# Is Mortgage Lending by Savings Associations Special?[1]


Elizabeth Laderman

Economist

Federal Reserve Bank of San Francisco

Phone: 415-974-3171

Fax: 415-974-3429

elizabeth.laderman@sf.frb.org

and

Wayne Passmore

Senior Economist

Board of Governors of the Federal Reserve System

Mail Stop 89

Washington D.C. 20551

Phone: 202-452-6432

Fax: 202-452-3819

spassmore@Frb.gov



First draft: June 20, 1997

Current Draft -- May 21, 1998


---

[1]The views expressed are those of the authors and do not necessarily reflect those of the Board of Governors, the Federal Reserve Bank of San Francisco, the Federal Reserve System or any of the staff at these institutions. The authors would like to thank Simon Kwan, Fred Furlong, Rajuram Rajan, and Glenn Rudebusch for helpful comments. Jamie Ingpen and Judy Penn provided excellent research assistance. All errors remain those of the authors.

In this paper, we investigate whether elimination of the savings association charter might reduce lending to nontraditional mortgage borrowers. We present a theoretical model of lender portfolio choice, in which nontraditional lenders have some market power and traditional lenders are price-takers in the mortgage market. The comparative statics indicate differences between nontraditional and traditional lenders in terms of their asset allocation responses to changes in borrower income and house prices. Empirical tests indicate the absence of such differences between savings associations and commercial banks, suggesting that elimination of the savings association charter would not impair lending to nontraditional mortgage borrowers.

## Introduction and Summary

During the past several years, Congress has debated eliminating the federal savings and loan (S&L) industry by merging the federal S&L charter into the commercial bank charter.[1] As the number of savings associations (which includes Federal- and State-chartered savings and loans, as well as Federal- and State-chartered savings banks) has declined sharply over the past decade (from 2,961 in 1986 to 1,779 at the end of 1997), the elimination of the savings and loan charter might seem to be simply one more step in financial consolidation. The initial policy goal of creating a savings and loan charter was to have a set of institutions with a special commitment to the housing market. In spite of the rapid growth of mortgage securitization and the prevalence of commercial and mortgage banks in mortgage lending, some observers argue that a depository institution with a special commitment to mortgage lending is still needed.

In the view of the proponents of a special charter for housing-intensive depository lenders, commercial and mortgage banks are "cream-skimmers" who make easy real estate loans, but who do not develop the relationships with unusual or nontraditional borrowers required for successful lending. A corollary to this view is that commercial banks provide only "plain vanilla" mortgages to borrowers who are easy to evaluate and can provide large downpayments (that is, only conforming mortgages that can be sold in the secondary mortgage market), while savings associations make "hard" mortgages that often must be held in the institution's portfolio. As illustrated later, these types of institutions may behave differently in their asset allocation in

---

[1] In some of these proposals, the regulator of most savings associations (the Office of Thrift Supervision or OTS) would be consolidated with commercial bank regulators (the Federal Deposit Insurance Corporation, the Office of the Comptroller of the Currency, and the Federal Reserve). The savings association industry has argued that charter elimination, if any, should be of the "charter-up" variety, giving all thrift powers to banks rather than limiting thrift powers to those of banks.

response to changes in interest rates or economic growth. Such differences may provide tests of whether or not special borrowers are served by these institutions. [2]

In this paper, we present a theoretical model of lender portfolio choice between home mortgages and an alternative investment in a government security. A distinction is made between traditional lenders, who are price takers in the mortgage market, and nontraditional lenders, who invest in information in order to obtain some market power in a nontraditional mortgage market. We then use realistic parameter values to simulate the comparative statics of the model. These simulations inform the structure of our estimated equations, where we find no evidence that savings associations are more oriented to nontraditional mortgage borrowers than commercial banks. Thus, the savings association charter does not appear to make savings associations behave more like nontraditional lenders.

## The Government's Commitment to A Special Depository for the Housing Sector

Savings associations had existed for about 100 years prior to the Great Depression as cooperatives that pooled the savings of members and then made loans to members for housing.

---

[2]Even with a "special commitment" by savings associations, the question persists as to why a special charter is needed to promote this commitment. Most of the mortgage-related activities, with the exception of some real estate development loans, can be undertaken by an institution with either a commercial bank or savings association charter. A logically consistent argument by proponents of a specialized industry would be that it is the regulator of the industry --in this case the Office of Thrift Supervision-- that creates the special commitment. The regulator, by being focused on the industry and understanding it better, allows more "relationship lending." It may be the sympathetic regulator that permits the special relationship, not the charter *per se*. Beyond this argument, it is difficult to understand why changing the charter of savings associations would change the activities of the savings associations.

But during the 1930's, the Federal government transformed the industry into a tool of public policy and made it a symbol of the government's commitment to housing.[3]

This tool worked well until the mid-1960's, when the S&L industry encountered the first of many crises. Because the industry funds longer-term mortgages with shorter-term deposits, each market or regulatory development that made it easier for depositors to place their funds elsewhere and receive higher yields placed pressure on industry profitability. The need for the S&L industry to adopt new strategies for funding mortgages was evident to many observers by 1970 but, as described by the 1993 National Commission established by Congress to examine the causes of the problems of the S&L industry, "Congress' insistence that S&Ls continue to function almost totally as vehicles for achieving national housing goals prevented needed adjustments from occurring."[4]

The S&L crisis of the 1980s was well underway by 1988, but even then the industry and Congress were able to block changes because of a fear that national housing policy would be damaged if the special nature of the S&L was altered.[5] As stated by Danny Wall, Chairman of the Federal Home Loan Bank Board (then regulator of the S&L industry) at the height of the thrift crisis:

> ...it seems clear to me that the Congress is absolutely committed to this industry, because of the predominance of its responsibility is focused on housing finance...

---

[3]A description of this transformation is given in National Commission (1993).

[4]National Commission (1993), page 23.

[5]There were, of course, many causes of the 1980s savings and loan crisis, and there are literally hundreds of publications about it. Some of the better ones are Barth (1991), Kane(1989), National Commission (1993) and White (1991).

> It is clear to me that the Congress, as the policy maker, wants an industry like this to exist, with a charter in community after community, unlike the mortgage bankers... Mortgage bankers expand and contract with the market, and that kind of ability is necessary and desirable. On the other hand, in the down times, the savings institution industry has still financed housing.[6]

In the 1990s, as Congress struggles to pass legislation to "modernize" bank charters, the need for a separate federal S&L charter is again being debated. While the financial modernization debate encompasses many topics, the theme that smaller depositories, particularly thrifts, are needed to accomplish important policy goals in housing and community development remains. For example, Nicolas Retsinas--Assistant Secretary of Housing and Urban Development, Federal Housing Commissioner, and Acting Director of the Office of Supervision--states:

> ...any proposal to modernize financial services must ensure that institutions are not discouraged and precluded from continuing to concentrate in mortgage lending. Public policy in this country has always recognized the value of promoting home ownership.
>
> ...We should not force institutions that focus on housing finance to abandon a business that not only is profitable but also fulfills a very important public purpose.[7]

**Providing Credit and the Special Nature of Intermediary Loans**

Banks invest in understanding their customers, as part of understanding the risks of lending. Evaluating loan applicants and monitoring loan borrowers allows banks to build up expertise, and this information may then be used to extend credit to borrowers who find it

---

[6]Wall (1988), page 237.

[7]Retsinas (1997)

difficult to obtain credit elsewhere.[8] Savings associations, with higher proportions of lending focused on mortgages, may build up special expertise in the mortgage market.

There are, in essence, two residential mortgage markets: the traditional mortgage market that usually provides fixed-rate mortgages with a 20 percent down payment to borrowers with well-known credit characteristics, and the nontraditional market. To illustrate how these markets might become segmented, consider a simple model with two types of borrowers--one type that has well-known risk characteristics and the other with nontraditional risk characteristics. Both types of borrowers have housing values as part of their Cobb-Douglas utility functions, as used by Stein (1995), and both are constrained by their budgets or:

$$U=\alpha_i \ln V_i + (1-\alpha_i)\ln F_i - \theta(r_M^D M_i + pF_i - I_i - r_f(S_i - D_i)), \tag{1}$$

where V is the house price, F is the quantity demanded of other goods (called food), $r^D_M$ is the rate demanded by borrowers for mortgage credit, M is the amount of mortgage credit demanded, p is the price of food, I is the borrower's income, S is the borrower's savings, D is the down payment on the mortgage, $r_f$ is the risk-free interest rate, which here is the opportunity cost of the down payment, $\alpha$ is a parameter of the utility function, $\Theta$ is the marginal utility of income, and the subscript i denotes the type of borrower (which will only be indicated when needed for clarity.) By definition, V=M+D, and we assume that the mortgage rate is higher than the risk-free interest rate and that the borrower is certain about his or her income. Thus, the borrower uses all savings for the down payment, or S=D. The borrower chooses the value of the house and

[8]See Blinder and Stiglitz (1983).

the quantity of goods he or she wishes to consume, yielding the first-order conditions:

$$\frac{\partial U}{\partial V} = \frac{\alpha}{V} - \theta r_M^D = 0$$
$$\frac{\partial U}{\partial F} = \frac{(1-\alpha)}{F} - \theta p = 0 \tag{2}$$
$$I = r_M^D(V-S) + pF.$$

By solving for the marginal rate of substitution between the value of the house and food, and using the income constraint, we find the mortgage amount desired by the borrower:

$$M = \frac{\alpha(I + r_M^D S)}{r_M^D} - S. \tag{3}$$

**Asset Allocation by Financial Institutions**

We assume that financial institutions minimize the variance of a portfolio for any given level of expected return, and then integrate this standard model of asset allocation with the supply and demand conditions in the mortgage markets. First, consider a traditional mortgage lender, who holds two types of assets--Treasury securities and traditional mortgages. Here, by traditional mortgages, we mean mortgages that meet well-understood and standardized underwriting criteria. The technology for creating such a firm--one that underwrites conventional, conforming mortgages--is readily available to many firms.

The traditional mortgage lender's expected return on a traditional mortgage is:

$$\mu_c = [r_M(1-d_c)+d_c l_c-\chi_c-r_f] \tag{4}$$

where $d_i$ is the probability of default for a traditional borrower, $l_c$ is the loss rate on a defaulted traditional mortgage ($l_c < 0$), and $\chi_c$ is the cost of underwriting a traditional borrower. Since the traditional mortgage lender can invest in Treasury securities as well, the expected return on the portfolio of this type of institution is:

$$\psi_c = x_c \mu_c + x_t r_f \tag{5}$$

where $x_c$ and $x_t$ (which here equals $1-x_c$) are the proportions of traditional mortgages and Treasury securities held in portfolio.

