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Patric H. Hendershott

Robert Van Order

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ABSTRACT

The securitization of fixed-rate mortgages suggests that the FHA/VA market was fully integrated with capital markets by the early 1980s and that the conventional market moved toward integration during the 1980s. Assuming full integration of FHA/VAs via the GNMA securitization process, we first estimate equations explaining near-par GNMA prices weekly for the 1981-88 period. The price is then set equal to the new-issue price and, based upon the preferred equation, the perfect-market retail coupon rate is computed. Next we estimate equations (for three year segments of the 1971-88 period) explaining conventional commitment mortgage coupon rates in terms of current and lagged values of this perfect-market coupon rate. Finally, we examine differences between the perfect-market and actual coupon rates and compute the impact of these differences on residential capital accumulation.

Patric H. Hendershott
Galbreath Prof. of Real Estate
The Ohio State University
1775 College Road
Columbus, OH 43210

Robert Van Order
Federal Home Loan Mortgage Corp.
1759 Business Center Drive
P.O. Box 4115
Reston, VA 22090

Integration of Mortgage and Capital Markets and the Accumulation of Residential Capital

Patric H. Hendershott and Robert Van Order

The fixed-rate home mortgage market appears to be fully integrated into "the capital market" broadly defined. That is, mortgage rates move in response to changes in other capital market rates, and mortgage funds are readily available at going market rates. Mortgage rates can diverge from other rates because the "technical" characteristics -- call provisions in particular -- of mortgages and other securities differ and the "price" of these characteristics can change, but in a fully integrated capital market shifts in the demands for or supplies of mortgage funds will not cause divergence to occur.

The mortgage market was integrated gradually throughout the 1970s and first half of the 1980s with the development of active markets for mortgage pass-through securities. Legislation in 1968 and 1970 established the Government National Mortgage Association (Ginnie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac), and by 1971 the Ginnie Mae pass-through program for government-insured FHA/VA mortgages and the Freddie Mac program for conventional mortgages were in operation. Integration was stimulated in the 1980s by the deregulation of deposit rate ceilings and the erosion of thrift tax subsidies, developments that eliminated thrift cost advantages in funding mortgages.

Mortgage market integration has had conflicting effects on homebuyers. During most of the 1960s and 1970s, existence of specialized housing finance institutions caused mortgage funds to be cheaper than they would have been with full integration. In contrast, during the credit crunches of 1969-70 and 1974-75 and during much of the early and middle 1980s, when the traditional housing finance institutions were under enormous pressures and the conventional secondary market had not yet exercised its full force, mortgage funds were either unavailable or relatively expensive, and homebuyers would have benefitted from a more integrated system.

This paper explains how the market for fixed-rate mortgages has developed since 1971 and how this development has affected the accummulation of residential capital. We begin with a discussion of the most important change in the market: the growth in mortgage pass-through securities. We then test how this change has altered the relationship between mortgage and Treasury rates. We do this by estimating (1) what the mortgage rate would have been had markets been "perfect" and (2) how actual rates responded to changes in the perfect-market rate for different subperiods of the 1971-88 time span. The perfect-market rate adjusts Treasury rates for the value of the prepayment option in mortgages. The impact of an imperfect mortgage market on residential capital accumulation is then measured as the difference between the accumulation based upon the actual mortgage rate (and credit rationing in the 1970s) and that based on the perfect rate (and no rationing). The vehicle for these calculations is a modified version of the Housing Sector of the Washington University Macro Model.

I. The Development of Mortgage Pass-Through Securities

In 1968, the Government National Mortgage Association (Ginnie Mae) was formed within the U.S. Department of Housing and Urban Development to administer government mortgage support programs. Two years later Ginnie Mae began guaranteeing mortgage-backed pass-through securities, GNMAs, representing shares in pools of FHA/VA loans. Investors in pass-throughs receive a *pro rata* share of the payments, both scheduled and early (in the event of prepayment or default), on the underlying mortgages. While investors in whole FHA/VA loans are insured by FHA or VA against loss of principal and interest, investors in GNMAs are guaranteed the full timely payment of principal and interest.

In 1970, the Federal Home Loan Mortgage Corporation (Freddie Mac) was chartered to spur the development of a secondary market for conventional mortgages. As part of this effort, Freddie Mac introduced the first conventional mortgage pass-through in 1971, the Mortgage Participation Certificate (PC). While Freddie Mac doesn't have a full faith and credit Federal guarantee, the underlying conventional mortgage is not itself fully insured. Thus the Freddie Mac guarantee adds more value to the underlying mortgage than does the Ginnie Mae guarantee. In 1981, the Federal National Mortgage Association (Fannie Mae) initiated a conventional mortgage-backed security (MBS) program similar to Freddie Mac's PC program. Fannie has intermediated in the more traditional sense, buying mortgages and issuing its own debt, since 1938, and it has an implied guarantee comparable to Freddie Mac's.

Statutes limit the dollar value of loans that can be pooled into the various pass-through securities. The limit on GNMAs follows from the limit on the underlying FHA and VA loans. The 1988 limit, which varies regionally, is $67,500 to $101,250. These limits have changed little in the 1980s. The dollar limit on conventional loans that Fannie Mae and Freddie Mac can purchase, the "conforming" limit, changes annually with a house price index, but does not vary regionally. The 1988 limit was $168,700 up 45 percent since 1985. In 1987, over 90 percent of fixed-rate home mortgage loans (85 percent of dollar volume) was eligible for pooling by the agencies.

The markets for fixed rate FHA/VA and conforming conventional loan pass-throughs developed at different rates. The top half of Table 1 presents data on the growth in the securitization of fixed-rate FHA/VA loans. The importance of pass-throughs to the new origination market is measured as the ratio of GNMA issues backed by 1-4 family loans to total originations of these loans (Ginnie

Mae is prohibited from securitizing FHA/VAs over 18 months old). By the second half of the 1970s, two-thirds of FHA/VA originations went into GNMA pools; by the early 1980s four-fifths did; since 1982 all FHA/VAs have gone into GNMAs.

