Also note that lenders cannot avoid the collateral's risk through diversification across mortgage loans.

[11] In the context of a pure discount loan, adjusted for the real estate's depreciation rate, this maximum loan to value ratio implies that $Ve^{-st} \geq Le^{-rt}$. This condition, in turn, implies that the expected market value of the real estate at mortgage maturity exceeds the face value of the mortgage, $E(V^*) > L$.

[12] The valuation risk of the mortgage also turns out to be affected by the valuation risk of the real estate. It is a straightforward exercise to show that the valuation risk of a mortgage σ_D^2 is positively related to the valuation risk of its collateral σ^2 in the following way:

$$\sigma_D = [1/(1+\Psi)]\sigma \quad \text{where} \quad \Psi \equiv Le^{-rt}N(d_2)/Ve^{-st}N(-d_1).$$

See Galai–Masulis (1976) for a more extensive treatment of this issue. This implies that the valuation risk of the mortgage is proportional but smaller than that of the real estate since $\sigma \geqq 0$ and $0 \leqq \Psi$. Further, the comparative statics of the mortgage's valuation risk indicate that it is a positive function of both the real estate's depreciation rate and valuation risk. The comparative statics are

$$\frac{\partial \sigma_D}{\partial \sigma} = \left[\frac{1}{1+\Psi}\right]\left[1 - \left(\frac{\sigma}{1+\Psi}\right)\left(\frac{\partial \Psi}{\partial \sigma}\right)\right] > 0 \quad \text{since} \quad \frac{\partial \Psi}{\partial \sigma} < 0 \quad \text{and} \quad \frac{\partial \sigma_D}{\partial s}$$

$$= \frac{\Psi\sqrt{t}}{1+\Psi}\left[\frac{Z(d_2)}{N(d_2)} + \frac{Z(-d_1)}{N(-d_1)}\right] > 0,$$

where $\partial \Psi / \partial \sigma < 0$ can be derived from the results in the appendix to Galai–Masulis (1976).

[13] Examples of these default costs are moving expenses, the difference between the borrower's valuation of the rental service flow of his customized house and the generally lower market valuation, and costs of a loss of credit standing.

[14] The introduction of lender borne default costs, z, decreases the market value of the mortgage as shown by Smith (1980) in the case of default and foreclosure costs which are linearly related to the market value of the real estate

Combining the assumptions of borrower borne default costs and attachable assets yields the modified mortgage valuation equation.[15]

$$\bar{D} = W\, e^{-st} N(-\hat{d}_1) + L\, e^{-rt} N(\hat{d}_1 - \sigma\sqrt{t}), \tag{2}$$

where

$$\hat{d}_1 = \frac{\ln\left(We^{-st}/(L-X)e^{-rt}\right)}{\sigma\sqrt{t}} + \frac{1}{2}\sigma\sqrt{t}$$

The comparative statics for this mortgage contract are identical to the simpler contract except that the mortgage's market value is now a positive function of the borrower borne default costs and the market value of the borrower's attachable assets. Consequently, the lender now has an incentive to not only be concerned with the real estate attributes but also with the value of the borrower's attachable assets and the income flow from the borrower's non-attachable assets net of maturing obligations. Such concern is manifested in the loan acceptance criteria of all major mortgage lenders. Since both high real estate valuation risk and depreciation rates imply a higher probability of mortgage default and therefore lower mortgage prices, real estate with either of these traits will be termed high-risk real estate; and borrowers using such real estate as collateral or having a poor credit rating and attachable assets of low market value will be termed high-risk borrowers.

4. Neighborhood real estate characteristics

In shifting focus from individual borrower to the neighborhood, it is important to take into account the empirical fact that housing price changes are generally positively correlated and often highly correlated in a given geographic area. This is reflected in the almost universal appraisal policy guideline which compares recent sales prices of similar housing units in the same geographic area. This positive correlation in real estate values implies that high-risk real estate should generally be clustered. As a result, we would expect to observe mortgages with relatively low market values, ceteris paribus, in these high-risk neighborhoods.[16] This positive correlation in real estate price changes also implies that depreciation rates of real estate are positively correlated within a given geographic area. Consequently, we would expect in neighborhoods composed of real estate with relatively high rates of depreciation to observe mortgages with relatively low market values, ceteris paribus.

Presently there is little empirical evidence available on the relationship between real estate valuation risk and depreciation rates in specific geographic areas or neighborhoods. However, there is empirical evidence that mortgage default rates differ across neighborhoods even after controlling for loan to value ratio and borrower's income and credit rating. Higher default rates are found in neighborhoods with low income, lower quality housing, and with a racial minority make-up.[17] Many of these areas also experience higher occupancy turnover rates, greater

---

collateral, $F + \emptyset V^*$.

[15] This formulation assumes that the market values of the real estate collateral and the attachable assets have unit correlation, so V can be replaced by W in the mortgage valuation equation, where the real estate's valuation risk and depreciation rate also apply to W.

[16] This conclusion has also recently been suggested by Guttentag-Wachter (1980). However, they failed to develop a mortgage valuation model to justify the proposition and consequently were unable to define the relevant measure of collateral risk which affects the mortgage's market value.