The variance in return on a traditional mortgage (because these institutions are assumed to hold all assets to maturity, there is no variance in the return on Treasury securities) is :

$$v_c = (r_M - l_c)^2 d_c (1-d_c) \tag{6}$$

and the traditional mortgage lender solves the problem:

$$\Pi_c = Min\ x_c^2 v_c\ s.t.\ \ u_p = \psi_c \tag{7}$$

where $\mu_p$ is the firm's target rate of return, and the traditional mortgage lender solves for $x_c$ and $x_t$.

Solving for $x_{c,}$ we find:

$$x_c^* = \frac{\mu_p - r_f}{\mu_c - r_f} \tag{8}$$

With free entry and exit in the traditional mortgage industry, the target rate of return is driven by competition to equal the expected risk-adjusted return on capital in the economy. We solve for the contractual traditional mortgage rate ($r_M$) so that:

$$\mu_c = (\mu_m - r_f)\frac{v_c}{v_m} + r_f \tag{9}$$

where ($\mu_m$, $v_m$) is the accepted risk-return trade-off in the economy (similar to a long-run or equilibrium return to capital).[9]

Using equation 9, we find $r_M$* from equation 4, and then solve equation 8 for $x_M$*, the *equilibrium* proportion of mortgages held by a traditional mortgage lender. The solution is complicated, but can be calculated without difficulty using *Mathematica*. The *Mathematica* code is described in the appendix.

**Asset Allocation for the Nontraditional Mortgage Lender**

Making nontraditional mortgages requires an "up-front" investment by the lender, so that the lender "knows the borrower." This initial investment makes the lender's market idiosyncratic, partly protecting the nontraditional lender from competitors. Having paid to be a monopolist, the nontraditional lender chooses the nontraditional mortgage rate to maximize total revenues (which here is equivalent to profit maximization) or:

[9] The above equation is similar to a capital market equation line, but instead of suggesting that an exogenous covariance exists between the market portfolio and the default risk of a mortgage (which we believe is difficult, if not impossible, to define and estimate), we argue that the entry and exit of firms in the market brings about an adjustment in mortgage rates that equates the firms' willingness to take risk with the willingness of investors generally.

$$Max \quad r_M^n M_n \tag{10}$$

where $r^n_M$ is the mortgage rate offered by the lender to a nontraditional mortgage borrower and $M_n$ is the demand for mortgages in the lender's nontraditional market.

Like the traditional lender, the nontraditional lender minimizes the variance of its portfolio subject to its target rate of return. However, the nontraditional lender can invest in Treasury securities and traditional mortgages, as well as nontraditional mortgages or:

$$\Pi_n = Min \; x_c^2 v_c + x_n^2 v_n \;\; s.t. \;\; u_p = \psi_n \tag{11}$$

where $\psi_n$ is $x_c\mu_c+x_n\mu_n+(1-x_c-x_n)r_f$, and $\mu_n$ is the expected return on a nontraditional mortgage (defined in a manner similar to that for the traditional mortgage.)

The nontraditional mortgage lender solves for the proportion of traditional and nontraditional mortgages to hold, subject to the contract mortgage rate in the nontraditional market (determined by equation 10) and the contract rate in the traditional market (determined by equation 9). Again, the solution is complicated but easily derived using *Mathematica*.

**Mortgage Holdings, and Interest Rate and Income Shocks**

To illustrate the effect of interest rate and income shocks, we use realistic parameters for our model and graph the effect of changes in interest rates and borrower income on the proportion of mortgage holdings for each type of lender. For simplicity, we assume that the parameters in the utility functions, and the income and savings of traditional and nontraditional mortgage borrowers are the same. We also assume that the covariance between the expected return on traditional and nontraditional mortgages is zero, although it is straightforward to use a given covariance structure. The complete list of parameter assumptions in given in appendix two.

The cumulative default rate for Freddie Mac mortgages during the 1980s and early 1990s was about 2.16 percent, with default rates ranging from .79 to 6.20 percent, depending on the loan-to-value ratio for the mortgage. This range implies annual default rates from under .08 percent to as high as .6 percent. For FHA loans, the cumulative default rates range from 5 percent to 15 percent, implying annual default rates ranging from .5 to 1.5 percent.[10] We will assume that traditional mortgage borrowers default at an annual rate of .08 percent and that nontraditional default at .50 percent.

For Freddie Mac, losses on a foreclosure run about 40 percent on their typical *conforming* mortgage of roughly $110,000 .[11] [12] Losses on FHA mortgages range from 45 to 55 percent. Thus, once a mortgage defaults, there seems to be little variance in the losses incurred as a proportion of the mortgage. We assume that losses on defaults are 40 percent of the loan amount for both traditional and nontraditional borrowers.

---

[10]For Fannie Mae and Freddie Mac delinquency rates, see their 1995 annual reports. For Freddie Mac's cumulative default rate, see R. Van Order and P. Zorn (1995). For FHA default rates, see Berkovec, *et. al* (1994). For an analysis which includes a comparison of the default and loss rates of these institutions see G. Canner, W. Passmore and B. Surette (1996).

[11]Van Order and Zorn, *op. cit.*

[12] However, if the mortgage is cured through either a loan modification or a home sale prior to foreclosure, the losses may fall to a range of $7,000 to $24,000. See "Examining Secondary Market Trends," *America's Community Banker*, April 1996.

Another parameter of interest is the cost of underwriting. We assume that traditional borrowers cost 1 percent of the mortgage amount to underwrite, and nontraditional cost 3 percent. The average cost of mortgage origination in 1989 has been estimated to range from 1 to 2 percent.[13] According to the trade press, total origination costs for the average mortgage in 1994 appear to be somewhat above 2 percent, but this cost involves much more than underwriting.

For the returns to investments, we choose two different sets of parameters--one based on long-run historical data and the other based on the data we will use later for our empirical work. Over the period 1926 to 1991, Treasury bonds yielded an annual return of 4.94 percent, with a standard deviation of 7.62 percent, and Treasury bills yielded 3.64 percent.[14] In our "historical simulations," we use the long-run return and standard deviation for Treasury bonds for the market's expected risk-return trade off on a portfolio of mortgages and bills. We use the long-run return on Treasury bills for the bank's cost of funds in those simulations where we vary parameters other than the bank's cost of funds.

The data we use for our empirical work runs from 1986 to 1996. Over this period, Treasury bonds yielded 7.5 percent, with a standard deviation of one percent, while Treasury bills yielded 6.01 percent. We use these values for our "recent market experience" simulations, as described in the next section.

---

[13]See Passmore (1992).

[14]These numbers are from Jagannathan and McGratten (1995).

**Comparative Statics**

We first examine the effect on the proportion of mortgages held by traditional and nontraditional lenders of a change in their cost of funds. The yield paid for their funds, $r_f$, is also the yield paid on the risk-free investment alternative available to the lenders. As the depository's cost of funds rises with interest rates, the proportion of mortgages held in lenders' portfolios declines because the relative attractiveness of Treasury securities rises (top panel, figure 1). The traditional lender contracts its share of traditional mortgages (the only type of mortgages it holds) more quickly than the nontraditional lender because the marginal profit on a traditional mortgage, while falling rapidly compared to a Treasury security, is not falling as rapidly as the marginal profitability of a nontraditional mortgage. Thus, the traditional-only lender is substituting Treasuries for traditional mortgages, while the nontraditional lender is substituting Treasuries for both traditional and nontraditional mortgages, and substituting traditional for nontraditional mortgages. As shown at the middle panel of figure 1, the proportion of nontraditional mortgages held by the nontraditional lender is falling rapidly as rates rise.[15]

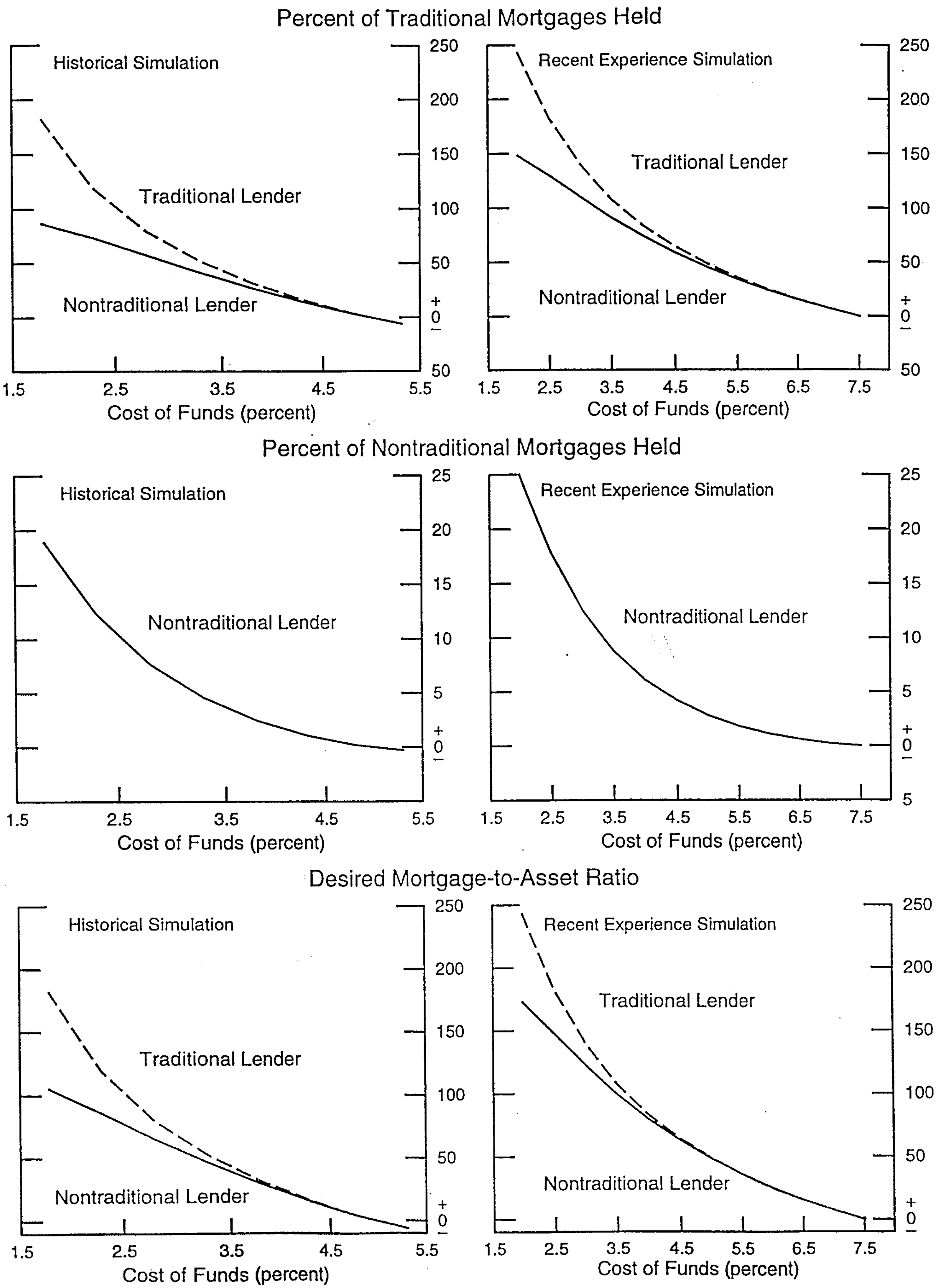
When examining the mortgage-to-asset ratio (bottom panel of figure 1), which will be the variable of interest in the empirical work that follows, the traditional lender contracts more rapidly than the nontraditional lender at lower levels of interest rates, but the contraction by these