The pass-through market for conforming conventional loans developed less rapidly (see the lower half of Table 1). The best measure of the two agencies' presence in this market is the share of new fixed-rate conventional FRMs (generally defined as less than one year since origination) eligible for agency securitization (under the conforming limit) that is, in fact, securitized by Freddie Mac and Fannie Mae. Column 1 indicates pass-through issues backed by new FRMs; the product of columns 2 and 3 is the total volume of FRM originations, conforming and nonconforming. Because roughly 80 percent of the dollar volume of FRM originations is under the conforming limit, the ratio of pass-throughs backed by new FRMs to 0.8 times FRM originations is an estimate of this best measure. In the early 1980s, less than 5 percent of newly-originated conforming conventional fixed-rate home mortgages was securitized, in contrast to 77 percent of FHA/VAs. By 1986-87, though, over half of these mortgages went into agency pass throughs.[1]

The difference in the development of FHA/VA and conventional pass-throughs in the 1970s and early 1980s stems largely from the historical differences in the origination of FHA/VA and conventional mortgages. Mortgage bankers have tended to dominate the FHA/VA market, accounting for 70 to 80 percent of originations (see top of table) versus only 7 to 15 percent of conventional originations (see bottom of table), and they sell virtually all their originations to other investors. Thus when an improved method for selling mortgages became available, mortgage bankers quickly took advantage of the opportunity. By the early 1980s, virtually all mortgage banker originations were sold to Ginnie Mae, Fannie Mae, and Freddie Mac (some conventionals were sold to Fannie Mae for its portfolio). In contrast, depository institutions have dominated conventional originations (80 to 90 percent), and, at least until the 1980s, they tended to keep their originations as portfolio investments. Thus an improved selling method alone was not sufficient to stimulate the conventional pass-through market. The explanation for the increased securitization of conventional FRMs is best left for later in the paper.

II. Models of Mortgage Rates and Markets

The last twenty years of mortgage-market analysis have been dominated by two rather extreme approaches. The first emphasized segmented markets dominated by thrifts and ad hoc empirical approaches with proxies for effects of rationing and regulations. The more recent approach has emphasized neoclassical competitive markets, implicitly at least on the grounds that the rise of the secondary markets has made mortgages just another bond traded in a very liquid market.

Both approaches appear to have been right, but at different times. The first approach was a reasonable one in the 1970s but has been supplanted by the neoclassical version in the middle 1980s. In this section we emphasize the neoclassical, competitive model because it will be the basis of our empirical work in section III. We then discuss the segmented market version and how it departs from the competitive model.

The Neoclassical Perfect Market Model: Theory

The neoclassical model applies recent work in financial markets under perfect competition [see, e.g., Black and Scholes (1973), Brennan and Schwartz (1977), and Cox, Ingersoll and Ross (1985)] to mortgages. The models derive prices for risky securities in a world free of both transaction costs and arbitrage profits.

The underlying methodology as applied to mortgage and other markets [see Brennan and Schwartz (1985) and Hendershott and Van Order (1988) for expositions applied to mortgage markets] comes from Black and Scholes' insight that in perfect capital markets with enough independent assets a portfolio of several assets can be set up that, at least over a short time period, exactly replicates the returns of the asset to be priced. From this portfolio, the price of the asset in question can, with some mathematical dexterity, be determined.

In mortgage markets the bulk of research has been on pricing long-term fixed-rate mortgages [see Dunn and McConnell (1981), Buser and Hendershott (1984), Brennan and Schwartz (1985) and Kau et. al. (1986)]. Most of the analyses have abstracted from default risk and focussed on the borrower's option to prepay at par. In our empirical explanations in Section III of Ginnie Mae prices or retail commitment coupon rates on 80% loan-to-value loans, this focus is appropriate because there is little default risk in 80% loan-to-value loans (maybe 3 to 8 basis points in coupon premium) or Ginnie Maes.[2]

An investor in a typical fixed-rate mortgage is long an amortizing 30-year bond but short an American call on the bond. Absent default risk and transaction costs, the risk in holding the mortgage comes only from interest rates and is composed of two parts: the usual interest rate risk on the bond and the interest rate risk on the option. The combination of the two leads to an asymmetry that is the central issue in mortgage pricing: when interest rates rise, the mortgage investor loses because mortgage price falls, but when rates fall, the investor's gains are limited because borrowers will exercise their option to prepay at par.

This option is most transparent in the case of the FHA/VA mortgages in Ginnie Mae pools because those mortgages can be assumed by new house buyers. Thus the financing and selling of the house are, in perfect markets, separate.

But there are transaction costs, and while people do seem to act qualitatively as the model says, they do not prepay as ruthlessly as some early applications of the models suggested. This is apparent from both prepayment data, which show only gradual changes in prepayment rates in the face of large interest rate declines, and empirical analysis of prepayments [e.g., Foster and Van Order (1985) and Green and Shoven (1986)]. Nonetheless, the frictionless model is a good beginning, and it certainly captures the qualitative properties of more complicated models.

The basic idea of the model is depicted in Figure 1. Line AM depicts the value of a noncallable amortizing bond as a function of "the" interest rate.[3] The bond has the usual downward sloping convex shape. Line BCM shows the value of a mortgage that is callable at par, and the difference between the two curves is the value of the call option. The mortgage can never have a value greater than par, and in fact the curve must become tangent to the par line. This tangency is a first order condition for optimal exercise of the call (see Hendershott-Van Order (1988) for a brief discussion). Note that the relationship between value and interest rate is complicated. For deeply discounted mortgages, the relationship is just like that for the bond (the option is too far out of the money to be valuable), but as value approaches par the curve becomes concave rather than convex (traders refer to this as negative convexity).

Because of various transaction costs, mortgages are not generally called in the frictionless manner described here. Transaction costs mean that the mortgage value curve can be above par as rates fall (the DM line) but there will be a tendency for the value to revert to par as rates become so low that exercise is quite probable. Hence, the value-interest rate curve for mortgages can, in principle, have an upward sloping segment (traders sometimes call this negative duration).

Empirical pricing models used on Wall Street (largely unpublished) generally take a probabilistic approach to prepayment, assuming that the odds of prepayment increase (in a nonlinear way) as the new-issue mortgage rate falls below the coupon rates on existing mortgages. These models capture the flavor of the option approach, but the changes in shape of the mortgage-value curve, particularly in the range just below par (which is the range corresponding to new issues), are not nearly as striking as we depicted in Figure 1.