[17] See studies by von Furstenberg (1969), Williams–Beranek–Kenkel (1975), von Furstenberg and Green (1974), Marcis–Hull (1975), Schafer (1978), Barth–Cordes–Yezer (1979) and King (1981). For critiques and summaries of these and other studies see the excellent survey papers by Benston (1979) and King (1979).

incidence of abandoned real estate, and represent primarily older dwelling units, which suggests that real estate in these neighborhoods exhibits relatively high valuation risk and depreciation rates.[18]

5. Regulatory environment

Given the existence of differences in real estate valuation risk and depreciation rates, the market value of mortgages with the same principal must necessarily differ unless these differences in real estate characteristics can be offset by varying mortgage terms. Following the earlier comparative statics, a lender could offset higher real estate valuation risk or rates of depreciation by:

(a) higher loan interest rate (currently interest rates are adjusted for differences in loan to value ratios, which is one variable but clearly not the only variable affecting the probability of default),
(b) a lower loan to value ratio (implying differing down payment requirements or additional pledges of collateral), [19]
(c) a shorter mortgage maturity,
(d) appraising the real estate below its market value,
(e) assessing a high origination fee or points which act as a discount on the mortgage's origination (or purchase) price where this price is required by regulation to equal the mortgage's principal.

All of these adjustments increase a mortgage's market value except (e), which decreases its origination price. Without these differences in contract terms, mortgages will differ in market values while their origination (or purchase) prices, which are set equal to mortgage principal, will be the same.

As primary mortgage lenders for residential real estate, savings and loan associations and commercial banks must originate mortgage loans within the framework of applicable Federal rules and regulations. Federal laws do not explicitly prohibit lenders from charging different interest rates to borrowers having different real estate valuation risk or depreciation rates. Nor do these laws explicitly prohibit lenders from adjusting for these differences in collateral characteristics by varying the combination of mortgage loan terms. However, under existing anti-redlining regulations (especially those implementing the Fair Housing and Equal Credit Opportunity Acts), any lender who varies the mortgage loan terms offered to its borrowers is likely to be sued for credit discrimination and is subject to severe penalties.[20] This threat of suit effectively precludes adjustments in mortgage terms to offset differences in valuation risk or depreciation rates.[21] In their studies of mortgage lending, Benston–Horsky–Weingartner (1978),

---

[18] Since there is a significant level of non-owner occupied residential real estate investment, especially in areas with lower priced housing, borrower financial condition frequently will not exhibit high correlation within geographic areas. Consequently, unlike real estate characteristics, owner financial condition should be of little help in explaining differences in mortgage origination patterns across neighborhoods. However, it can help to explain differences in default rates across neighborhoods under mortgage subsidy systems.

[19] Note that while decreasing the loan to value ratio decreases the probability of default, it also implies larger down payments by the borrower. However, larger down payments lower the borrower's other marketable assets, which increases the probability of default.

[20] For further details on these regulations, see Barth–Cordes–Yezer (1979).

[21] Interestingly, bank regulatory agencies recognized that high loan to value ratio mortgages increase default risk,

Schafer–Ladd (1979) and King (1981) found no statistically significant evidence that mortgage lenders discriminate among borrowers with respect to mortgage terms.[22] In addition to the previously mentioned laws, federally chartered savings and loan associations and commercial banks are currently required to undertake an independent and unbiased appraisal of the market value of collateral. This precludes implicit pricing of the mortgage risk through an appraisal value below the market value of the property, which would increase the loan to value ratio and mortgage interest rate.[23]

Thus, it appears that under existing laws, mortgage terms cannot be varied across borrowers and the origination price is effectively set equal to the mortgage's principal,[24] so that differences in the valuation risk and depreciation rate of real estate cause differences in the market values of mortgages not offset by differing purchase prices. These differences in mortgage market values reflect the differences in default probabilities and their associated losses. Consequently, at a fixed origination price, the mortgages having a relatively high probability of default will realize market values which fall below their origination prices. From this analysis, it should be clear that mortgage lenders are forced to subsidize high-risk borrowers. As a consequence, economic incentives are created which make originating mortgage loans on high valuation risk or high depreciation rate real estate unprofitable.

As an alternative to subsidizing high-risk borrowers, lenders can refuse to lend to them by designing their loan acceptance criteria to exclude this group. Such loan acceptance criteria are also subject to limited federal regulation under the laws prohibiting redlining. However, under current regulations the use of loan to value ratio, monthly payments to income ratio, credit rating, and real estate quality are explicitly recognized as legitimate mortgage acceptance criteria.[25] Furthermore, under these regulations, empirical evidence that a variable other than race, color, age, marital status or national origin has a statistical relationship with mortgage defaults, can justify its inclusion in loan acceptance criteria.[26]

6. Lender alternatives to subsidizing high-risk mortgage borrowers

Requiring lenders to offer loans to both high- and low-risk borrowers on the same terms effectively forces lenders to subsidize high-risk borrowers since the low-risk borrower cannot be

---

and put restrictions on their origination. They also have recognized credit rating and income as legitimate loan acceptance criteria. However, the default risk caused by relatively high collateral valuation risk or depreciation rates is not recognized as a legitimate loan acceptance criterion in these regulations or in their enforcement.

[22] Exceptions are some evidence of slightly shorter maturities being originated in minority neighborhoods and the general policy of mortgage lenders to charge higher interest rates on higher loan to value ratios. However, these differences can only offset small differences in depreciation rates and valuation risk of borrowers. Further, the difference in loan maturities may actually be due to differences in borrower demand for mortgage contract terms rather than because of differences in lender requirements.

[23] Also appraisers fall under the Fair Housing and Equal Credit Opportunity Acts which preclude biased appraising. See Dennis (1980) for a further discussion. Further King (1981) finds no evidence of biased appraisals.

[24] Points can be charged which exceed origination expenses, but differential treatment of borrowers is not prevalent and the number of points charged is usually small.

[25] The current law also requires that a borrower obtain mortgage insurance on the top 20 percent of the loan if the loan to value ratio is between 90-95 percent. The lender may require the borrower to obtain mortgage insurance at his discretion if the loan to value ratio is below 90 percent. Thus the lender has at least one means of adjusting the loan terms for differences in collateral risk.