---

[15]Note that the level of the nontraditional mortgage-to-asset ratio is usually very small relative to the level for the traditional mortgage-to-asset ratio. There is little empirical evidence about the level of nontraditional mortgages. For a brief time, the Office of Thrift Supervision collected information from savings associations on the amount of mortgages they made with greater than 80 percent loan-to-value ratios and carrying no private mortgage insurance. This type of mortgage is often extended to nontraditional borrowers. Many of the institutions had less than five percent of their mortgages in this category.

Figure 1

The Effect of Interest Rate Shocks on Mortgage Holdings



lenders becomes almost identical at higher levels of interest rates. These representative simulations suggest that changes in mortgage-to-asset ratios of lenders in response to interest rate shocks are unlikely to differ much by type of lender.[16]

Similarly, changes in the expected return on a market portfolio (figure 2) are very similar for both lenders with low and lenders with high proportions of nontraditional mortgages in their portfolios. In addition, these changes affect the proportion of mortgages of all lenders in a linear and direct fashion, with increases as the expected return on the portfolio increases (holding risk--which results only from holding mortgages--constant) resulting in larger relative holdings of mortgages.

Income shocks have very different effects on traditional and nontraditional lenders. In our model, traditional mortgages are provided by a classic, atomistic group of suppliers. Changes in the level of income of traditional mortgage borrowers result in changes in the overall size of the traditional mortgage market, but do not result in changes in the relative proportion of assets allocated to mortgages by traditional lenders (top panel, figure 3). In contrast, nontraditional mortgages are provided by lenders who "know their community" and see the downward slope of the community's demand curve. Thus, an increase in these borrowers' incomes raises the profitability of providing mortgages to these borrowers, causing the ratio of nontraditional mortgages-to-assets to rise (middle panel, figure 3) and the ratio of traditional

[16]Note that the desired amount of mortgages can be negative or can exceed 100 percent, depending on their relative return. If the institution has the ability to "short" mortgage securities or Treasury securities, it might pursue these strategies. Otherwise, we could assume the mortgage-to-asset ratio is capped at zero or 100 percent. For the discussion of the comparative statics, this makes no difference.

Figure 2

The Effect of Market Portfolio on Mortgage Holdings

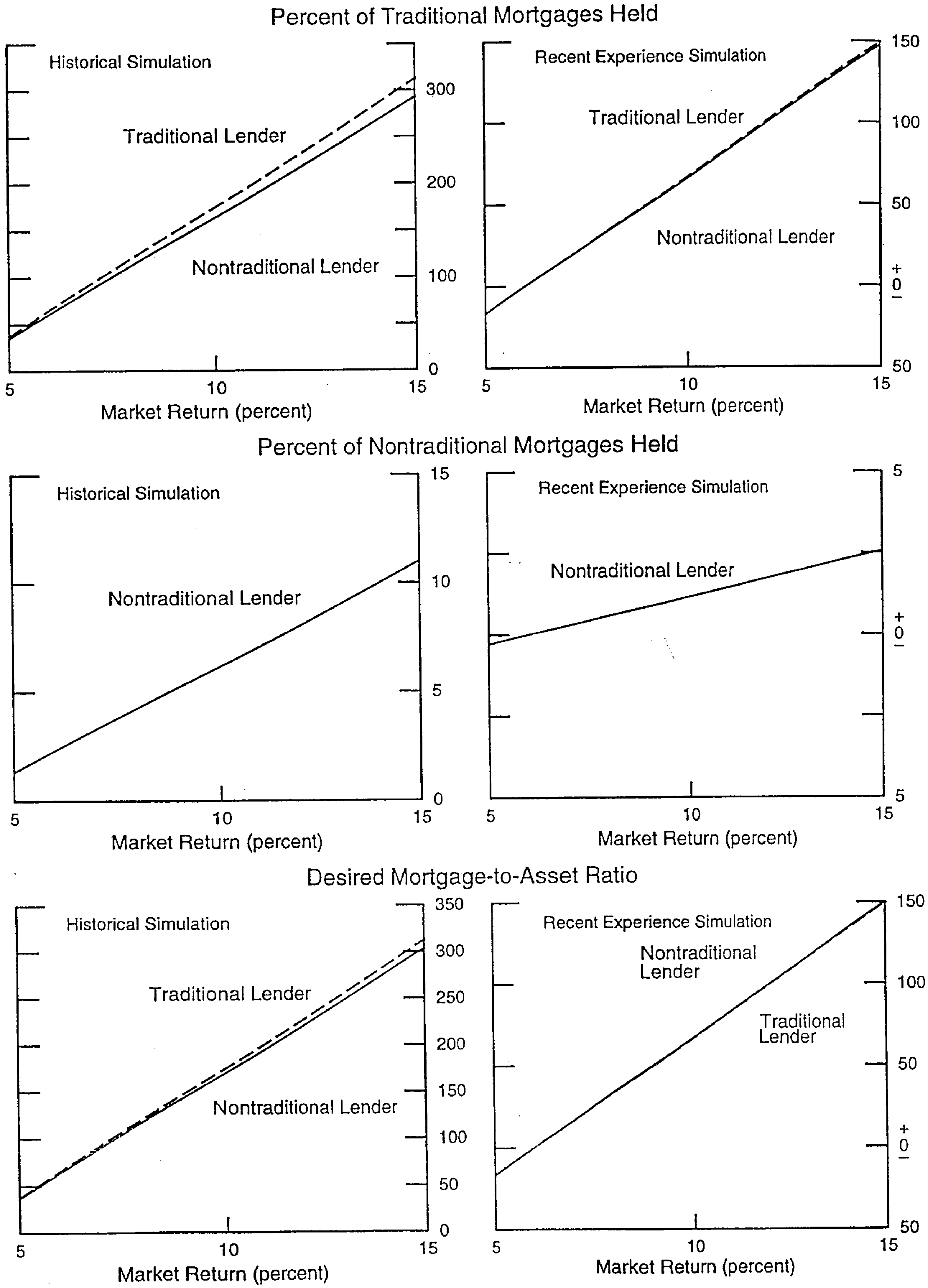
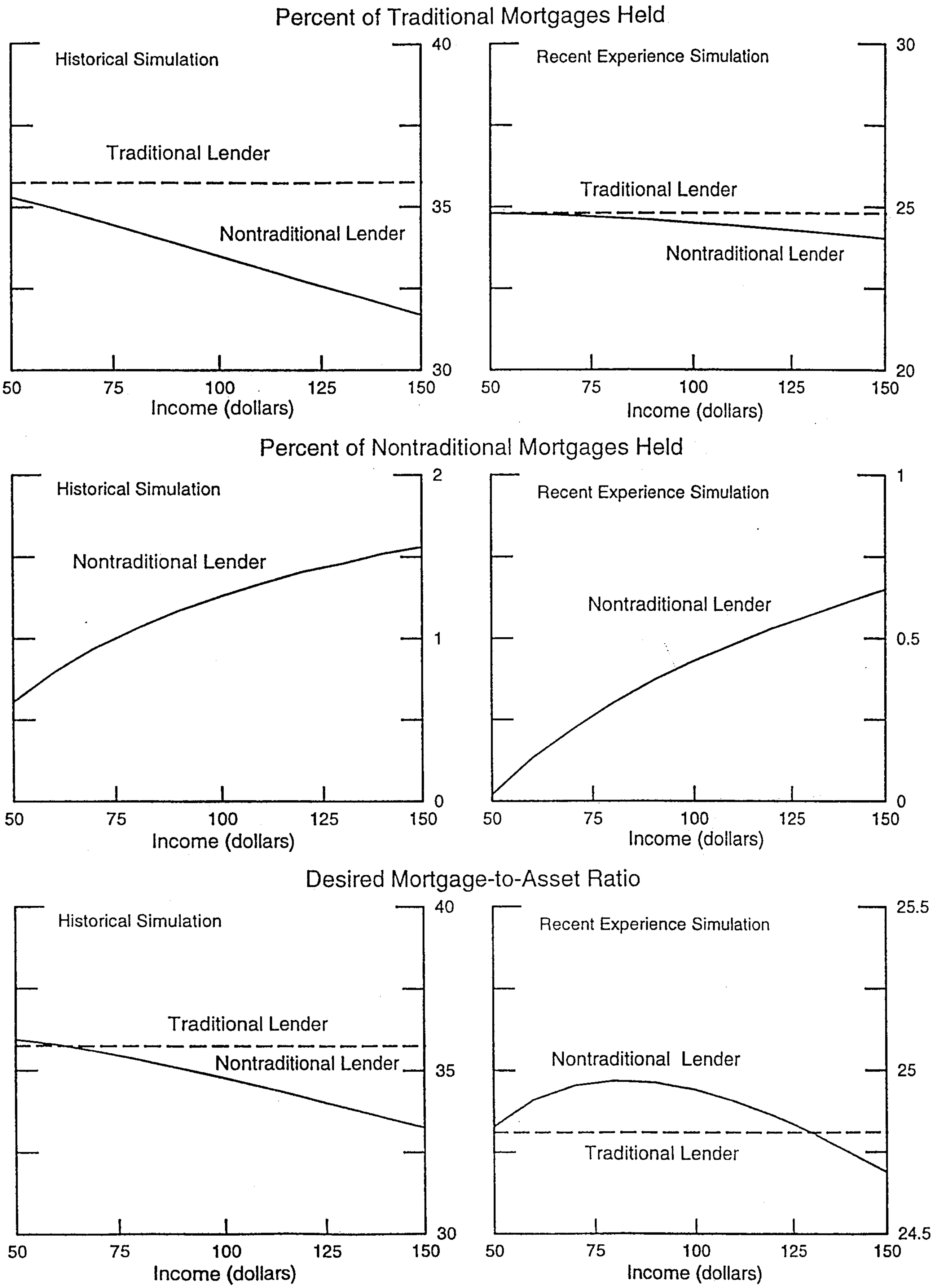


Figure 3

The Effect of Income Shocks on Mortgage Holdings



mortgage-to-assets to fall at nontraditional lenders (top panel, figure 3).