Neoclassical Perfect Market Model: Empirical Implications

The option-oriented pricing models, given a prepayment function, provide exact predictions of mortgage price in a similar way to that in which the Black-Scholes model provides an exact prediction of a stock option's price. We do not intend to use the model that way. Rather we shall regress mortgage price on the variables that the model tells us should affect the values of the call option and the underlying noncallable bond, and we shall see if qualitative properties of the model hold up. What the models suggest is that the price of a standard fixed-rate mortgage should depend only on: its coupon rate, term to maturity, market interest rates of various maturities, and the volatility of the interest rates. More specifically:

(1) an equal rise in all market interest rates, holding the coupon constant, should lower mortgage price (except in the extreme negative duration case discussed above).

(2) a twisting of the yield curve (holding the "average" of rates constant) that increases the difference between long and short rates (the slope) should raise the value of a mortgage because the implied increased probability that interest rates will rise reduces the value of the call option.

(3) increases in volatility will lower mortgage value because greater volatility raises the value of the homeowner call option.[4]

(4) interactions among the variables should matter. In particular:

a) When the mortgage is at a big discount (the coupon rate is low relative to interest rates), the effect of volatility and slope should be smaller because the option is out of the money. Thus slope and volatility should both be interacted with the difference between the coupon rate and market rates.

b) When rates are expected to rise, the effect of volatility should be smaller because the option is less likely to be exercised. Thus volatility and slope should be interacted.

c) When rates are expected to fall and thus the expected mortgage life is short, mortgage value will depend more heavily on short term rates and less heavily on long term rates. Thus slope squared should be included.[5]

In summary, if we write the price of a mortgage as:

$$P = M(c, r, \Delta, \sigma) \tag{1}$$

where c is the coupon, r market interest rates, Δ the slope of the yield curve (long less short) and σ interest rate volatility, then

$$M_c > 0, \quad M_r < 0, \quad M_\Delta > 0, \quad M_\sigma < 0, \tag{2}$$

$$M_{(c-r)\Delta} > 0, \quad M_{(c-r)\sigma} < 0, \quad M_{\Delta\sigma} > 0, \; M_{\Delta\Delta} > 0, \text{ and } M_{\sigma\sigma} < 0.$$

All of these are reflections of the complex interactions of the call option with the bond value.

Alternatively, if we explain new issue coupon rates -- set the price at par (less points net of origination costs), then

$$c = \theta(r, \Delta, \sigma), \tag{3}$$

where $\theta_r > 0$, $\theta_\Delta < 0$, $\theta_\sigma > 0$, $\theta_{\Delta\sigma} < 0$, $\theta_{\Delta\Delta} < 0$, and $\theta_{\sigma\sigma} >$.

Segmented Markets

The perfect market model says that mortgage price (or alternatively the mortgage coupon rate for a given mortgage price) depends on a small number of general capital market variables, that the response to changes in those variables is predictable and fast, and that mortgage price (or coupon rate) does not depend on variables peculiar to the mortgage market, like details of particular lending institutions.

This would have seemed like a silly model twenty years ago, when mortgage lending was tied to particular institutions, the thrifts. Portfolio restrictions on savings and loans (no corporate loans, bonds, or equity issues) encouraged their investment in residential mortgages, and these investments were especially profitable to thrifts owing to special tax advantages. The tax preference was the ability of thrifts to compute loan loss reserves that far exceeded a reasonable provision for normal losses, as long as thrifts invested a large fraction of their assets in housing-related loans or liquid assets (Hendershott and Villani, 1980 appendix). In effect, thrifts were allowed to transfer large portions of their before tax income to reserves, thereby avoiding taxes. Between 1962 and 1969, the transfer was limited to 60 percent of taxable income; between 1969 and 1979, the fraction was gradually reduced to 40 percent; the Tax Reform Act of 1986 lowered the fraction to 8 percent.

The incentive provided by the extraordinary loan loss provisions for investment in residential mortgages depends on the expected level of thrift taxable profits (with no profits, the incentive is zero), the income tax rate, and the statutory fraction of income that can be transfered to reserves. Assuming a one percent net pretax return on assets, the incentive was substantial in the 1960s and 1970s. In the 1960s when the transfer fraction was 60 percent, savings and loans would have accepted a three-quarters percentage point lower pretax return on tax preferred housing-related assets than on comparable nonpreferred assets. By 1979, when the transfer fraction was down to 40 percent, they would have accepted a half percentage point less.

In the 1960s and 1970s world, connections with capital markets were tenuous and gradual. A rise in interest rates could raise mortgage rates if it increased deposit rates, but deposit rates had ceilings. Increased rates might cause deposit outflows, i.e., disintermediation, but that was gradual and to the extent there was mortgage rationing (from state usury laws, FHA ceilings and/or general sluggishness) the effect of rising market rates on mortgage rates was slow and tenuous. Hence most researchers at the time focussed on things peculiar to the thrift industry, such as deposit rates and deposit flows, rather than general capital market conditions. If we regressed actual mortgage price or rates during such a period on fictional mortgage prices or rates predicted by the perfect market model, we would expect to see a bad fit. Moreover, to the extent that the predicted price/rate had any effect, it would be a lagged one.

A separate issue is whether mortgage rates in the 1970s were higher or lower than they would have been in the perfect market case. One might suspect that they were generally lower owing to the large tax advantages until recently enjoyed by thrifts, the portfolio restrictions that kept thrifts out of many other lending activities, and the possibility that thrifts did not fully appreciate the value of the call option borrowers were receiving. Deposit rate ceilings probably lowered rates in some periods and raised them in others.

III. Analysis of GNMA Price Data

Roth (1988) analyzes the integration of mortgage and capital markets by looking at changes in the correlation between conventional commitment mortgage rates and Treasuries. He finds that the correlation has increased over time and is currently quite high. In this section we extend that sort of analysis by constructing a perfect mortgage-like capital market rate, looking at lags in the adjustment of conventional commitment mortgage rates to perfect rates (rather than to Treasury rates), and estimating whether observed mortgage rates have been higher or lower than perfect capital markets would have warranted.