[26] For a further discussion of the regulations applying to mortgage loan acceptance criteria see Barth–Cordes–Yezer (1980a).

overcharged to subsidize his high-risk counterpart in a competitive mortgage market. Obviously, profit maximizing lenders will attempt to minimize this forced subsidy without violating the letter of the law and if the forced subsidy is sufficiently high, they will leave the industry.

Some government regulations go further in their drive against redlining by requiring a minimum number of mortgage loans distributed in a specific way within a geographic area surrounding lender offices or branches. This is implicitly mandated by California Administrative Code, Title 10, Subchapter 4, Section 145.7, for example. The Community Reinvestment Act of 1977 makes a less specific but similar requirement. Lenders would be expected to react to these regulations by attempting to minimize the forced subsidy through (a) closing or not opening offices or branches in high-risk areas, as suggested by Guttentag–Wachter (1980), (b) requiring full mortgage insurance of all mortgage contracts, and (c) decreasing mortgage lending as a percentage of lenders' portfolios.

7. Lender specialization as an alternative to subsidizing high-risk mortgage borrowers

Lenders could avoid subsidizing high-risk borrowers if individual lenders offered different fixed interest rates and had different minimum loan acceptance criteria for all mortgage applicants which were more stringent for the low interest rate lenders, or if the low interest rate lender specialized in originating loans in low-risk neighborhoods by judicious choice of branch office locations combined with a loan acceptance criteria restricting originations to areas adjacent to its offices. As a result, only the relatively high-risk borrower would choose to borrow from the higher interest rate lender, because the low-risk borrower who meets both lenders' mortgage acceptance criteria would obviously choose to borrow from the lower cost lender. The result would be little or no subsidy to the high-risk borrower. Yet this possibility is unlikely given the need for a large number of specialized lenders where economies of scale have to be sacrificed to attain this specialization.[27] This limitation is compounded by the prohibition against interstate branching of the major mortgage lenders. Empirically, this specialization requires a wide range of mortgage interest rates, but the observed differences in interest rates charged by various lenders in individual SMSAs appear to be quite limited.[28] This finding supports the conclusion that lender specialization is not an effective means of circumventing the government's prohibition against credit discrimination.

This is not to say that no segmentation of mortgage lending exists. Studies by the Home Ownership Development Program (1975) and the Urban Studies Center (1978) do offer some empirical evidence of a very general level of segmentation by loan acceptance criteria in the mortgage market; namely, that the riskier loans are originated by mortgage bankers under FHA and VA insurance programs, while less risky loans are made by savings and loan associations and commercial banks. S&Ls and commercial banks separate these less risky borrowers into a relatively more risky category (usually mortgages with higher loan to value ratios) which must purchase mortgage insurance and a less risky category which need not. Further, private mortgage insurers with more restrictive underwriting criteria generally charge lower premiums than under FHA and VA insurance. Overall, the evidence of market segmentation supports only a very crude differentiation among borrowers for differences in default risk. As a result, it appears unlikely that sufficient lender specialization exists to eliminate the regulatory induced incentives of lenders to avoid originating mortgages with relatively high default probabilities.[29]

---

[27] See Benston (1970, 1972) and McNulty (1981) for evidence on the economies of scale in mortgage lending.

[28] See, for example, the study by the Home Ownership Development Program (1975).

[29] Refer to the studies by the Home Ownership Development Program (1975) and Weingartner–Benston–Horsky

8. Government subsidies to high risk mortgage borrowers

The origination and servicing of mortgage loans can be separated from the lending function if the mortgages are sold in the secondary market. However, mortgage lenders cannot normally circumvent the government mandated subsidy to high-risk borrowers by selling these mortgages in the secondary market. This follows because in an efficient capital market these mortgages' higher risk will be reflected in lower market prices realized on their sale, even though these mortgages are originated (purchased from the borrower) at the generally higher mortgage principal. The difference between the origination and secondary market prices (adjusting for origination and servicing fees) represents the mortgage originator's subsidy to the high-risk borrower. Consequently, the existence of a secondary mortgage market does nothing to lessen the incentives of lenders to minimize the origination of high-risk mortgages.

If the government enters the secondary mortgage market with a standing limit order to purchase any and all mortgages offered at a fixed purchase price, all relatively risky mortgages with market prices lower than the government purchase price will be sold to the government. In that way, the government subsidizes the origination of relatively high-risk mortgages by an amount equal to the difference between the government purchase price and the secondary market price. As long as the lender's origination price is lower than or equal to the government's standing purchase price, the lender no longer has any incentive to avoid originating high-risk mortgages. In this case, the lender is being reimbursed for its subsidy to the high-risk borrower. However, it should be clear that the government should expect to realize losses on its mortgage portfolio due to a high rate of defaults. This is another manifestation of the government's subsidy to the high-risk borrower. It is important to note at this point that the mortgage originator no longer has any incentive to reject even the highest risk borrower. Consequently, the government will be forced to establish loan acceptance criteria by establishing minimum quality standards for the mortgages it stands willing to purchase if it wants to limit the size of the mortgage loan subsidies.[30]

9. The effects-of mortgage insurance on the mortgage lending process

A lender can effectively increase the interest rate charged on relatively risky mortgages by requiring these borrowers to purchase mortgage insurance.[31] Thus the default risk on the mortgage is shifted from lender to the insurer, while the borrower pays an effective interest rate equal to the mortgage interest rate plus the insurance premium, which is assessed per dollar of mortgage face value insured. This suggests that, if the anti-redlining legislation didn't effectively prohibit variable mortgage insurance requirements across borrowers, one should observe a higher frequency of mortgage insurance on high-risk loans (when it is not required by government regulation, i.e., for loan to value ratios below 90 percent) so that mortgage insurance would be expected to be much more prevalent in high-risk neighborhoods. One should also observe higher

---

(1980).

