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THE TERMINATIONS PREMIUM IN MORTGAGE COUPON RATES: EVIDENCE ON THE INTEGRATION OF MORTGAGE AND BOND MARKETS

Patric H. Hendershott

Kevin E. Villani

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ABSTRACT

During the last three years mortgage rates have risen relative to yields on comparable maturity bonds. The questions addressed in the present paper are what is the extent of this increase and to what is it attributable? We find the increase between early 1978 and early 1981 in coupon rates on GNMA mortgage pools relative to "the" rate on a comparable portfolio of Treasury bonds to be about 100 basis points. We attribute the increase to a rise in the terminations premia built into mortgage coupon rates. The premia is the price borrowers are charged for the option to repay the mortgage when it is to their benefit (to refinance if interest rates decline). This price has risen in response to an increase in interest rate uncertainty. Our empirical results suggest that the increase is due to both greater uncertainty regarding the inflation premium in interest rates and the lesser weight the monetary authorities give to interest rate stability in their deliberations.

Patric H. Hendershott
Krannert Graduate School of Management
Purdue University
West Lafayette, IN 47907
(317) 494-4421

Kevin E. Villani
Department of Housing and Urban Development
Office of Economic Analysis
451 7th Street, S.W.
Washington, D.C. 20410
(202) 755-5980

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The Terminations Premium in Mortgage Coupon Rates:
Evidence on the Integration of Mortgage and Bond Markets*

Patric H. Hendershott and Kevin E. Villani
Ohio State University and HUD

Financial markets have behaved somewhat differently in recent years than in the previous quarter century. Two changes are particularly relevant to this paper. First, interest rates have been more volatile generally. Second, while all interest rates have risen to unprecedented levels, mortgage rates have increased by more than rates on other securities of comparable maturity. This contrasts markedly with the previous quarter century, when mortgage rates were typically described as "sluggish." We suspect that the second of these two phenomena follows from the first. Mortgage rates contain a terminations premium to compensate lenders for expected reductions in effective yields relative to quoted coupons owing to borrowers prepaying at a faster or slower rate, depending on which is to their economic benefit (and to the detriment of the lender). An increase in interest rate uncertainty increases expected reductions due to the terminations option and raises the terminations premium in mortgage coupon rates. That is, the coupon rate adjusts to maintain parity between the expected effective yields on mortgages and securities without call options.

There are two pieces of evidence that interest rate uncertainty has increased in recent years. First, the importance the Federal Reserve attached to interest rate stability was substantially reduced in late 1979 and 1980. One indication of this was the increase in the targeted band for the federal funds rate from less than a percentage point in

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1978 to 4 percentage points on October 6, 1979 and as much as 7 percentage points in 1980. Second, the standard deviation of one-year inflation forecasts of the participants in the Livingston survey rose above two percentage points for the first time in 1979-80. Given a relationship between interest rates and inflation, uncertain inflation implies uncertain interest rates.

Two specific questions are addressed in the present paper. First, how much have mortgage coupon rates (more specifically, that on newly-issued GNMA pools) risen relative to a comparable maturity portfolio of Treasury securities? Second, is the increase reasonably attributed to a rise in the terminations premium owing to an increase in interest rate uncertainty or must an explanation appeal to other factors? To answer these questions we first calculate the terminations premia implied by coupon rates and prices on newly-issued pools of GNMA securities over the past several years under the assumption that the mortgage market is fully integrated with capital markets generally. The resulting "options premia" are then examined for their plausibility (related empirically to reasonable proxies for interest rate uncertainty).

The first three sections of the paper provide a framework for performing the calculations. The sections include a method of valuing pools of level-payment mortgages when termination rates are certain, a discussion of the impact of interest rate outcomes on termination rates, and a description of methodologies for measuring the terminations premium in mortgage coupon rates. Basically, the premium is the difference between the pool coupon rate and the internal rate of return on a portfolio of Treasury securities with cash flows identical to those of the mortgage pool after netting out payments for the terminations option. Premia are calculated in Section IV for the 40 months from January 1978 to April 1981 and are related empirically to proxies for interest rate uncertainty. A summary concludes the paper.

I. The Value of Mortgage Pools When Termination Rates are Certain

The formula for the scheduled payment on a level-payment mortgage with an initial principal of X dollars is:

$$(1.1)\quad PAY^{s} = iX(1+i)^{M}/[(1+i)^{M}-1],$$

where M is the maturity of the loan (the period over which the loan is amortized), and i is the mortgage coupon rate. The scheduled outstanding principal at time t on this mortgage is:

$$(1.2)\quad PRIN_{t}^{s} = X[(1+i)^{M} - (1+i)^{t}]/[(1+i)^{M}-1].$$

The above expressions hold whatever unit of time is chosen.[1]

The decline over time in the scheduled principal of level-payment mortgages results exclusively from amortization. The cash-flow generated by a portfolio or pool of mortgages will be greater than this by the amount of the servicing fee which is a percentage of the outstanding principal. Also, expost cash flow will exceed scheduled cash flow if any mortgages prepay.

[1]These expressions also hold for variable-rate and renegotiable mortgages if interest rates are expected to be unchanged in the future.

Let ϕ_t^c denote the fraction of the N loans, each of value X, in the pool that will terminate at time t and s be the servicing fee (the c superscript indicates that the values are viewed as certain). The total payment on the mortgage pool in period t contingent on ϕ_t^c is then:

$$(1.3)\quad TMPAY_t^c = (\phi_t^c - s)NPRIN_t^s + (1-\phi_T^c)NPAY^s \ ,$$

where $\phi_T^c = \sum_{j=1}^{t-1} \phi_j^c$ and $\phi_{M+1}^c = 1$ because all mortgages are terminated by period M. That is, the payment is simply the principal termination, less the servicing fee, plus the scheduled payment (interest plus amortization) on the remaining principal outstanding.