Our analysis consists of two parts. First, we assume that the GNMA market has been integrated with capital markets since 1981. This is because GNMAs have full faith and credit guarantees and have traded like Treasuries, with comparably low transactions costs and high volume, at least since 1981. We begin by estimating a price equation for GNMAs. The neoclassical model says that the price of a GNMA should depend on its coupon and term, market interest rates, and interest rate volatility, with properties discussed in Section II. We then estimate this equation, set price equal to the new-issue price, and solve the equation for the perfect-market retail coupon rate.

Second, we regress conventional commitment mortgage coupon rates on current and past values of the estimated perfect-market coupon rate taken from the GNMA equation. If markets are perfect, there should be no lag and the coefficient of the current rate should be unity. We test this, and we also look at the difference between actual and predicted rates over time to see when actual mortgage rates were above or below the perfect-market rate.

GNMA Prices

Our analysis of the determinants of mortgage prices is based upon weekly GNMA price and coupon data from the DRI data base for the January 1981-July 1988 period. These data are supposed to be for current-coupon, near-par mortgages; in fact, the GNMA prices vary from 91 to 101. The seven-year constant maturity yield is the basic Treasury rate, and slope is defined as the difference between the seven-year and six-month Treasury rates. All interest rates, including the mortgage coupon rate, are computed on a bond- equivalent basis and are measured in percentage points. Volatility is measured as the cumulative absolute change in the seven-year rate over the previous 20 weeks. Using historic volatility presents some problems because it will probably lag behind traders' expected volatility.

The first equation explaining the GNMA price in Table 2 includes only the coupon rate, the seven-year rate, the slope, and volatility. The basic call-option model is confirmed: price is positively related to the slope (high slope, lower probability of call) and negatively related to volatility (greater volatility, greater probability of call). Price is also positively and negatively related, respectively, to the coupon and seven-year Treasury rates, with their coefficients being virtually identical in absolute value. The latter is consistent with the proposition that an equal rise in the coupon rate and all interest rates should not affect the price of a bond that is close to par. While the regression coefficients are all statistically significant at the 0.01 level, the residuals are positively correlated.[6] When a semi-difference transformation is performed, the coefficients change little, and the slope and volatility coefficients are still 2 and 3 times their respective standard errors.

The third and fourth equations include the interaction of slope and volatility with the spread between the coupon and seven-year rates. A large spread says the option is in the money and thus mortgage price will be quite sensitive to slope and volatility. In contrast, price should be relatively insensitive when the spread is zero or negative. As expected, the slope and volatility coefficients in the previous equations are now apportioned between the straight variable and its interaction with the coupon-seven year spread, with the latter having greater statistical significance. As the spread declines (the mortgage goes to a discount), the impact of slope and volatility (the call value) decreases.

The fifth and sixth equations in Table 3 include the slope and volatility square terms, as well as their product. Because interpretation of these equations is difficult, Table 3 has been constructed. Partial derivatives of price with respect to volatility and slope are computed from equation 2-6 in Table 2 for slope varying from -1.5 percentage points to +2.5 percentage points and volatility ranging from one to five (three to five when the yield curve is downward sloping), reflecting the values generally experienced over the 1971-88 period. For a positively sloped yield curve, the partials are as expected: positive and negative with respect to slope and volatility, respectively, and smaller in absolute magnitude the more the mortgage is at a discount (the call is less in the money). For negatively sloped yield curves, though, the partial with respect to slope is effectively zero, and the partial with respect to volatility is reduced in absolute magnitude.

We ran similar regressions for the 1980-88 and 1982-88 periods, and we ran regressions using the 10 year and 3 month Treasury rates. While in some cases the signs of the cross partials were not as expected, the results were broadly similar to those in Table 2. We chose the 1981-88 regression because it looked the most like what the neoclassical model says and, hence, is the best perfect market benchmark. None of the results that follow are changed much if the other regressions are used.

Conventional Commitment Mortgage Rates

To determine how the conventional mortgage market has been integrated with capital markets generally, we regress retail conventional commitment rates on the current and lagged one to eight week values of the perfect-market rate implied by the GNMA price equation. To obtain this perfect-market rate, we solve the estimated price equation (2-6 in Table 2) for the coupon rate, set the mortgage price equal to 100 less the actual points charged in the conventional market (less one point presumed to equal origination costs), recompute the coupon rate using the observed values of the other variables, convert the rate to a mortgage (rather than bond-equivalent) basis, and add 50 basis points for servicing and other costs. The retail commitment rate and points are those obtained by the Federal Home Loan Mortgage Corporation in a weekly survey of 125 major lenders conducted since the spring of 1971. To the extent that integration has occurred, we should expect changes in the perfect-market coupon rate to be reflected quickly and fully in the conventional commitment rate.

Table 4 contains the estimated coefficients and standard errors, with the semidifference transformation, for weekly data from the 1986-88, 1983-85, 1980-82, 1976-79, and 1971-75 time periods. These estimates are summarized in Table 5, which reports the cummulative adjustment concurrently and over two, four, six, and eight week lags. The shift toward integrated markets is striking. The percentage of the change in the GNMA rate that is reflected instantaneously in the retail conventional rate rises monotonically from effectively zero in the 1970s to 8 in the 1980-82 period, 16 in the 1983-85 period, and 59 in the 1986-88 period. The fraction of the change in the GNMA rate reflected in the conventional rate within two weeks rises monotonically from a sixth in first half of the 1970s, to almost half in the early 1980s, to over half in the 1983-85 period, and to nearly one in recent years.

This shift is confirmed by direct regressions (specific results not reported here) of the conventional commitment rate on proxies for the call premium and current and lagged values of the seven-year Treasury rate.[7] The percentage change in the Treasury rate that is reflected instantaneously in the conventional rate rises from 3 and 5 in the earlier periods to 20 for the 1984-86 period and 52 for 1986-88. Similarly, the percentage reflected within two weeks rises from 30 to 40 to 50 to 75.