[30] The FHA liberalized their mortgage underwriting criteria in 1966 and 1968 under sections 223 and 225 programs. After realizing large losses from mortgage defaults, the FHA reversed itself and tightened its previous mortgage insurance underwriting criteria by suspending implementation of the section 235 program. See Wachter (1980) for more details.

[31] However, at least part of the demand for mortgage insurance is created by government regulations, namely (a) the Federal Home Loan Bank Board requirement that mortgages originated by savings and loan associations at loan to value ratios between 90-95 percent must have mortgage insurance on the top 20 percent of the loan's value, (b) the FHLMC and FNMA requirements that there be mortgage insurance coverage on the top 20 percent (or 25 percent) of the mortgage value for mortgages sold to them where the loan to value ratio exceeds 80 percent (or 90 percent).

insurance coverage [insurance in excess of the top 20 percent of the loan, which is the usual coverage in VA and private mortgage insurance (PMI)] and longer periods of coverage in high-risk areas.[32]

The availability of FHA, VA and PMI mortgage insurance should act to offset at least part of the incentive for lenders not to make loans on high-risk real estate collateral. Under full coverage mortgage insurance, the lender bears no default risk on the mortgage and hence has no incentive to reject risky mortgage borrowers. In this case the lender originates and services the contract and makes an insured loan and bears no risk. This analysis implies that by increasing the availability of partial or full coverage mortgage insurance in low-income areas having a relatively high probability of default. Lender incentives not to originate mortgages in these areas can be diminished or eliminated. However, this does not necessarily imply that the mortgage insurers will find that underwriting mortgage insurance in these areas is profitable.

To see this point more clearly, consider the valuation of a mortgage insurance contract in a perfect mortgage insurance market when there are no costs of default or foreclosure, and under the previously stated OPM assumptions. The simplest type of mortgage insurance fully covers the lender from all losses due to mortgage default for the life of the mortgage contract, as in FHA mortgage insurance. Valuation of this contract can easily be obtained using the OPM since the insurance converts the risky mortgage contract into a riskless loan. The market value of the mortgage insurance contract for the life of the mortgage can be shown to equal

$$I = Le^{-rt} - D = Le^{-rt}N(-d_2) - Ve^{-st}N(-d_1) \geq 0 \tag{3}$$

which represents the discounted value of the expected loss on the mortgage from the insurer's viewpoint.[33] This contract can also be valued directly once it is recognized that an insurance contract is equivalent to a put option which gives the holder (the insured) the right to sell a risky asset (the real estate) to the option writer (the insurer) at a fixed price (the insurance coverage) over the life of the insurance contract (until the mortgage's maturity). An important property of this valuation equation is that when the valuation risk of the real estate is eliminated, the mortgage becomes a riskless loan,[34] $D = Le^{-rt}$, and the cost and market value of fairly priced mortgage insurance is zero. Thus, it is only when the real estate has positive valuation risk that mortgage insurance is valuable.

Turning to the comparative statics of the mortgage insurance contract's market value, it is easily shown that $I = I(V, L, r, s, \sigma, T)$, where[35]

$$\partial I/\partial V, \quad \partial I/\partial r < 0, \quad \partial I/\partial L, \quad \partial I/\partial s, \quad \partial I/\partial \sigma < 0, \quad \text{and} \quad \partial I/\partial T \gtreqless 0.$$

The economic interpretation of these partial derivatives is that a rise in the collateral's market value or a fall in the loan's present value due to a rise in the riskless interest rate decreases the

---

[32] Since VA and FHA insurance limits the size of the maximum loan taken, one would also expect to find most VA and FHA loans in areas with low real estate prices, which may or may not be relatively high risk areas. It is also noteworthy that PMI covers essentially all lender borne default costs while VA and FHA insurance only cover a portion of these costs.

[33] For a more extensive derivation of the valuation formulas for various forms of insurance contracts and the properties of the resulting valuation equations, see Merton (1977).

[34] To see this, refer to eq. (1).

[35] The sign of $\partial I/\partial T$ can be negative because, as t rises, the present value of the insurance coverage Le^{-rt} was held constant, then $\partial I/\partial T > 0$.

default risk on the mortgage and hence the market value of the mortgage insurance. An increase in the mortgage interest and principal, the valuation risk, or the depreciation rate of the real estate collateral increases the probability of default and the resultant losses on the mortgage and therefore increases the market value of mortgage insurance.

Partial mortgage insurance, the type of coverage offered by VA and PMI, is less valuable than full insurance. To obtain an exact valuation formula for partial mortgage insurance on the top θ percent of the mortgage's face value, one must realize that this is equivalent to full insurance on the mortgage minus full insurance on a second mortgage whose face value equals 1-θ percent of the first mortgage, where both mortgages are written on the same risky real estate asset for the same period of time. Analytically, the market value of this partial insurance contract over the life of the mortgage is

$$\bar{I} = I(V, L, r, s, \sigma, t) - I(V, (1-\theta)L, r, s, \sigma, t)$$

$$= Le^{-rt}[N(-d_2) - (1-\theta)N(-d'_2)] - Ve^{-st}[N(-d_1) - N(-d'_1)], \qquad (4)$$

where

$$d'_1 = d_1 + \frac{\ln(\theta L)}{\sigma\sqrt{t}} \quad \text{and} \quad d'_2 = d'_1 - \sigma\sqrt{t}$$