As shown on the bottom panel of figure 3, the fall in traditional mortgages can exceed the rise in nontraditional mortgages at nontraditional lenders, with the result that a positive income shock has a negative effect on the mortgage-to-asset ratio at nontraditional lenders. (But as shown on the right-hand side of the panel, a nonnegative relationship between income and the mortgage-to-asset ratio, or one that is only slightly different from that experienced by traditional lenders, is also possible.) As will be seen below, the possibility of a non-zero response is a key distinction in our effort to separate lenders who provide a commodity-like mortgage product from those who serve markets with nontraditional borrowers.

Similarly, changes in house prices (which, in our model, are equal to changes in down payment requirements) have different effects on traditional and nontraditional lenders. Higher home prices (or higher down payment requirements) cause consumer demand for mortgages to contract. The effects are equivalent to a negative income shock, with the marginal profitability of nontraditional mortgages falling as housing prices or down payment requirements rise, and lenders then contracting the proportion of nontraditional mortgages in their portfolios (figure 4, middle panel). However, overall mortgage-to-asset ratios at nontraditional lenders rise, as relatively more traditional mortgages (with their small marginal profits) are added to compensate for the decline (the lower panel of figure 4). Traditional lenders, who do not see consumer demand in their objective functions, do not change the relative proportions of their portfolios.

Finally, we calculated the mortgage rates implied by our model (figure 5). Traditional mortgage rates vary with interest rates, and span a reasonable range of values. Nontraditional

Figure 4

The Effect of House Price on Mortgage Holdings

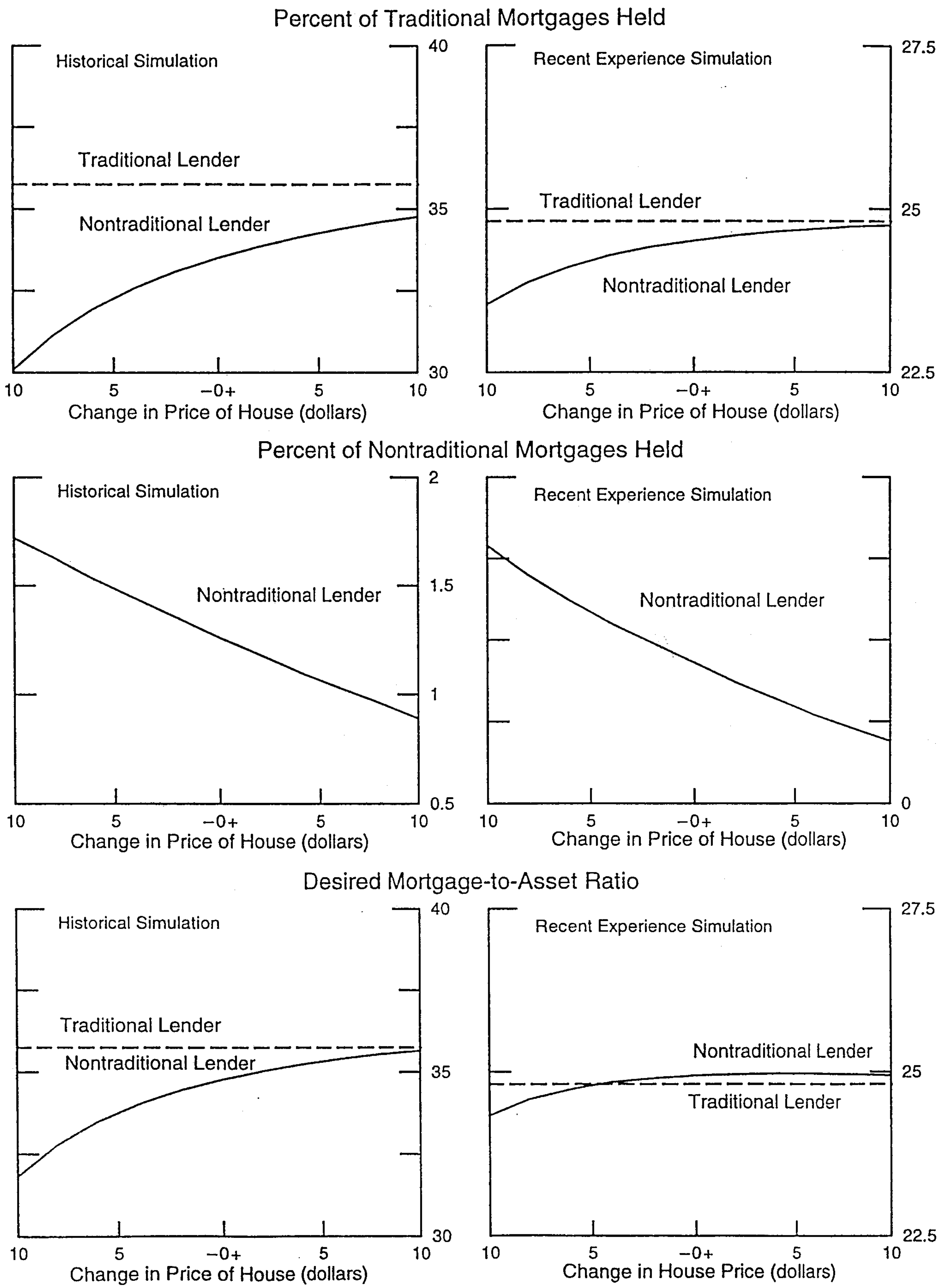
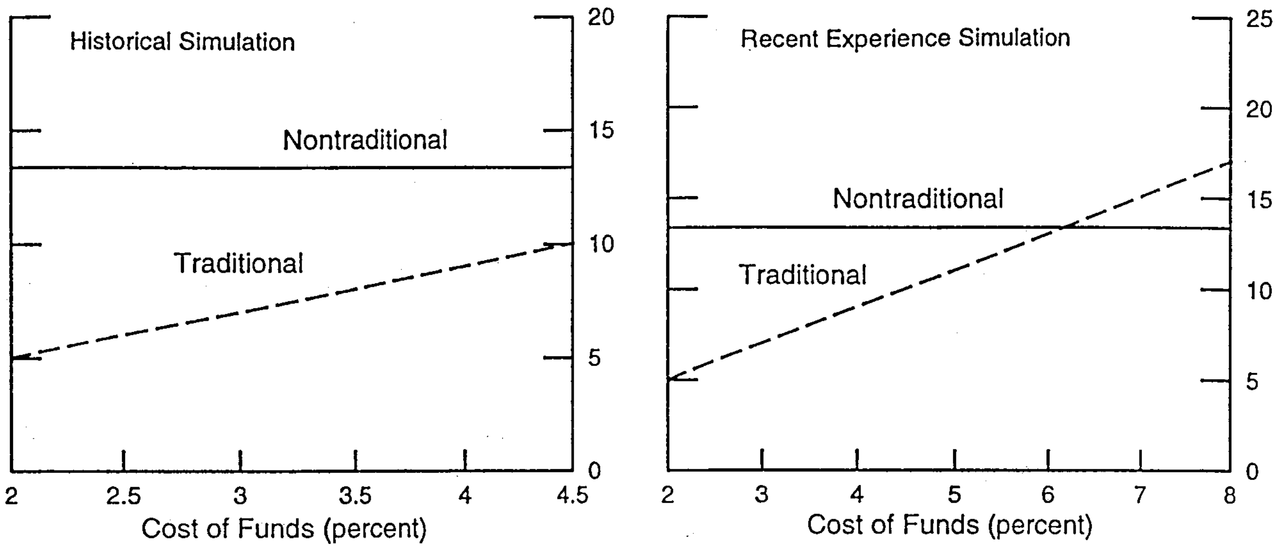


Figure 5

Mortgage Rates



mortgage rates are set at the revenue-maximizing level, and are not influenced by other interest rates. Generally, the nontraditional rate derived from our simulations is a good deal higher than the traditional rate.

**A Regression Analysis of Bank and Savings Association Lending Behavior**

To both test our theory and describe the differences in lending behavior between commercial banks and savings associations, we develop a regression model based on the theory presented earlier. Our theory suggests that interest rates have a negative and nonlinear effect on the mortgage-to-asset ratio at both traditional and nontraditional lenders, while the market return has a positive and linear effect. For nontraditional lenders, both the income of borrowers and house prices can affect the mortgage-to-asset ratio, but for traditional lenders, income and house prices have no effect.

Let $m_t$ be the mortgage-to-asset ratio, and assume that the depository institution desires to move this ratio to a ratio of m*. We assume a partial-adjustment process:

$$m_t = m_{t-1} + k\,(m_t^* - m_{t-1}), \tag{12}$$

where t is a time subscript. The optimal mortgage-to-asset ratio, $m_t$*, is modeled as a function of interest rates, market returns, borrower incomes, house prices, and delinquency rates, as well as control variables for the region of the country and the size class of the institution.

*A Linear Model*

Despite the nonlinear nature of our theoretical model, our first regression has a simple linear specification. This regression provides us with initial values for the parameters in the nonlinear regression estimation, as well as a check on the robustness of other results. The linear model for the optimal mortgage-to-asset ratio is:

$$\begin{aligned} m_t^* = {} & c + \alpha r_{f_t} + \beta I_t + \gamma V_t + \lambda \mu_{m_t} + \theta_1 NE + \theta_2 S \\ & + \theta_3 MW + \theta_4 LARGE + \theta_5 MED + \theta_6 MNPDNA. \end{aligned} \tag{13}$$

In equation (13), $r_f$, I, V, $\mu_m$, and MNPDNA are based upon the theoretical model. In our empirical work, we use the 1-year Treasury bill interest rate for $r_f$, real average hourly earnings in the state in which the institution is located for I, the weighted average real value of median house prices in the state in which the institution is located for V, and the 10-year Treasury bond interest rate for $\mu_m$.[17] MNPDNA is the long-run average of the ratio of the institution's past-due and nonaccruing mortgage loans to total mortgage loans, measured in percent.[18] The interest rates are measured in percent, as is the dependent variable in the regression. Real average hourly earnings are in dollars. The house price is in thousands of dollars.