Differences in Actual and Perfect-Market Commitment Rates

The first three columns of Table 6 list the annual average values of the actual conventional mortgage commitment rate, our fictional perfect-market rate, and the difference between them for the 1971-88 period.[8] The next column contains the average yearly difference between the actual GNMA coupon and the estimated coupon obtained by solving equation (2-6) in Table 2. As can be seen, these estimation errors are less than 10 basis points in all but two years, 1982 and 1984, and less than 30 basis points in those. These errors reflect our inability to fully specify all the nonlinearities and interactions in the pricing of GNMAs, as well as to measure the variables (especially volatility) precisely. Thus the difference between the conventional error and the GNMA error (zero prior to 1980 because we have no better estimate), is our best estimate of the difference between actual and perfect-market retail conventional commitment rates, and the perfect-market rate plus the GNMA error, shown in the last column, is our best estimate of the perfect-market rate.

The precise differences are, of course, subject to some error; the actual rate is a survey rate and the perfect rate is computed from an empirical equation estimated with some error. Nonetheless, the overall pattern of the differences seems both systematic and plausible enough to be taken seriously. The actual rate was three-quarters of a percentage point below the perfect-market rate in the 1971-75 period; a third of a point below in the 1976-80 period; and roughly half a point above the perfect rate in the 1982-86 period. Beginning in the middle of 1987, the actual rate is very close to the perfect rate, the conventional conforming fixed-rate mortgage market seemingly being fully integrated into capital markets.

As explained above, the low mortgage rates in the 1970s can be attributed to tax advantages for thrift mortgage investments and portfolio restrictions against nonmortgage investments. The switch in the 1980s reflects a sharp relative shift of thrifts out of home mortgage investments. Most strikingly, the share of saving and loan total assets in home mortgages and agency securities (largely Fannie and Freddie pass-throughs) fell from 72 to 57 percent during the 1982-87 period. This portfolio shift reflects the reduced profitability of savings and loans, first due to high interest rates and a maturity mismatch and then due to disinflation and credit losses, the expansion of savings and loan asset powers, and a regulatory enhanced aversion to interest rate risk. The reduced profitability eroded the tax incentives for residential mortgage investment, while the expansion of powers and regulatory aversion encouraged thrifts to invest more widely (the latter also encouraged switching from FRMs to ARMs).

The half percentage point premium in the early 1980s provided the incentive for the securitization of conventional FRMs. The premium covered the start up costs of the securitizers and the liquidity premium demanded by investors. As the volume of mortgage pools grew, bid/ask spread were bid down (and thus the liquidity premium fell), and the per dollar costs of the securitizers declined. As a result, the yields on conforming conventional loans fell by 30 basis points relative to those on nonconforming loans (Hendershott and Shilling, 1988).

IV. Imperfect Mortgage Market and Residential Capital Accumulation

The imperfect (subsidized) home mortgage market in the 1970s led to more residential capital accumulation than a perfect, fully-integrated market would have, while the disruption of the market in the early 1980s did the reverse.

Also, with a perfectly integrated mortgage market, credit rationing would not have existed. This would have increased housing construction during the "rationing" periods, but decreased construction during the subsequent "catch up" periods. Obtaining a measure of how residential capital accumulation would have differed had the mortgage market been fully integrated is the purpose of this section.

We first considered using a general equilibrium simulation model to compute the long run equilibrium impact. However, the largely self-reversing nature of the disturbances -- higher mortgage rates in the 1970s but lower in the 1980s and greater housing starts late in the cycle (removal of rationing) but lesser starts early in the next one (removal of catch up) -- ruled this approach out; the long run impact is negligible. We decided instead to modify the residential investment sector of the Washington University Macro Model (WUMM) and to simulate it.[9] In what follows we first describe the WUMM residential sector and our adjustments to it and then report the simulations.

The housing sector of WUMM determines residential investment, disaggregated into the value of single-family homes constructed, the value of multi-family homes constructed, the value of mobile homes shipped, and a residual component consisting mostly of the value of additions and alterations to existing residential structures. Housing starts and the stock of houses, both measured in units, are explained by a neoclassical model of investment in which the equilibrium housing stock is determined by demographic factors, the real after-tax cost of housing, and cyclical considerations. Starts are translated into completed units through a completion or phase-in schedule. Finally, the value of residential construction is derived as the product of the number of units completed and an exogenous real value per completion.

We adjust the WUMM sector in a number of ways. First, for the 1971-1988 period we replace their secondary market mortgage rate in the rental costs of capital for owner-occupied and rental housing, respectively, with our computed effective mortgage commitment rate and the WUMM corporate bond rate. The effective commitment rate is the coupon rate adjusted for points.[10] We switch from the secondary mortgage market rate in the rental cost of capital for multifamily housing to the corporate rate, rather than the mortgage commitment rate, because we are not analyzing the impact of a perfectly integrated multifamily mortgage market. Second, we reestimate the single-family starts equation using the effective mortgage rate and including a credit rationing variable for the 1969-77 period. Third, we endogenize the real value of single-family completions. The starts and real value equations follow Hendershott (1980).[11]

The model is first "adjusted" to reproduce history. That is, add factors are put into each equation so that all variables track historic values precisely. Two simulations are then run. In both, the credit rationing variable is set equal to zero. In the second, the actual home mortgage rate is replaced by the adjusted perfect-market rate.

The effect of removing credit rationing in the 1973.2 to 1975.4 period on housing starts is illustrated in Figure 2. Rationing aggrevated the slowdown in single-family starts in 1974-75 and reinforced the 1976-77 recovery. With a perfectly integrated mortgage market, rationing would not have existed and this housing cycle would have been less severe.[12] An extra 15 billion (1982$) of housing would have been accumulated by the first quarter of 1976, but by the second quarter of 1978 the stock would have been back its original value, i.e., 15 billion dollars of housing construction would have been pulled forward in time.

Next we analyze the impact of shifting the mortgage rate to its perfect-market path and setting the rationing variable to zero. Figure 3 indicates the impact on the real value of residential capital. The 75 basis point increase in the mortgage rate to the perfect market rate in 1971-73 lowers the real stock by 9 billion (1982$). Then the impact of removing credit rationing comes into play; the real value rises by 14 billion (from -9 to +5) and then reverses itself by late 1978. The additional reduction in the real housing stock in the late 1970s and early 1980s reflects the generally lower level of real price of single family units constructed. We then see the effect of the perfect mortgage rate falling from nearly a half point above the actual rate in 1980 to a half point below in the 1981-86 period; the housing stock rises from nearly 12 billion below actual to 5 billion below in early 1983. The difference between the simulated stock and the actual then oscillates around this value for the rest of the simulation period.