For relatively low loan to value ratios and low real estate valuation risk and depreciation rates, the second put option in the 20% partial insurance contract generally has little value so that the market value of full insurance will not differ significantly from that of this partial insurance contract. Nevertheless, partial mortgage insurance always leaves the lender bearing some risk of loss in a default. Importantly, the comparative statics for this partial insurance contract are the same as in the full insurance contract with the addition of $\partial I/\partial\theta > 0$. Thus the market value of the partial insurance contract is also a positive function of the valuation risk and depreciation rate of the real estate collatera1.[36]

If mortgage insurance is priced to reflect the differences in real estate valuation risk and depreciation rates, a borrower would effectively be paying a market interest rate on his loan which was based on the risk of loss from mortgage default. Furthermore, the mortgage insurer would have no incentive to avoid underwriting the risky mortgage borrower.

10. Impact of government regulations on mortgage insurance

While there are clear incentives for mortgage insurers to vary premiums to reflect differences in real estate valuation risk and depreciation rates, the threat of suit for credit discrimination under Executive Order 11063 issued in 1962, and more recent anti-redlining legislation effectively preclude private mortgage insurers from adjusting their mortgage insurance premiums in this way. In practice, mortgage insurance is quoted on a fixed price per dollar of mortgage face value insured, adjusted only for: (a) the percentage of face value covered by the insurance (e.g., the top 10, 20, or 30 percent), (b) the length of time over which the

[36] The market value of mortgage insurance is increased when lender borne default expenses are covered by the insurance. With the introduction of borrower borne default expenses, the market value of mortgage insurance falls and is affected by the financial condition of the borrower. To derive these results simply replace d_1 and d_2 in eq. (3) with $\hat{d}_1$ and $\hat{d}_2$ from eq. (2).

insurance coverage extends (though the medium coverage is one year, renewal is guaranteed), and (c) the loan to value ratio.[37] Since the risk of loss from mortgage default is also a positive function of the real estate's valuation risk and depreciation rate, which are *not* priced in the insurance premium schedule, this has the effect of shifting the incentive to reject relatively risky mortgages from the lender to the mortgage insurer. Under this pricing structure the high-risk borrowers are effectively being subsidized by the insurer because there is a higher risk of loss from these borrowers even though they are charged the same price per dollar of insurance. As a consequence, existing anti-redlining regulations create strong economic incentives for mortgage insurers to avoid the underwriting of mortgage insurance in high risk areas through mortgage underwriting guidelines to lenders which specify acceptable mortgage characteristics. These underwriting guidelines are modeled after the Federal Home Loan Mortgage Corporation (FHLMC) and the Federal National Mortgage Association (FNMA) guidelines to lenders which describe mortgages acceptable for purchase by these government agencies.[38]

Under existing anti-redlining regulations, underwriting relatively high risk mortgages is not profitable because individual insurers are effectively prohibited from varying mortgage insurance premiums for differences in mortgage default risk. However, if individual insurers specialized in mortgages with different levels of default risk and charged premiums commensurate with the restrictiveness of their underwriting guidelines, they could avoid subsidizing the high risk mortgage borrowers. However, this would entail a loss of economies of scale otherwise realizable by mortgage insurers.[39] Empirically, such specialization would imply a wide range of premiums across insurers which are correlated with the exclusiveness of their underwriting criteria. Such dispersion in mortgage insurance premiums is not observed. Instead, it appears that most of the high-risk mortgage insurance contracts which are underwritten are insured through the government-sponsored VA and FHA programs.[40]

11. Real estate hazard insurance

The market value of real estate collateral at any future point in time is negatively related to the probability of hazard (e.g., fire, flood, earthquakes). These events cause negative jumps in the price of the real estate which can trigger mortgage default, causing the lender to bear much of the hazard risk. Under the Black–Scholes OPM, jumps in the real estate's market value in short periods of time are ruled out. However, under the more general OPM formulation developed by Merton (1976) and Cox–Ross (1976) jumps are possible. In these latter models, the mortgage's value is affected not only by the real estate's valuation risk measured by its rate of return variance, but also by the probability of finite jumps in its value and the probability distribution of the jump's size and direction. In the Merton model, it is further assumed that (a) the probability of a jump's occurrence in any period of time is Poisson distributed,[41] and (b) the distribution of

---

[37] This is based on the premium schedule of Mortgage Guarantee Insurance Corporation, the largest private mortgage insurer.

[38] See 'How to Package and Sell Conventional Home Mortgage Loans to the Mortgage Corporation' by the FHLMC, 1978.

[39] For evidence of significant economies of scale in the insurance industry see Cummins–Van Derhei (1979) and Doherty (1981).

[40] For evidence of this, see the studies by the Home Ownership Development Program (1975) and the Urban Studies Center (1978).

[41] Further, it is assumed that the Poisson process which determines the occurrence of jumps has probability measure with compact support and is independent of the standard Gauss–Wiener process which determines the smooth (non-jump) changes in the value of the risky real estate asset.

any jump's magnitude is arbitrary, though jumps must be independent and identically distributed.[42] A special case of this model is where the jump size is non-random, negative and equal to the current value of the underlying risky asset. This can be interpreted as the case when occurrence of the hazard causes the real estate's market value to go to zero. In this special case, the mortgage's market value is

$$\bar{D} = Ve^{-\delta t}N(-\bar{d}_1) + Le^{-(r+\lambda)t}N(\bar{d}_2) \tag{5}$$

where

$$\bar{d}_1 = \frac{\ln(Ve^{-\delta t}/Le^{-rt}) + (\lambda + \frac{1}{2}\sigma^2)t}{\sigma\sqrt{t}}, \qquad \bar{d}_2 = \bar{d}_1 - \sigma\sqrt{t}$$

and $\lambda \equiv$ the mean number of hazards occurring per unit of time.