---

[17]The house price variable was constructed in several steps. First, median house prices for 1987 were obtained from the National Association of Realtors. These data are in thousands of nominal dollars and are available by Metropolitan Statistical Area (MSA). Next, MSA data were aggregated to the state level using population weights. Then, for each state, a time series of house prices was generated by multiplying the 1987 house price by a time series of repeat sales house price indices for that state. The house price index is normalized to be 100 in every state in 1987, so the resulting house price time series was divided by 100 to yield a time series of nominal house prices, in thousands of dollars. Nominal house prices were then converted into real house prices using the Consumer Price Index.

[18]The past-due and nonaccruing ratio was taken as the sum of mortgage loans past-due 90 days or more plus nonaccruing mortgage loans, divided by total mortgage loans. The long-run average was taken over the years in the sample period for which data were available: 1990.Q1-1996.Q4 for savings associations and 1991.Q1-1995.Q3 for commercial banks.

The control variables NE, S, and MW are dummy variables, with values of 1 indicating that the institution is in the Census-defined Northeast, South, or Midwest, respectively. (The West is the omitted category.) The variable LARGE takes a value of 1 if the institution has total assets greater than or equal to $1 billion as of the third quarter of 1988, and the variable MED takes a value of 1 if the institution has total assets greater than or equal to $500 million , but less than $1 billion, as of the same date.

Our data are quarterly, and cover the period from the third quarter of 1988 to the fourth quarter of 1996.[19,20] We screened our sample to include only well-capitalized survivors of the S&L crisis--institutions that existed throughout the sample period and that were well-capitalized as of the third quarter of 1988. We also excluded savings associations with unusually high or unusually low mortgage-to-assets ratios, restricting the sample to those institutions with ratios between 10 percent and 85 percent, inclusive, in every quarter of the sample.[21] The same screens were applied to commercial banks as were applied to savings associations. After applying these screens, we had 3,230 banks and 693 savings associations in our sample.

---

[19]During the early 1990s, lending by commercial banks and savings associations contracted sharply. This contraction was referred to as a credit crunch, and has been the source of much academic research and press commentary. For an excellent review of the academic research, see Sharpe (1995). If nontraditional borrowers constitute a larger proportion of savings associations' mortgage portfolios than they do in commercial banks' mortgage portfolios, the credit crunch would have been a time when differences in lending behavior between savings associations and commercial banks would have been most evident (See Passmore and Sharpe, 1994, for a theoretical discussion of the credit crunch.)

[20]Since the regression includes the lagged dependent variable on the right-hand side, the first observation for the dependent variable is in the fourth quarter of 1988.

[21]In addition, we use only savings associations that are regulated by a regulator--the Office of Thrift supervision--that is separate from the regulators of commercial banks.

Figure 6 presents the time series of the cross-sectional means of the dependent variable, for banks and saving associations (panels A and B, respectively). As seen in the figure, savings associations do much more residential mortgage lending than commercial banks; the mean mortgage-to-asset ratio over our savings association sample ranges from 48.8 percent to 54.8 percent, whereas for banks it ranges from 20.4 percent to 24.2 percent. Also, savings associations' response to the credit crunch of the early 1990s was very different from that of banks in terms of mortgage lending; savings associations cut back sharply, while banks increased at a steady pace.

Panels A and B of table 1 present sample statistics for the regression variables, for the commercial bank and savings association samples, respectively.

*Model Estimation and Results*

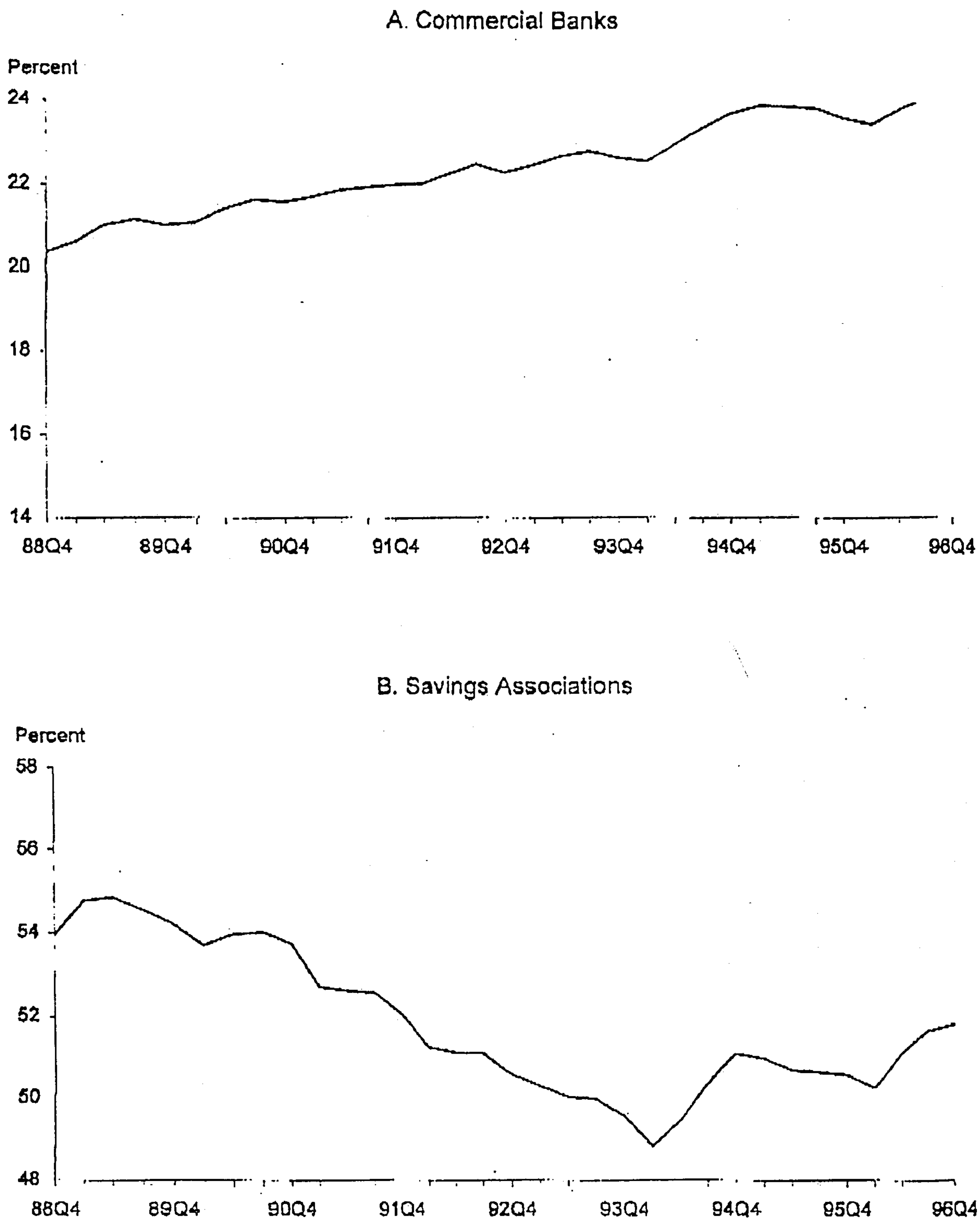
Inserting equation (12) into equation (13) and dropping the t subscripts on $r_f$, I, V, and $\mu_m$, we estimate the following regression equation:

$$\begin{aligned} m_t &= (1-k)m_{t-1} + kc + k\alpha r_f + k\beta I + k\gamma V + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S \\ &\quad + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon, \end{aligned} \tag{14}$$

where $\epsilon$ is a normally distributed error term.

The regression results are presented in table 2. Except for $m_{t-1}$, we present only the long-run coefficients, which affect the desired mortgage-to-asset ratio. The results suggest that the banks behave as predicted by the theoretical model--the long-run coefficient on the risk-free rate is negative and significant, and the coefficient on the market return is positive and significant. In

## Figure 6
## Mean of the Mortgage-to-Asset Ratio



contrast, for savings associations, the coefficient on the risk-free rate is positive and significant, while the coefficient on the market return is negative and significant.[22]

The estimation also indicates that there is no statistically significant difference between how banks' and savings associations' mortgage-to-asset ratios respond to changes in income or changes in house prices. We calculated confidence intervals for the estimates of the long-run coefficients on income and house prices for the two types of institutions and found that they overlapped.[23]

*A Constrained Linear Model*

To check our results that the responses of the mortgage-to-asset ratio to changes in income and the home price at banks and savings associations are not significantly different, we also estimate the linear model with our theoretical constraints imposed on the long-run coefficients for the risk-free rate and the market return. Specifically, we restrict the coefficient on the risk-free rate to be less than or equal to zero and the coefficient on the market return to be greater than or equal to zero.

Imposing the constraints on the estimation of the risk-free rate and market return coefficients results in a zero coefficient for the risk-free rate and a positive and significant

---

[22]Both the risk-free interest rate and the 10-year Treasury bond rate were on a declining trend from the end of 1988 to about the end of 1993, and then turned up for about a year before levelling off.

[23]The 90-percent confidence intervals for the bank and savings association coefficients on income overlapped, as did the 90-percent confidence intervals for the bank and savings association coefficients on the house price.

coefficient for the market return for savings associations (table 3).[24] These results are more consistent with the simulations of the theoretical model than were the unconstrained regression results for savings associations.

As in the unconstrained regression, the savings associations' long-run income and home price coefficients are not significantly different from that of banks. Based on these results, one cannot say that savings associations behave more like the theoretically modelled nontraditional lender than do commercial banks. However, two considerations cloud the interpretation of this result. First, our model suggests that the partial derivative of the mortgage-to-asset ratio with respect to home prices is dependent on the levels of other variables. Second, the unconstrained savings associations' results depart from the predictions of the theoretical model about how the mortgage-to-asset ratio is affected by the risk-free interest rate and the market return. We can correct for the first problem by turning to a nonlinear model.