IV. Conclusions

The conventional wisdom that mortgage markets have gradually become integrated with capital markets is clearly consistent with the data. The fixed-rate government insured mortgage market (FHA/VA) appears to have been integrated by the early 1980s, and the conventional FRM market became integrated during the 1980s. This integration accelerated in the 1986-88 period when the share of newly-originated conventional conforming fixed-rate mortgages securitized by the Fannie Mae and Freddie Mac jumped to 50 percent. The regressions imply that virtually all of the adjustment to a capital market shock is completed within two weeks. Because our retail mortgage rate is a list (rather than transaction) price, the lag may in fact be even shorter.

Rates on fixed-rate conventional mortgage loans are currently about what one would expect given capital market (GNMA) rates. In contrast, conventional rates were a half percentage point "too low" in the 1970s, owing to thrift tax advantages and portfolio restrictions, and a half point "too high" in the 1982-86 period because thrift profits and portfolio restrictions had effectively disappeared. This half point "excess" return on mortgages stimulated development and use of the Freddie Mac and Fannie Mae pass-through programs. Since early 1987, rates on conforming FRMs have been in line with those on GNMAs.

Had mortgage rates always been about right, housing production would have been less in the 1971-80 period and more in the 1981-83 span. Moreover, housing cycles would have been dampened. On net, the residential housing stock would be only slightly below today's level.

Footnotes

[1] The agencies also securitize adjustable rate and multifamily mortgages. Between 1975 and 1982, 8 to 16 percent of FHA multifamily mortgages were securitized (Seiders, 1983 p. 278). The securitization of conventional conforming ARMs and multifamilies by Fannie Mae and Freddie Mac is a more recent phenomenon. In 1984-85, only 2 to 3 percent were securitized; in 1986-87, the percentage was still only about 10. The greater securitization of fixed-rate single-family mortgages relative to adjustable rate and multifamily mortgages likely reflects both the greater standardization of the former and the greater desire of originators of ARMs to hold them in portfolio.

[2] Because default on a guaranteed loan causes prepayment at par, default could in principle affect required returns, but for the close to par loans that we analyze the effect must be trivial.

[3] In general, the price is a function of a vector of interest rates, i.e., the entire yield curve matters. In some models (e.g., Cox, Ingersoll, Ross (1985)), all interest rates can be written as a function of a single state variable, the instantaneous rate. The Brennan-Schwartz papers look at two rates, a long and a short rate. A casual, but reasonable, simplification is to look at the yield on a Treasury of duration similar to the mortgage (but the latter's expected duration itself depends on the slope of the yield curve).

[4] Volatility also has two offsetting effects on the value of the noncallable bond. Increased volatility of rates tends to increase expected capital gains because of the convexity of the bond curve in Figure 1, which raises value, but to the extent there is risk aversion, increased volatility lowers value.

[5] Let "the" market rate relevant to mortgage prices be a weighted average of short (r_s) and medium (r_m) term rates, where the weight depends on the difference (Δ) between r_m and r_s. Then $r = wr_s + (1-w)r_m$ and $w = w_o - w_1\Delta$. Substituting, $r = r_m - w_o\Delta + w_1\Delta^2$.

[6] The correlation between residuals is generally close to, but less than, unity. A perfect positive correlation would mean that the unexplained part followed a random walk, a property consistent with efficiency in the GNMA market. That the correlation is less than unity may be due to errors in measuring volatility.

[7] Roth (1988) presents regressions of changes in the commitment rate on the spread between the ten-year Treasury rate and the previous weeks commitment rate. The results are comparable.

[8] The rates in this table are not adjusted for points, i.e., they are the coupon rates consistent with whatever points were charged. The adjustment would not affect the differences between actual and perfect rates because the adjustment to both rates would be identical.

[9] We had initially intended to use the full WUMM in order to take into account numerous feedback effects. For example, a stimulus to housing would raise output, creating reinforcing multiplier and accelerator effects. On the other hand, these would raise interest rates generally, offsetting some of the stimulative effect on housing and causing a negative impact on nonhousing capital. We have not bothered to incorporate feedback effects because our "disturbances" are self reversing.

[10] The adjustment adds (Points-1)/(4.20 + .106 slope - .345 vol) to the coupon rate. The denominator in this adjustment is the partial of the coupon rate with respect to price implied by equation 2-6 in Table 2.

[11] The credit rationing variable is the AA variable used by Hendershott (1980, pp. 412-13). Rationing was presumed to exist when the average quarterly growth rate in real adjusted deposits during the previous two quarters was less than one-quarter percent. No evidence of rationing after 1978 could be found.

[12] Less severity in housing cycles would likely lower housing costs and prices (Hendershott and Villani, 1978, pp. 77-80).

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Table 1: The Growth in the Securitization of Fixed Rate Mortgages

A. FHA/VA 1-4 Family Loans

	1 FHA/VA Originations ($bil.)	2 GNMA Issues ($bil.)	3=2/1 Share of Originations Securitized	4 Mortgage Banker Share of Originations
1971-73	15.6	2.7	.17	.70
1974-75	13.5	5.8	.43	.75
1976-79	28.3	17.6	.62	.78
1980-82	21.5	16.6	.77	.81
1983-86	55.0	55.6	1.01	.78
1987	75.2[a]	97.0	1.28[a]	.70[a]

B. Conforming 1-4 Family Conventionals

	1 Passthroughs Backed By New FRMs ($bil)	2 Total Originations ($bil)	3 Fraction Fixed Rate	4=1/(2x3x0.8) Share of New Conforming FRMs Securitized	5 Mortgage Banker Share of Originations
1976-81	3.5	119.6	1.00	.04	.07
1982	9.4	77.8	0.64	.24	.15
1983	14.1	154.2	0.70	.16	.15
1984	10.8	176.0	0.48	.16	.15
1985	31.7	204.6	0.57	.34	.14
1986	120.2	357.1	0.78	.54	.15
1987	95.4	369.2	0.66	.49	.16

[a]Mortgage banker issues are likely understated. Thus originations and the mortgage banker share are too low, and the share of originations securitized is too high.