The comparative statics of this formulation are identical to the simpler Black–Scholes formulation except that the market value of the mortgage is now a negative function of λt, the probability of at least one hazard occurring in period *t*. It is important to realize that when the probability distribution of the jump magnitude is concentrated around large negative jump values, a small increase in the probability of a hazard can cause a large change in the market value of the mortgage.

Differences in hazard risk vary greatly across real estate, causing large differences in real estate valuation risk. If these hazard risks remain uninsured, lenders would need to charge much higher interest rates to compensate them for bearing risk of loss from mortgage defaults when hazards occur. This would imply very significant differences in mortgage interest rates across borrowers if mortgage loan portfolios are to remain profitable. Likewise, if mortgage insurers included coverage of hazard related losses, they would need to charge highly variable mortgage insurance premiums to remain profitable. However, as previously shown, such actions are effectively prohibited under current anti-redlining legislation. As a result, it is not surprising that mortgage insurance does not cover losses resulting from hazard related mortgage defaults and that all major lenders require borrowers to have hazard insurance whenever the probability of hazard is not negligible (e.g., probability of fire is almost always considered non-negligible and in flood prone areas, flood insurance is required also). In addition, this hazard insurance must be continued for the life of the mortgage where the minimum level of coverage is the unpaid mortgage principal and interest.[43] As a result of this requirement, the valuation risk of real estate is decreased and made more homogeneous.

The probability of hazard is generally similar within a neighborhood, so that neighborhoods can be classified in terms of the level of hazard risk.[44] Under perfect competition, hazard insurers

---

[42] It is also assumed that the distribution of the jump's magnitude is independent of the return on the market portfolio.

[43] It is noteworthy that mortgage insurance requires the borrower to have hazard insurance coverage equal to the greater of: (a) the unpaid principal and interest on the mortgage; (b) minimum coverage level necessary to avoid risk sharing of the hazard by the borrower. In standard homeowners' policies, this is a coverage requirement of 80 percent of real estate structure's appraised value. Also, if the hazard insurance is cancelled and not renewed at any point in the life of the mortgage, the lender stands to bear substantial risk which is not covered under standard mortgage insurance contracts. As a result, it is not surprising that a mortgage is considered to be in default if the hazard insurance coverage is lost.

[44] For instance, residential fire insurance rate schedules are in large part determined by neighborhood. A detailed discussion of these rate schedules is found in Bickelhaupt (1974).

would offer coverage in any area where policies were profitable; however, for policies to be profitable in different neighborhoods, the insurance rates need to be very different to reflect the differences in the risk of loss. In areas with high probabilities of hazard, insurers actually refuse to offer insurance coverage.[45] In part, this is due to municipal and state insurance regulators having placed or threatening to place explicit or implicit ceilings on premiums combined with a prohibition against selective cancellation of policies where these regulations are justified on the basis of alleged price discrimination by hazard insurers.[46] When high hazard risk neighborhoods are also low income, minority neighborhoods (which can often be true of fire hazards), these hazard insurance underwriting guidelines effectively eliminate loan originations in these areas, as noted by Agelasto and Listokin (1977) and U.S. Department of Housing and Urban Development (1978).[47] This result occurs because hazard insurance coverage, which is not available in these high-risk neighborhoods, is needed to make mortgage originations profitable under existing anti-redlining regulation.

12. Eliminating regulations which cause mortgage originations to be unprofitable

This analysis leads to a set of alternative proposals for eliminating those regulations which have combined to cause higher risk mortgage originations to be unprofitable. These regulatory changes in one way or another allow the mortgage lender to vary his origination price or mortgage contract terms so as to offset differences in default probabilities due to differences in real estate valuation risk and depreciation rates and the borrower's credit rating and market value of attachable assets. These proposals, which require modification of current anti-redlining legislation, are

(a) Allow mortgage interest rates to be adjusted by the property's depreciation rate and valuation risk,[48] or, alternatively, allow for differences in origination prices or points charged to adjust for differences in real estate valuation risk and depreciation rates.

(b) Allow the lender to offset differences in real estate risk characteristics by offsetting changes in the acceptable loan to value ratio and mortgage maturity. (As seen from our comparative statics analysis, a decrease in this ratio or in the mortgage maturity will increase the market value of the mortgage per dollar of principal.)

(c) Allow appraisal of a property's market value to be adjusted for the property's appraised valuation risk and depreciation rate.

(d) Allow mortgage insurance premiums (per dollar of mortgage principal insured) to be a positive function of the collateral's valuation risk and depreciation rate.

13. The impact is of subsidizing high risk mortgage borrowing

In addition to altering existing regulations, the government can decrease the cost of mortgage lender originations and mortgage insurer underwritings in high risk areas through

---

[45] Hazard insurance may not be profitable in high hazard risk areas if there are large selling and administrative expenses.

[46] See the discussion of the industry's perspective on redlining in U.S. Department of Housing and Urban Development (1978).

[47] The term redlining may actually be derived from the practice of tire insurers to refuse to underwrite in certain urban areas. See U.S. Department of Housing and Urban Development report 'Insurance Crisis in Urban America', 1978.