*The Nonlinear Model*

The basic nonlinear model for the desired mortgage-to-asset ratio is:

$$\begin{aligned} m_t^* = \delta r_f^{\alpha} I^{\beta_0} V^{\gamma_0} + \beta_1 I + \gamma_1 V + \lambda \mu_m + \theta_1 NE + \theta_2 S \\ + \theta_3 MW + \theta_4 LARGE + \theta_5 MED + \theta_6 MNPDNA. \end{aligned} \tag{15}$$

The form of equation (15) was suggested by three features of the simulation results shown in

[24]Since the commercial banks' regression results already met the restrictions, the constraints have no effect on their results. However, for ease of comparison, we report these results again in table 3, along with the constrained results for savings associations.

figures 1-4. First, the partial derivatives of the mortgage-to-asset ratio with respect to the risk-free interest rate, income, and the value of the house can be nonlinear, while the partial derivative with respect to the market return is linear for both traditional and nontraditional lenders. Second, the shapes of the partial derivatives of nontraditional lenders' mortgage-to-asset ratios with respect to the risk-free rate, income, and house price depend on the other variables. Third, the simulation results show that the partial derivatives of nontraditional lenders' mortgage-to-asset ratios with respect to income and home price may be concave. Including the parameter $\delta$ and the linear income and home price terms permits enough flexibility in the functional form so that the partial derivatives of the mortgage-to-asset ratio with respect to income and home price can be concave.

Inserting equation (12) into equation (15), we attempted to estimate the following nonlinear equation[25]:

$$\begin{aligned} m_t = (1-k)m_{t-1} + k\delta r_f^{\alpha} I^{\beta_0} V^{\gamma_0} + k\beta_1 I + k\gamma_1 V + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S \\ + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon. \end{aligned} \quad \textbf{(16)}$$

The estimation of the model in equation (16) converged for savings associations but not for banks, so we simplified the specification to exclude the linear terms in income and home price. This restricts the partial derivatives with respect to income and home price to be either positive or

[25]In order to do the nonlinear estimation, we had to provide initial values for each of the parameters. Setting $\delta$=1 and $\beta_1=\gamma_1=0$, and using sample means for the explanatory variables, we assigned initial parameter values so as to equate the value of each of the partial derivatives in the nonlinear regression with the corresponding partial derivative in the corresponding (bank or savings association) unconstrained linear regression.

negative throughout (with the slope either decreasing or increasing throughout), constant, or zero. Note that this excludes the possibility of a positive and decreasing slope turning to a negative and decreasing slope as income or home price increases. In other words, it excludes the possibility of a concave shape for the derivative.[26]

The simplified regression model then is:

$$\begin{aligned} m_t &= (1-k)m_{t-1} + k\delta r_f^{\alpha} I^{\beta} V^{\gamma} + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S \\ &+ k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon. \end{aligned} \tag{17}$$

The estimation of equation (17) converged for both banks and savings associations (table 4). Again, except for $m_{t-1}$, we only report the partial derivatives of the optimal mortgage-to-asset ratio with respect to each of the variables. For both banks and savings associations, we evaluate these partial derivatives at the pooled sample (banks and savings associations together) means for the explanatory variables. Using the same values for the relevant explanatory variables to calculate the partial derivatives that depend on these variables in the bank and savings association regressions ensures that any differences in these partial derivatives are due to factors other than differences in the underlying variables.

As in the linear regressions, there is no statistically significant difference between banks

[26]We also attempted to estimate the following equation:

$$\begin{aligned} m_t &= \delta(\alpha_0 r_{f_t})^{\alpha_1}(\beta_0 I_t)^{\beta_1}(\gamma_0 V_t)^{\gamma_1} + \beta_2 I_t + \lambda\mu_m + \theta_1 NE + \theta_2 S \\ &+ \theta_3 MW + \theta_4 LARGE + \theta_5 MED + \theta_6 MNPDNA. \end{aligned}$$

The estimation converged for savings associations, but not for banks.

and savings associations in the estimated partial derivatives of their mortgage-to-asset ratios with respect to income or the house price.

We attempted to estimate equation (17) with constraints imposed on the signs of the partial derivatives of the mortgage-to-assets ratio with respect to the risk-free interest rate and the market return, but the estimation did not converge for savings associations.

*High Mortgage-Ratio Banks*

The regression results so far suggest that these is no difference between banks and savings associations in terms of their responses to shifts in the demand-side variables. Yet these results were derived assuming that our model adequately describes the behavior of commercial banks and savings associations. Empirically, commercial banks seem to conform to our model, whereas savings associations do not, suggesting that our model may not correctly capture the behavior of depository institutions that specialize in mortgage lending.

By selecting a group of banks that specialize in mortgage lending, we can extend our comparison of mortgage lending institutions and, in the process, determine if our model of a depository is adequately capturing the response of mortgage-oriented lenders. We create a set of mortgage-oriented commercial banks--those with a mortgage-to--asset ratio of at least 40 percent as of the third quarter of 1988. This cut-off results in only 80 banks in the sample, highlighting the strong differences in the degree of specialization in mortgages by banks and savings associations. These mortgage-oriented banks have a mean mortgage-to-asset ratio that declines in a fashion similar to the mean savings association mortgage ratio, suggesting that these banks adjust their portfolios in a manner similar to savings and loans (figure 7).

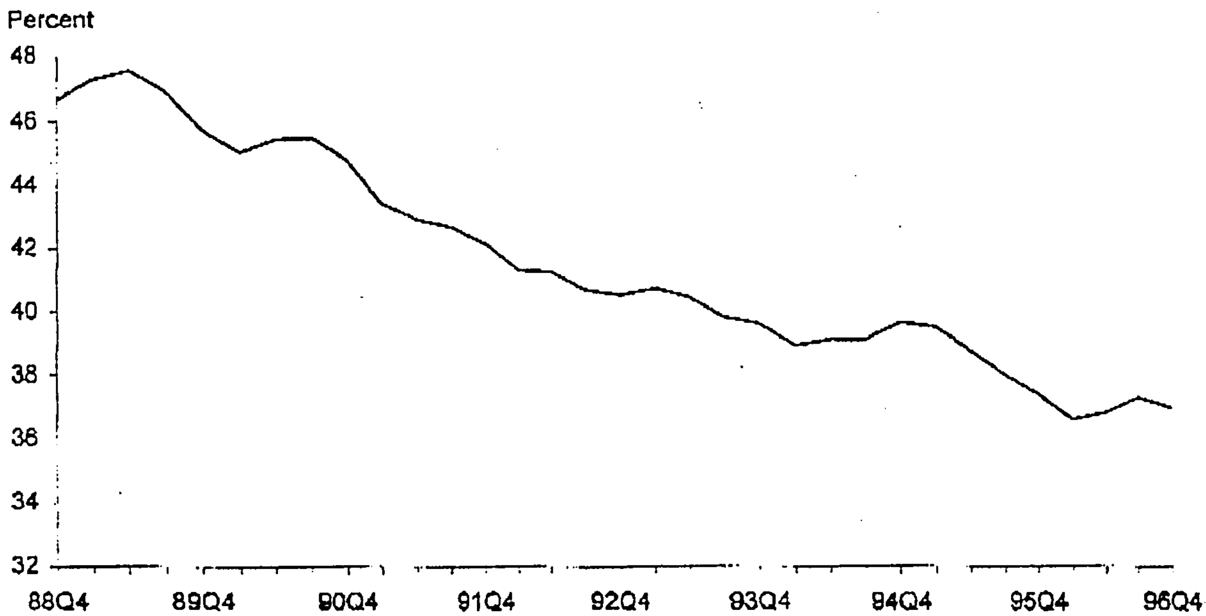
To test this theory, we estimate equation (14) for the high mortgage ratio banks. Table 5 shows the sample statistics. (Note that all of the high mortgage ratio banks are small.) The results are reported in table 6, along with our previous results for the unconstrained and constrained linear regressions for the savings associations. The high mortgage ratio banks show no statistically significant difference from savings associations in their long-run responses to changes in the home price or changes in income. This provides further support to the hypothesis that the savings association charter does not give savings associations special market power in mortgage lending, as compared with commercial banks.

We also estimated the nonlinear equation (17) for the high mortgage ratio banks. These results (table 7) again suggest that there is no difference between high mortgage ratio banks and savings associations in terms of their responses to shifts in home price or borrower income. Finally, the negative coefficients on the interest rate and the positive coefficients on the market return suggest that our model does capture the behavior of depository institutions that specialize in mortgage-lending.

## Conclusion

This paper presents a theoretical model of lender portfolio choice between home mortgages and an alternative investment in a government security. A distinction is made between traditional lenders, who are price takers in the mortgage market, and nontraditional lenders, who invest in information in order to obtain some market power in a nontraditional

**Figure 7**
**Mean of the Mortgage-to-Asset Ratio for High Mortgage Ratio Banks**



mortgage market. Traditional lenders may allocate assets between government securities and mortgages to traditional borrowers, whereas nontraditional lenders may allocate assets between government securities, mortgages to traditional borrowers, and mortgages to nontraditional borrowers (those about whom the nontraditional lender has some special knowledge).

Using realistic parameter values, the comparative statics of the model are simulated, providing information on the signs and relative sizes of the partial derivatives of total mortgages with respect to the model's variables. The simulation results highlight that the traditional lender's portfolio choice is independent of changes in demand-side variables, whereas the nontraditional lender's is not.

The model is then estimated using data for commercial banks and savings associations, to determine whether savings associations are "special" --that is, whether they behave more like nontraditional lenders than do commercial banks. For a large panel of banks and savings associations, the regression results suggest that savings associations are no more sensitive to changes in borrower income or home prices than are banks. However, we have some concerns about how well our model describes the behavior of savings associations, and thus also estimated the model using a sample of high mortgage ratio banks. These additional results implied that our model is appropriate for mortgage-oriented depository institutions, as well as confirmed that savings associations do not behave more like nontraditional lenders than do banks. Overall, our results suggest that the savings association charter could be eliminated without impairing lending to nontraditional mortgage borrowers.

**References**

Barth, James R., 1991, *The Great Savings and Loan Debacle,* American Enterprise Institute for Public Policy Research, Washington D.C.

Blinder, Alan S. And Joseph E. Stiglitz, 1983, Money, Credit Constraints, and Economic Activity. *American Economic Review Papers and Proceedings*, (May), 287-302.

Jagannathan, Ravi and Ellen McGratten, 1995, The CAPM Debate, Federal Reserve Bank of Minneapolis Quarterly Review, Fall, pp. 2-16.

Kane, Edward J., 1989, *The S&L Insurance Mess: How Did it Happen?*, The Urban Institute Press, Washington D.C.

National Commission on Financial Institution Reform, Recovery and Enforcement,1993, *Origins and Causes of the Savings associaiton Debacle: A Blueprint for Reform*, U.S. Government Printing Office, Washington D.C., (July).

Passmore, Wayne, 1992, Can Retail Depositories Fund Mortgages Profitably?, Journal of Housing Research, vol, 3. No.2, pp. 305-340.