Sources: 1971-81 from Seiders (1983, 1985); 1982-87 from DataBase, <u>Secondary Mortgage Markets</u>, FHLMC and Hendershott and Shilling (1988).

Table 2: Equations Explaining GNMA Prices Weekly, 1981-88

	Intercept	Coupon	R7	Slope	Vol	$Slope^2$	Vol^2	SlopeVol	Slope(Coup-R7)	Vol(Coup-R7)	ρ	R^2	RMSE
(2-1)	95.13	2.70	-2.66	.324	-.520							.63	1.26
	(0.45)	(0.14)	(0.12)	(.064)	(.083)								
(2-2)	95.00	2.73	-2.70	.267	-.445						.70	.46	0.89
	(0.90)	(0.17)	(0.15)	(.126)	(.144)						(.04)		
(2-3)	94.67	2.71	-2.62	.093	-.541				.265	-.048		.64	1.25
	(0.77)	(0.43)	(0.42)	(.128)	(.148)				(.102)	(.087)			
(2-4)	93.12	3.64	-3.54	.175	-.190				.192	-.245	.70	.48	0.88
	(1.17)	(0.52)	(0.51)	(.169)	(.199)				(.112)	(.104)	(.04)		
(2-5)	96.28	4.26	-4.11	-.891	-2.141	.235	.201	.245	-.027	-.335		.67	1.21
	(0.98)	(0.51)	(0.49)	(.436)	(0.375)	(.050)	(.043)	(.095)	(.109)	(.104)			
(2-6)	94.44	4.20	-4.07	-.078	-1.283	.123	.142	.066	.106	-.345	.68	.50	0.88
	(1.53)	(0.58)	(0.56)	(.574)	(0.613)	(.067)	(.069)	(.122)	(.120)	(.114)	(.04)		

Table 3

Mortgage Price Partial Derivatives with Respect to Slope and Volatility

Parameter Values			Partial Derivatives	
Slope	Volatility	Coupon-R7	Slope	Volatility
2.5	1	1.5	.73	-1.39
2.5	3	1.5	.86	-.83
2.5	5	1.5	.99	-.28
-1.5	3	1.5	-.07	-1.07
-1.5	5	1.5	.06	-.51
2.5	1	0.0	.57	-.87
2.5	3	0.0	.70	-.32
2.5	5	0.0	.83	.24
-1.5	3	0.0	-.25	-.55
-1.5	5	0.0	-.10	.01

Table 4: Regressions of the Conventional Commitment Rate on Current and Lagged Values of the Fictional Perfect-Market Rate

Time Period	Intercept	Current	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	ρ	R^2	RMSE
1986-88	1.78	.59	.23	.13	.03	-.02	-.03	-.06	.04	-.07	.92	.65	.090
	(0.94)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.06)	(.04)		
1983-85	1.81	.16	.20	.19	.05	.08	.08	.07	.01	.04	.92	.81	.053
	(0.50)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)		
1980-82	-.58	.08	.22	.15	.20	.10	.15	.03	.11	.01	.94	.63	.164
	(1.12)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.03)		
1976-79	1.10	.01	.28	.07	.22	.04	-.02	.06	.09	.11	.96	.61	.060
	(0.56)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.02)		
1971-75	1.62	.06	.08	.03	.11	.09	.09	.10	.10	.08	.96	.55	.041
	(0.44)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.02)		

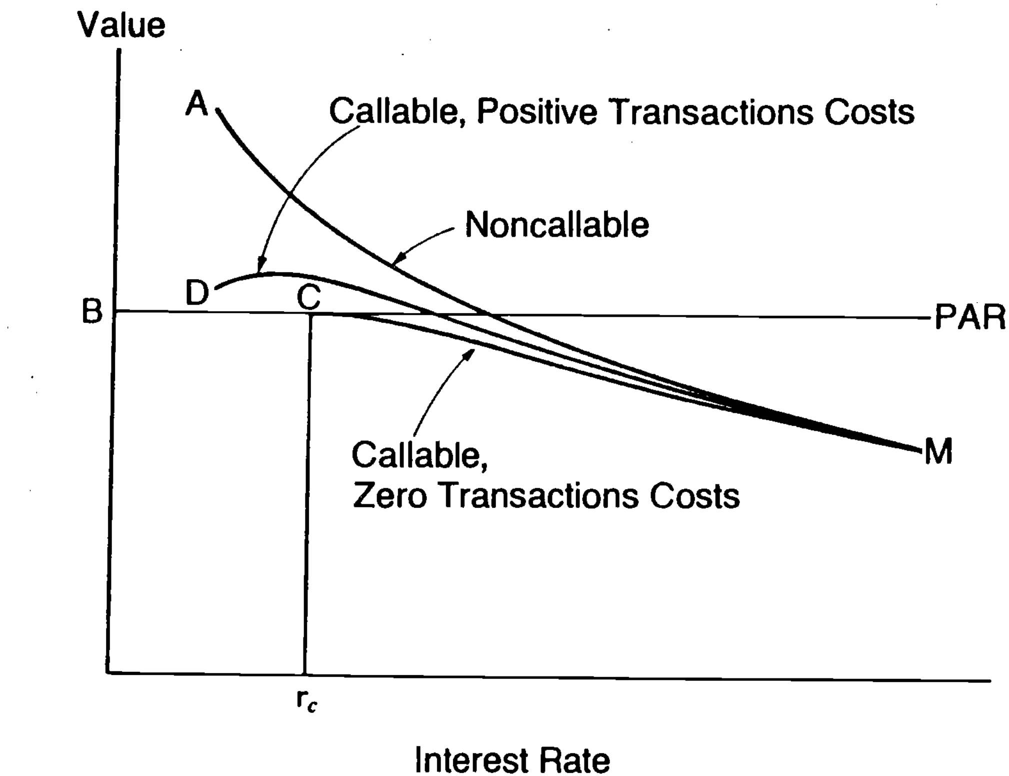
Table 5
The Time Response of Conventional Commitment Rates
to Fictional Perfect Market Rates