[48] It is also likely that there is greater uncertainty about the appraised market value in the case of high-risk real estate. A conservative appraisal policy of choosing the lowest sale price of a comparable unit would allow a partial means for adjusting for the relative risk of the real estate.

government subsidies given directly or indirectly to the high-risk borrower. These subsidies include HUD's 'Housing in Declining Neighborhoods' (Section 223e) and 'Special Credit Risks' (Section 237) programs which allow FHA insurance at standard premiums but liberalized loan underwriting criteria and the Ginnie Mae tandem program where the agency stands willing to purchase relatively high-risk mortgages at a standard price regardless of their market values.[49] Unfortunately, under either government or involuntary private sector subsidy programs there are serious detrimental effects which arise when credit is made available to high-risk borrowers at below market interest rates. Furthermore, even under these programs strict government enforced underwriting requirements must be implemented if the size of the subsidy is to be limited.

The major reason that subsidizing risky mortgage borrowing causes detrimental effects is because it creates incentives for additional risk taking by individuals least able to bear the potential losses that are associated with this risk. To see this, we can again refer to the OPM to show that the probability of default on the mortgage contract described in eq. (2) is a negative function of the market value of borrower collateral and borrower borne default costs. Furthermore, the market value of the mortgage contract is a negative function of the probability of default. It follows that a liberalization of the mortgage insurance underwriting criteria, allowing borrowers with less valuable attachable assets and real estate collateral (and therefore higher loan to value ratios) and lower credit ratings (and therefore lower borrower borne default costs) to be insured, implies a higher default frequency and higher expected losses from defaults. This implies lower market values for these mortgages and therefore more valuable mortgage insurance, holding the level of insurance coverage fixed.[50] Furthermore if premiums aren't raised to reflect this higher insurance value, then high-risk borrowers receive a subsidy on their insurance equal to the difference between the market value of the mortgage insurance and the premiums charged.

The adverse effects of these subsidies only become clear when it is realized that there are dead weight losses to society from mortgage defaults and foreclosures representing borrower and lender borne costs of default. Some of the obvious lender borne costs are lost interest, legal fees associated with foreclosure, the costs and losses associated with vandalism of the real estate between foreclosure and resale. In addition, a borrower expecting to default will not have the incentive to maintain the property, contributing to a further decline in the real estate's market value. These last two default costs also contribute to neighborhood decline since nearby real estate is adversely affected by this property deterioration. Thus, mortgage loan and insurance subsidies which are aimed at improving lower income, minority neighborhoods actually can cause significant decline in these neighborhoods.[51]

14. Summary

It was shown that differences in real estate valuation risk and rate of depreciation as well as borrower credit rating and attachable asset value affect the market value of a mortgage. Given that these characteristics differ across borrowers while mortgage purchase prices are fixed by regulation, there are economic incentives to vary mortgage contract terms across borrowers to

---

[49] Note that not all of these loans are necessarily high risk. See Departmental Program, U S Department of Housing and Urban Development, August 1980, for further description of these programs.

[50] To determine the market value of full coverage mortgage insurance when borrower borne default costs and attachable assets exist, replace d_1 and d_2 in eq. (3) with $\hat{d}_1$ and $\hat{d}_2$ from eq. (2). It is easy to show that $\partial I/\partial X < 0$, and $\partial I/\partial W < 0$.

[51] A similar observation is made by Wachter (1980).

offset differences in these borrower characteristics. Further, laws which prohibit or severely penalize lenders for any variation in mortgage contract terms across borrowers actually discourage mortgage lending in high-risk areas since this higher risk of loss cannot be offset by higher interest rates, lower purchase prices or stricter terms, thereby making these mortgages unprofitable. Thus, economic incentives exist to limit the supply of mortgage loans in many low-income minority neighborhoods because of a preponderance of real estate with high valuation risk and depreciation rates.

It was shown that two effective means of eliminating the incentives not to originate mortgages in high-risk areas exist: either the government must accept (1) market pricing of mortgage originations, or (2) the offering of variable mortgage contract terms to compensate lenders and insurers for differences in mortgage default probabilities. The only alternative is for the government to offer a direct or indirect subsidy to the high-risk borrower. However, these government subsidies encourage risk taking by financially weak investors contributing to much higher mortgage default rates especially in neighborhoods primarily composed of high-risk real estate. Furthermore, mortgage default and foreclosure is frequently associated with substantial lender borne default costs representing physical deterioration in the mortgaged real estate. This deterioration, in turn, adversely affects the overall neighborhood contributing to neighborhood decline. Moreover, even these subsidy programs require the government to impose loan acceptance criteria precluding originations of especially high risk mortgages if the magnitude of these subsidies is to be controlled.

It is noteworthy that this analysis has shown that variation in mortgage loan terms and in mortgage insurance terms across borrowers which are correlated within geographic areas can often be economically justified. Consequently, the presumption that geographic variation in mortgage loan and insurance terms is necessarily motivated by racial bias is unjustified without further evidence. In addition, federal regulations which view such actions as potentially illegal cause a partial breakdown in the mortgage loan and insurance markets available to the high risk borrower because these regulations make these loan originations and insurance underwritings unprofitable for the mortgage lender and insurer.

References:

Agelasto, M. and D. Listokin, 1977, Redlining in perspective: An evaluation of approaches to the urban mortgage dilemma. In: D. Phares, ed., A decent home and environment: Housing urban America (Ballinger, Cambridge. MA).

Asay, M., Rational mortgage pricing, 1979, Research Papers in Banking and Financial Economics. July (Board of Governors, Federal Reserve System, Washington, DC).

Barth, J., J. Cordes and A. Yezer, 1979, Financial institution regulation, redlining, and mortgage markets, in: The regulation of financial institutions, Oct. (Federal Reserve Bank of Boston, Boston, MA).