Passmore, Wayne and Steven A. Sharpe, 1994, Optimal Bank Portfolios and the Credit Crunch, Finance and Economic Discussion Series 94-19, Federal Reserve Board.

Retsinas, Nicolas, 1997, Financial Modernization Testimony, *Hearings before the House Subcommittee on Financial Institutions and Consumer Credit,* (February 13).

Wall, Danny M., 1988, The Tasks Ahead, *The Future of the Thrift Industry; Proceedings of the*

*Fourteenth Annual Conference,* Federal Home Loan Bank of San Francisco, (December), 231-238.

White, Lawrence J., *The S&L Debacle: Public Policy Lessons for Bank and Thrift Regulation*, 1991 Oxford University Press, New York.

Table 1

Sample Statistics for Regression Variables

A. Commercial Banks

| Variable | Mean | Median | Minimum | Maximum | S.D. |
|---|---|---|---|---|---|
| $m_t$ | 22.44 | 20.77 | 10 | 80.89 | 8.21 |
| $r_f$ | 5.89 | 5.64 | 3.18 | 9.57 | 1.77 |
| I | 2.76 | 2.79 | 2.02 | 3.75 | .31 |
| V | 29.15 | 28.05 | 13.83 | 83.98 | 7.04 |
| $\mu_m$ | 7.26 | 7.2 | 5.36 | 9.36 | 1.05 |
| NE | .1 | 0 | 0 | 1 | .29 |
| S | .39 | 0 | 0 | 1 | .49 |
| MW | .47 | 0 | 0 | 1 | .5 |
| LARGE | .005 | 0 | 0 | 1 | .07 |
| MED | .009 | 0 | 0 | 1 | .09 |
| MNPDNA | .91 | .64 | 0 | 11.93 | .95 |

B. Savings Associations

| Variable | Mean | Median | Minimum | Maximum | S.D. |
|---|---|---|---|---|---|
| $m_t$ | 51.79 | 52.63 | 10.37 | 84.81 | 51.41 |
| $r_f$ | 5.89 | 5.64 | 3.18 | 9.57 | 1.77 |
| I | 2.82 | 2.83 | 2.02 | 3.75 | 0.3 |
| V | 31.05 | 28.5 | 13.83 | 83.98 | 8.96 |
| $\mu_m$ | 7.26 | 7.2 | 5.36 | 9.36 | 1.05 |
| NE | 0..2 | 0 | 0 | .1 | .0.4 |
| S | .0.32 | 0 | 0 | .1 | .0.47 |
| MW | .0.4 | 0 | 0 | .1 | .0.49 |
| LARGE | 0.03 | 0 | 0 | .1 | .16 |
| MED | 0.04 | 0 | 0 | .1 | ..18 |
| MNPDNA | 1.26 | 0.83 | 0 | 17.34 | 1.43 |

Table 2

Regression Results for Mortgage-to-Asset Ratio†

$$m_t = (1-k)m_{t-1} + kc + k\alpha r_f + k\beta I + k\gamma V + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon$$

| Explanatory Variable | Commercial Banks (98,408 observations, adjusted $R^2$=.96) | Savings Associations (21,177 observations, adjusted $R^2$=.974) |
|---|---|---|
| $m_{t-1}$ | .981*** | .985*** |
| | (.001) | (.001) |
| constant | -.993 | 43.8*** |
| | (4.45) | (16.9) |
| $r_f$ | -1.11*** | 9.64*** |
| | (.302) | (1.41) |
| I | 4.35*** | 1.17 |
| | (1.15) | (4.82) |
| V | .142*** | -.23 |
| | (.043) | (.161) |
| $\mu_m$ | 3.91*** | -6.21*** |
| | (.537) | (2.14) |
| NE | 8.87*** | -8.91* |
| | (1.63) | (5.09) |
| S | 1.26 | -1.56 |
| | (1.49) | (5.04) |
| MW | 1.79 | -.168 |
| | (1.45) | (5.21) |
| LARGE | -3.78 | 6.68 |
| | (4.09) | (7.38) |
| MED | -5.14* | -6.93 |
| | (3.02) | (6.24) |
| MNPDNA | -3*** | -2.42*** |
| | (.317) | (.887) |

†Except for $m_{t-1}$, reported numbers are partial derivatives of $m^*$; standard errors in parentheses
* (***) statistically significant at the 10 (1) percent level

Table 3

Constrained Regression Results for Mortgage-to-Asset Ratio† ($\alpha \leq 0$, $\lambda \geq 0$)

$$m_t = (1-k)m_{t-1} + kc + k\alpha r_f + k\beta I + k\gamma V + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon$$

| Explanatory Variable | Commercial Banks (98,408 observations, adjusted $R^2$=.96) | Savings Associations (21,177 observations, adjusted $R^2$=.974) |
|---|---|---|
| $m_{t-1}$ | .981*** | .985*** |
| | (.001) | (.001) |
| constant | -.993 | -7.03 |
| | (4.45) | (16.2) |
| $r_f$ | -1.11*** | 0 |
| | (.302) | (0) |
| I | 4.35*** | 2.14 |
| | (1.15) | (4.87) |
| V | .142*** | -.169 |
| | (.043) | (.162) |
| $\mu_m$ | 3.91*** | 7.85*** |
| | (.537) | (1.2) |
| NE | 8.87*** | -8.78* |
| | (1.63) | (5.14) |
| S | 1.26 | -.737 |
| | (1.49) | (5.09) |
| MW | 1.79 | .396 |
| | (1.45) | (5.27) |
| LARGE | -3.78 | .617 |
| | (4.09) | (7.45) |
| MED | 5.14* | -7.04 |
| | (3.02) | (6.31) |
| MNPDNA | -3*** | -2.49*** |
| | (.317) | (.898) |

† Except for $m_{t-1}$, reported numbers are partial derivatives of $m^*$; standard errors in parentheses
* (***) statistically significant at the 10 (1) percent level

Table 4

Regression Results for Mortgage-to-Asset Ratio†

$$m_t = (1-k)m_{t-1} + k\delta r_f^{\alpha} I^{\beta} V^{\gamma} + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon$$

| Explanatory Variable | Commercial Banks (98,408 observations, adjusted $R^2$=.96) | Savings Associations (21,177 observations, adjusted $R^2$=.974) |
|---|---|---|
| $m_{t-1}$ | .981*** | .985*** |
| | (.001) | (.001) |
| $r_f$ | -.629*** | 9.13*** |
| | **(.009)** | **(.0001)** |
| I | .986* | -1.23 |
| | **(.055)** | **(.794)** |
| V | .038* | -.06 |
| | **(.07)** | **(.735)** |
| $\mu_m$ | 4.03*** | -4.98** |
| | (.202) | (2.08) |
| NE | 9.1*** | -7.17 |
| | (1.53) | (5.06) |
| S | 2.26* | .802 |
| | (1.28) | (4.95) |
| MW | 3.62*** | 3.67 |
| | (1.28) | (5.05) |
| LARGE | -4.15 | 5.89 |
| | (4.07) | (7.42) |
| MED | -4.88 | -7.53 |
| | (3) | (6.3) |
| MNPDNA | -2.99*** | -2.48*** |
| | (.315) | (.898) |

†Except for $m_{t-1}$, reported numbers are partial derivatives of $m^*$; standard errors in unbolded parentheses; significance levels in bold parentheses

* (**) (***) statistically significant at the 10 (5) (1) percent level

Table 5

Sample Statistics for Regression Variables for High Mortgage Ratio Banks

| Variable | Mean | Median | Minimum | Maximum | S.D. |
|---|---|---|---|---|---|
| $m_t$ | 41.51 | 42.43 | 7.44 | 80.89 | 11.08 |
| $r_f$ | 5.89 | 5.64 | 3.18 | 9.57 | 1.77 |
| I | 2.79 | 2.81 | 2.02 | 3.75 | .31 |
| V | 32.87 | 30 | 13.83 | 67.54 | 8.56 |
| $\mu_m$ | 7.26 | 7.2 | 5.36 | 9.36 | 1.05 |
| NE | .33 | 0 | 0 | 1 | .47 |
| S | .34 | 0 | 0 | 1 | .47 |
| MW | .26 | 0 | 0 | 1 | .44 |
| LARGE | 0 | 0 | 0 | 0 | 0 |
| MED | 0 | 0 | 0 | 0 | 0 |
| MNPDNA | 1.15 | .88 | .03 | 5.54 | 1.01 |

Table 6

Regression Results for Mortgage-to-Assets Ratio†

$$m_t = (1-k)m_{t-1} + kc + k\alpha r_f + k\beta I + k\gamma V + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S + k\theta_3 MW + k\theta_4 MNPDNA + \varepsilon$$

| Explanatory Variable | High Mortgage Ratio Banks (2,478 observations, adjusted $R^2$=.923) | Savings Associations (Unconstrained) (21,177 observations, adjusted $R^2$=.974) | Savings Associations (Constrained) (21,177 observations, adjusted $R^2$=.974) |
|---|---|---|---|
| $m_{t-1}$ | .963*** | .985*** | .985*** |
| | (.006) | (.001) | (.001) |
| constant | -39.4* | 43.8*** | -7.03 |
| | (22.9) | (16.9) | (16.2) |
| $r_f$ | -.232 | 9.64*** | 0 |
| | (1.76) | (1.41) | (0) |
| I | 17.4** | 1.17 | 2.14 |
| | (6.75) | (4.82) | (4.87) |
| V | -.505** | -.23 | -.169 |
| | (.235) | (.161) | (.162) |
| $\mu_m$ | 4.95 | -6.21*** | 7.85*** |
| | (3.02) | (2.14) | (1.2) |
| NE | 13.5* | -8.91* | -8.78* |
| | (7.12) | (5.09) | (5.14) |
| S | 16.5** | -1.56 | -.737 |
| | (6.9) | (5.04) | (5.09) |
| MW | 3.69 | -.168 | .396 |
| | (7.65) | (5.21) | (5.27) |
| LARGE | --- | 6.68 | 6.17 |
| | | (7.38) | (7.45) |
| MED | --- | -6.93 | -7.04 |
| | | (6.24) | (6.31) |
| MNPDNA | -4.54** | -2.42*** | -2.49*** |
| | (1.91) | (.887) | (.898) |

†Except for $m_{t-1}$, reported numbers are partial derivatives of $m^*$; standard errors in parentheses
* (**) (***) statistically significant at the 10 (5) (1) percent level