Time Period	Adjustment to One Point Rise in Perfect Rate				
	Current	3 weeks	5 weeks	7 weeks	9 weeks
1986-88	.59	.95	.96	.87	.84
1983-85	.16	.55	.68	.83	.88
1980-82	.08	.45	.75	.93	1.05
1976-79	.01	.36	.62	.66	.86
1971-75	.06	.17	.37	.56	.74

Table 6: Actual and Perfect Market Effective Conventional Commitment Rates (%)

	Actual	Perfect Market	Conventional Error	GNMA Error	Adjusted Error	Adjusted Perfect Market
1971	7.54	8.33	-.74		-.74	8.33
1972	7.38	7.92	-.53		-.53	7.92
1973	8.04	8.97	-.93		-.93	8.97
1974	9.19	9.78	-.60		-.60	9.78
1975	9.05	9.92	-.87		-.87	9.92
1976	8.86	9.22	-.35		-.35	9.22
1977	8.84	9.09	-.24		-.24	9.09
1978	9.64	10.08	-.44		-.44	10.08
1979	11.20	11.34	-.14		-.14	11.34
1980	13.76	14.24	-.48		-.48	14.24
1981	16.69	16.48	.20	.07	.13	16.55
1982	15.97	14.97	1.00	.27	.73	15.24
1983	13.23	12.80	.43	.06	.37	12.86
1984	13.89	13.80	.09	-.28	.37	13.52
1985	12.43	12.01	.42	-.06	.48	11.95
1986	10.19	9.62	.56	.07	.49	9.69
1987	10.21	9.94	.27	.07	.20	10.03
1988	10.23	10.24	-.01	-.03	.02	10.21

Figure 1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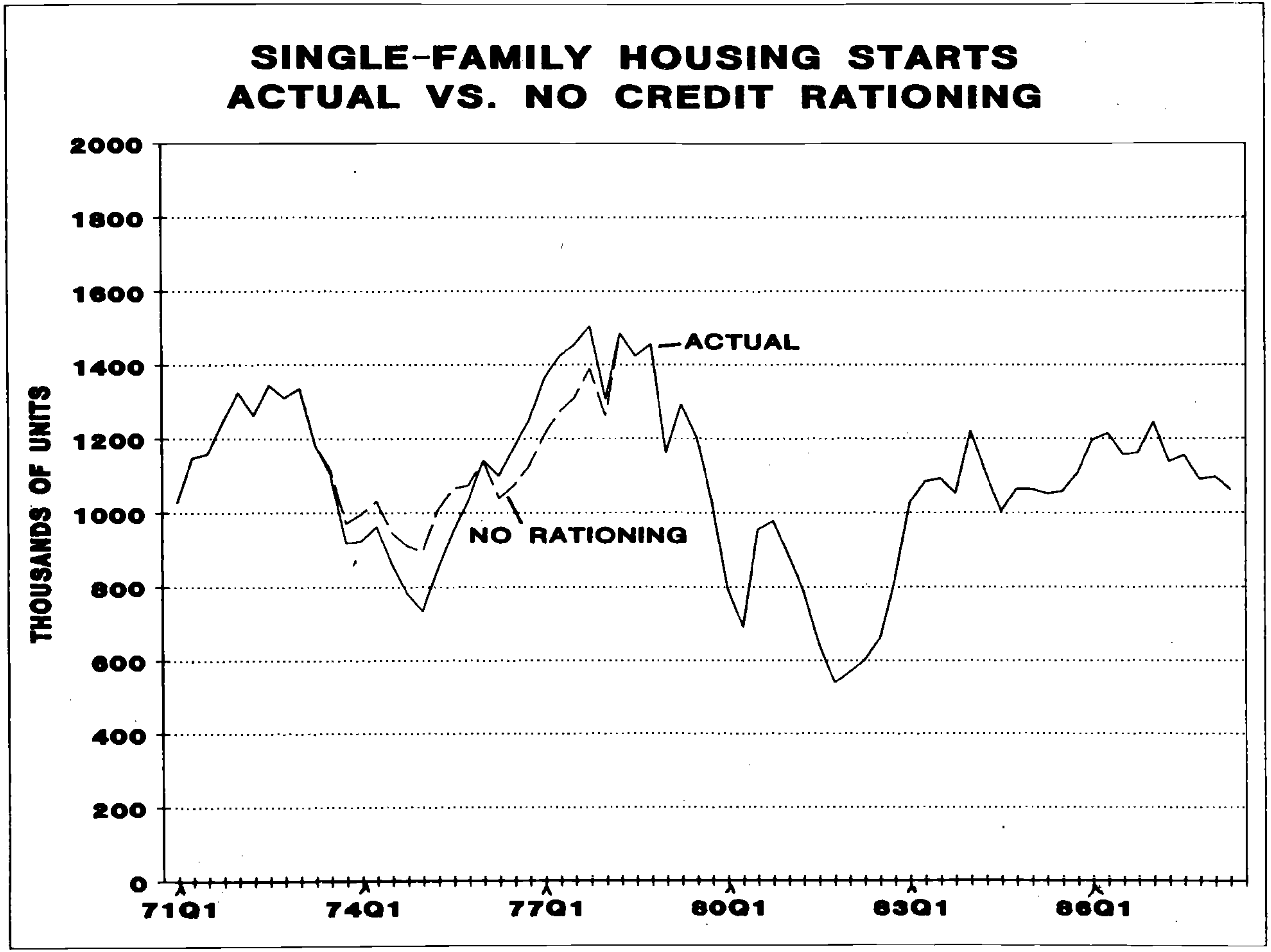
Callable, Positive Transactions Costs
Noncallable
D
C
B
PAR
Callable,
Zero Transactions Costs
M
r_c
Interest Rate


SINGLE-FAMILY HOUSING STARTS
ACTUAL VS. NO CREDIT RATIONING
THOUSANDS OF UNITS
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1800
1600
1400
1200
1000
800
600
400
200
0
ACTUAL
NO RATIONING
71Q1
74Q1
77Q1
80Q1
83Q1
86Q1

REAL RESIDENTIAL HOUSING STOCK
IMPACT OF PERFECT MORTGAGE MARKET