Barth, J., J. Cordes and A. Yezer, 1980a, Federal government attempts to influence the allocation of mortgage credit: FHA mortgage insurance and government regulations. Presented at the Conference on the Economics of Federal Credit Activity, April 10 (Congressional Budget Office, Washington, DC).

Barth, J., J. Cordes and A. Yezer, 1980b, Defining and detecting redlining in an urban housing market, Working paper, May (George Washington University, Washington, DC).

Benston, G., 1970, Cost of operations and economies of scale in savings and loan associations, in: Study of the savings and loan industry, Federal Home Loan Bank Board (U.S. Government Printing Office, Washington, DC) 677-761.

Benston, G., 1972, Economies of scale of financial institutions, Journal of Money, Credit and Banking, May, 312-341.

Benston, G., 1979, Mortgage redlining research: A review and critical analysis, in: The regulation of financial institutions, Oct. (Federal Reserve Bank of Boston, Boston, MA).

Benston, G., D. Horsky and M. Weingartner, An empirical study of mortgage redlining, Monograph Series in Finance and Economics, no. 1978-5 (New York University, New York) 1-113.

Bickelhaupt, D., 1974, General insurance, 9th ed. (Irwin, Homewood, Il).

Black, F. and M. Scholes, 1973, The pricing of options and corporation liabilities, Journal of Political Economy, June, 637-659.

Cox, J. and S. Ross, 1976, The valuation of options for alternative stochastic processes, Journal of Financial Economics, Jan./March, 145-165.

Cummins, J. and J. Van Derhei, 1979, A note on the relative efficiency of property-liability insurance distribution systems, Bell Journal of Economics, Autumn, 709-719.

Dennis, W., 1980, Does the appraisal report unintentionally discriminate? A consideration for the reviewer, in: The National Association of Review Appraisers, ed., Principles and techniques of appraisal review (Todd Publishing, St. Paul, MN).

Doherty, N., 1981, The measurement of output and economies of scale in property-liability insurance, Journal of Risk Insurance, Sept., 390-402.

Galai, D. and R. Masulis, 1976, The option pricing model and the risk factor of stocks, Journal of Financial Economics, Jan./March, 53-81.

Guttentag, J. and S. Wachter, Redlining and public policy, Monograph Series in Finance and Economics, no. 1980-1 (New York University, New York).

Home Ownership Development Program, 1975, Home ownership and the Baltimore mortgage market, Hearings on the Home Mortgage Disclosure Act of 1975, U.S. Senate Committee on Banking, Housing, and Urban Affairs, May 5-8.

King, A.T., 1979, Redlining: A critical review of the literature with suggested research, Research working paper no. 82, Feb. (Federal Home Loan Bank Board, Office of Policy and Economic Research, Washington, DC).

King, A.T., 1981, Discrimination in mortgage lending: A study of three cities, Monograph Series in Finance and Economics (New York University, New York) forthcoming.

Marcis, R. and E. Hull, 1975, Analysis of the socio-economic determinants of foreclosures on 221(d) (2) and 235 mortgages, Federal National Mortgage Association Meeting.

McNulty, J., 1981, Economies of scale in the savings and loan industry, Federal Home Loan Bank Board Journal, Feb., 2-8.

Merton, R., 1974a, A rational theory of option pricing, Bell Journal of Economics and Management Science, Spring, 141-183.

Merton, R., 1974b, On the pricing of corporate debt: The risk structure of interest rates, Journal of Finance, May, 449-470.

Merton, R., 1976, Option pricing when underlying stock returns are discontinuous, Journal of Financial Economics, Jan./March, 125-143.

Merton, R., 1977, An analytic derivation of the cost of deposit insurance and loan guarantees: An application of modern option pricing theory, Journal of Banking and Finance, Jan., 3-11.

Schafer, R., 1978, Mortgage lending decisions: Criteria and constraints (Joint Center for UrbanStudies of MIT and Harvard University, Cambridge, MA).

Schafer, R. and H. Ladd, 1979, Equal credit opportunity: Accessibility to mortgage funds by women and by minorities (HUD, Washington, DC).

Smith, C., 1980, On the theory of financial contracting, the personal loan market, Journal of Monetary Economics, July, 333-357.

U.S. Department of Housing and Urban Development, 1978, Insurance crisis in urban Amenca, June (U.S. Government Printing Office, Washington, DC).

U.S. Department of Housing and Urban Development, 1980, Departmental programs, Aug. (U.S. Government Printing Office, Washington, DC).

Urban Studies Center, 1978, Housing in Louisville, The problem of disinvestment, July (University of Louisville, Louisville, KY).

Von Furstenberg, G., 1969, Default risk on FHA insured home mortgages as a function of the terms of financing, Journal of Finance, June, 459-477.

Von Furstenberg, G. and R. Green, 1974, Estimation of delinquency risk for home mortgage portfolios, Journal of the American Real Estate and Urban Economics Association, Spring, 5-19.

Wachter, S., 1980, The 1968 congressional FHA amendments to the national housing act: Their impact on urban areas, in: N. Glickman, ed., The urban impacts of federal policies (Johns Hopkins Press, Baltimore, MD).

Weingartner, M., G. Benston and D. Horsky, 1980, The methodology of redlining research and the Rochester

experience, Working paper, March (Vanderbilt University, Nashville, TN).

Williams, A., W. Beranek and J. Kenkel, 1975, Factors affecting mortgage credit risk in urban areas – A Pittsburgh prototype analysis, Hearings of the U.S. Senate Committee on Banking, Housing, and Urban Affairs on the Home Mortgage Disclosure Act of 1975, May 5-8, 628-657.