Table 7

Regression Results for Mortgage-to-Asset Ratio†

$$m_t = (1-k)m_{t-1} + k\delta r_f^{\alpha} I^{\beta} V^{\gamma} + k\lambda\mu_m + k\theta_1 NE + k\theta_2 S + k\theta_3 MW + k\theta_4 LARGE + k\theta_5 MED + k\theta_6 MNPDNA + \varepsilon$$

| Explanatory Variable | High Mortgage Ratio Commercial Banks (2,478 observations, adjusted $R^2$=.923) | Savings Associations (21,177 observations, adjusted $R^2$=.974) |
|---|---|---|
| $m_{t-1}$ | .963*** | .985*** |
| | (.006) | (.001) |
| $r_f$ | -.232 | 9.13*** |
| | **(.601)** | **(.0001)** |
| I | 6.48 | -1.23 |
| | **(.459)** | **(.794)** |
| V | -.147 | -.06 |
| | **(.429)** | **(7.35)** |
| $\mu_m$ | 3.45*** | -4.98** |
| | (.78) | (2.08) |
| NE | 13.49** | -7.17 |
| | (6.82) | (5.06) |
| S | 14.66** | .802 |
| | (6.28) | (4.95) |
| MW | 3.54 | 3.67 |
| | (7.13) | (5.05) |
| LARGE | --- | 5.89 |
| | | (7.42) |
| MED | --- | -7.53 |
| | | (6.3) |
| MNPDNA | -4.61** | -2.48*** |
| | (1.92) | (.898) |

† reported numbers are partial derivatives of m*; standard errors in unbolded parentheses; significance levels in bold parentheses

** (***) statistically significant at the 5 (1) percent level

# *Mathematica* Appendix for "Is Mortgage Lending by Savings Associations Special?"

**An Example of how the comparative statics are calculated. This example uses a recent experience simulation "interest rate shock" as described in the text.**

First we assume that the house value is the sum of the mortgage and the downpayment. There are two borrowers--traditional borrowers (denoted c for conforming) and a nontraditional (denoted s for special) borrowers.

```
Vc=Mc+Dc;
```

```
Vs=Ms+Ds;
```

Since the mortgage rate is higher than the interest rate on savings, the borrower uses all savings for the downpayment.

```
Sc=Dc;
```

```
Ss=Ds;
```

The borrower's utility function is based on housing and food. The traditional and nontraditional borrower have the same type of utility function.

```
Uc = Simplify[alphac Log[Vc] + (1 - alphac) Log[Fc] -
  thetac (mratec Mc+ p Fc -Incomec -frate (Sc-Dc))]
```

```
(Incomec - Mc mratec - Fc p) thetac +
  (1 - alphac) Log[Fc] + alphac Log[Dc + Mc]
```

```
Us = Simplify[alphas Log[Vs] + (1 - alphas) Log[Fs] -
  thetas (mrates Ms+ p Fs -Incomes -frate (Ss-Ds))];
```

We use the optimization program writtten by Hal Varian at the University of California at Berkeley

```
<<Varian`Symbopt`
```

We find the first-order conditions for the traditional borrower and solve for the utility maximizing mortgage and food amount, and apply the budget constraint. (For ease of use, we write the mortgage amount in terms of the mortgage interest rate.)

```
FOC[Uc,{Mc,Fc,thetac}];
```

```
sols = Solve[FOC[Us,{Ms,Fs,thetas}],{mrates,Fs,thetas}];
```

```
solc = Solve[FOC[Uc,{Mc,Fc,thetac}],{Mc,Fc,thetac}];
```

Define the mean returns on traditional and special mortgages

```
meanc = mratec (1-dc) +lc dc -costc;

means = mrates*(1-ds) +ls ds -
costs;
```

Define the variances in the returns on traditional and special mortgages.

```
variancec = (mratec -lc)^2 dc^2 (1-dc)^2;

variances = (mrates -ls)^2 ds^2 (1-ds)^2;
```

Write out the first-order condition for a traditional lender who can choose only between a tresaury bond and funding a traditional mortgage. Note that the yield on the treasury bond is the same as the lender's funding rate (frate).

```
proptrad = (meanport - frate)/(meanc-frate);
```

Solve for the mortgage rate that sets the risk-adjusted expected profits (that is, profits with the same variance as the market return) equal to zero.

```
ratesconform=Simplify[Solve[mratec == (((meanport-
frate)/varport) (mratec -lc)^2 dc^2 (1-dc)^2 +
frate)/(1-dc)-lc dc +costc +frate,mratec]];
```

Since the solution is quadratic, choose the solution that is within the bounds appropriate for an interest rate.

```
mortgageconform =Simplify[First[solc][[1]][[2]] /.
ratesconform];
```

Impose the parameter values of the recent experience simulations.

```
rulesconform ={costc->.01, meanport->.075,varport->.0001,
dc->.0008,Incomec->100,p->1,alphac->.1, lc->-.4, Dc->20}


{costc -> 0.01, meanport -> 0.075, varport -> 0.0001,
  dc -> 0.0008, Incomec -> 100, p -> 1, alphac -> 0.1,
  lc -> -0.4, Dc -> 20}

mratecrules=ratesconform[[1]] /. rulesconform;
```

Solve for the proportion of traditional mortgages in the traditional lender's portfolio.

```
propconform=proptrad /. mratecrules /. rulesconform;

propsolution = proptrad /. mratecrules;

mortgageconform[[1]] /. rulesconform;

conformmrate =First[ratesconform];
```

# Solve the Nontraditional mortgage market

Pull the nontraditional borrower's choice of mortgage interest rate (mortgage amount demanded) from the utiilty maximization problem.

```
First[sols][[2]]
```

```
                      alphas Incomes
mrates -> -(-------------------------)
             -Ds + alphas Ds - Ms
```

The nontraditional lender maximizes total revenues from its special borrowers, taking into account the demand function of the special borrowers.

```
profit = Simplify[Ms*means /. First[sols][[2]]];

maxprofit = Simplify[FOC[profit,{Ms}]];
```

Find the optimal amount of mortgages for the lender to supply. Since the profit function is quadratic, there are two solutions. Choose the positive solution.

```
msstar = Solve[maxprofit,{Ms}];

mssolone = msstar[[2]];
```

Apply the parameter values for the recent experience simulations.

```
rules = {dc->.0008,ds->.005,costc->.01,
costs->.03,lc->-.4, ls->-.4,
costc->.01,meanport->.075,varport->.0001,
Incomes->100,p->1,alphas->.1, Dc->20, Ds->20}

{dc -> 0.0008, ds -> 0.005, costc -> 0.01, costs -> 0.03,
  lc -> -0.4, ls -> -0.4, costc -> 0.01, meanport -> 0.075,
  varport -> 0.0001, Incomes -> 100, p -> 1, alphas -> 0.1,
  Dc -> 20, Ds -> 20}
```

Create the rule for setting the nontraditional mortgage rate.

```
mstarrule = First[sols][[2]] /. mssolone;
```

The nontraditional lender minimizes the variance of returns for a given expected return on a portfolio of three assets.

```
v= Simplify[propc^2*variancec + props^2*variances +
+lambda(meanport -
propc*meanc -props*means -(1-propc-props)frate)];
```

Find the first-order conditions for the objective function and solve for the proportion of assets allocated to each investment.

```
solnonconforming = Simplify[FOC[v,
{propc,props,lambda}]];

solutions = Solve[solnonconforming,{props,propc,lambda}];
```

Incorporate the mortgage rule that maximizes revenues from nontraditional mortgages into the optimal choice of investment proportions, and apply the parameter values.

```
solmratec = solutions /. conformmrate /. mstarrule/. rules;
```

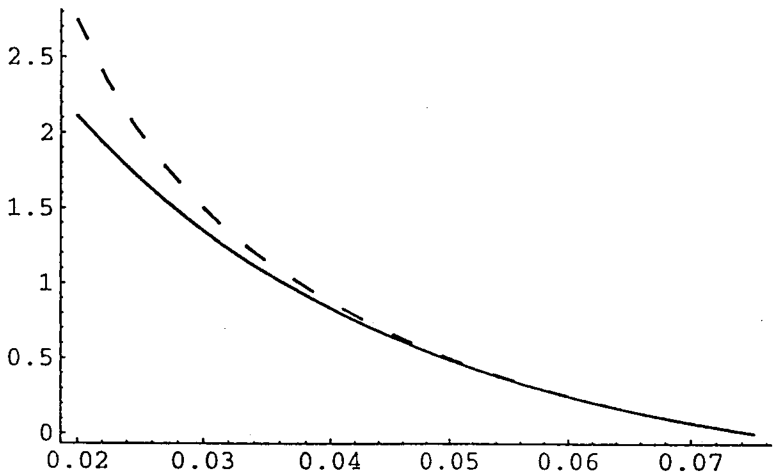
Pick out the proportion of traditional and nontraditional mortgages held by the special (nontraditional) lender.

```
propspecialconform=First[solmratec][[3]][[2]];

propspecialnonconform=First[solmratec][[2]][[2]];
```

Plot out the proportion of traditional mortgages held by the traditional and special lender as shorter-term interest rates change (right-hand side graph on first panel of figure 1). Other simulations and compartive statics are done in a similar manner.

```
Plot[{propconform,propspecialconform},
{frate,.02,.075},Frame->{
True,True,False,False}, Axes->False, PlotStyle->
{Dashing[{.03,.05}],{}}]
```




```
-Graphics-
```

| Appendix Two--Description of Parameters and Values used in Simulations | | |
|---|---|---|
| Parameter Description | Historical Simulation Value | Recent Experience Simulation Value |
| Annual Default Rate on Conforming Mortgage (dc) | .08 percent | Same |
| Annual Default Rate on Nonconforming Mortgage (ds) | .50 percent | Same |
| Cost of Underwriting a Conforming Mortgage (costc) | 1 percent | Same |
| Cost of Underwriting a Conforming Mortgage (costs) | 3 percent | Same |
| Loss Rate on Both Conforming and Nonconforming Defaulted Mortgages (lc and ls) | 40 percent | Same |
| Mean Return on Market Portfolio (meanport) | 4.94 percent | 7.50 percent |
| Variance on Market Portfolio (varport) | .58 percent | .01 percent |
| Return on Short-Term Treasury Bills (frate) | 3.64 percent | 6.01 Percent |
| Income of Conforming and Nonconforming Borrowers (Incomec and Incomes) | $100 | Same |
| Price of Non-housing Goods | $1 | Same |
| Down-payment Requirement on Both Conforming and Nonconforming Mortgages (Dc and Ds) | $20 | Same |
| Relative Preference for Housing versus other Goods for Both Conforming and Nonconforming Borrowers (alphac and alphas) | .1 | Same |