Now consider an existing pool k periods after origination where Q_k is the fraction of the N mortgages in the original pool that are still outstanding. The fraction of mortgages that will terminate in each period t subsequent to k is defined as ${}_k\phi_t^c$ and the cummulative fraction of mortgages that will be terminated by time t-1 is denoted by ${}_k\phi_T^c = \sum_{j=k}^{t-1} {}_k\phi_j^c$. The total payment in time t (contingent on ${}_k\phi_t^c$) on a portfolio of mortgages k-1 periods old is then:

$$(1.4)\quad {}_kTMPAY_t^c = ({}_k\phi_t^c - s)Q_k NPRIN_t^s + (1-{}_k\phi_T^c)Q_k NPAY_t^s \ .$$

The value of this mortgage pool is simply the discounted present value of the total payments or

$$(1.5) \qquad {}_kV^c = \sum_{t=k+1}^{M} \frac{{}_kTMPAY_t^c}{(1+y_{t-k})^{t-k}} .$$

Because these payments are known with certainty, the appropriate discount rates are the yields on risk-free pure-discount securities of the matching maturity.[2] That is, y_{t-k} is the yield on a riskless pure discount bond of maturity t-k. Although such yields are not directly observable in the securities markets as coupon rates, capital markets will implicitly determine a unique spectrum of these yields, which when plotted form a yield curve.[3]

Even though the cash flows of the pool are certain, interest-rate uncertainty could affect the value of the pool through its effect on the discount rates. The yields on pure discount default-free securities might contain interest-rate risk or term premia if the marginal investor is averse to the risk that future rates might differ from those currently anticipated. The magnitude of these premia will reflect the degree of uncertainty. Thus, for example, "flat" interest rate expectations might generate an upward sloping yield curve, where the degree of slope reflects the uncertainty of future interest rates and investor aversion to this uncertainty . Because our focus is on the impact of interest-rate uncertainty on the relative values of mortgage pools with certain and

[2]Garbade (1980) calculates ${}_kV^c$ from equation (1.5), discounting mortgage cash flows based on some multiple of FHA experience by the term structure of Treasury yields. [${}_kV^c$ is described as "the market value" of a portfolio of Treasury securities having the same (but certain) cash flows as the mortgage pool.] Next he determines the single "internal rate of return" for the given ${}_kV^c$ and cash flows. Finally, he adds a premium to this rate just sufficient to equate the discounted present value of these cash flows to the observed market price of GNMA pools. Garbade does not develop an interpretation of the premium.

[3]When the yield curve is flat, the single y_t in (1.5) is Curley and Guttentag's (1974) internal rate of return.

uncertain cash flows, we shall assume, for ease of exposition and with no loss of generality, that term premia are zero and thus that a flat yield curve implies constant interest rate expectations.

While prices for securities are generally quoted as a percent of par value, we shall express prices as a fraction of par. Thus the price at time k of a portfolio of securities is:

$$(1.6) \qquad {}_kP = {}_kV^c/(Q_k PRIN_k^s).$$

That is, the quoted price at time k is the market value at time k as a fraction of the principal still outstanding at time k.[4]

[4] Taxes have been ignored in the above analysis. This is permissible if either: (1) the pool is trading at par so there is no need to distinguish between capital gains and interest income which are taxed at differential rates or (2) the marginal investor in the pool is a tax-exempt institution. If neither of these conditions holds and if one knew the tax rate of the marginal investor, then the differential tax treatment of gains and interest could be accounted for directly.

II. Interest Rates and Terminations Rates

The terminations rate for mortgages is akin to the mortality rate for life insurance companies. A "mortality" table has in fact been calculated for FHA experience.[5] Termination rates are often expressed as some multiple, say 200 percent, of actual (and projected) FHA repayment experience for mortgages issued during a given period. Most generally

$$(2.1)\quad \phi_t^x = \frac{x\phi_t^{100}(1-\phi_T^x)}{100(1-\phi_T^{100})},$$

where $\phi_T^x = \sum_{j=1}^{t-1} \phi_j^x$. Thus the fraction of the pool still outstanding $(1-\phi_T^x)$ that is repaid in a given period (ϕ_t^x) is x percent of the fraction of a pool with actual FHA experience that would be repaid in that same period $[\phi_t^{100}/(1-\phi_T^{100})]$.

The terminations schedule on a mortgage pool is defined in terms of all the terminations rates. The schedule is a random variable that depends in a rather complex way on the initial subjective (joint conditional Bayesian) probabilities that an individual mortgage will terminate in each subsequent future period. We define the "most likely" terminations schedule as the collection of termination rates that are given the highest initial subjective probabilities.

The timing of mortgage repayments is irrelevant to the valuation of pools only if (1) the yield curve is flat and (2) the mortgage pool is trading at par. Consider two pools, both carrying

[5] See Herzog (1981, p. 21) for the latest available table.

coupons equal to the current new issue coupon. If the yield curve is upward sloping, indicating that future interest rates are expected to be higher, then faster repaying pools will be valued above slower repaying pools. And the converse is true if the yield curve is downward sloping. On the other hand, even if the yield curve is flat, faster and slower repaying pools with equal coupons will be valued differently if this coupon differs from the current new issue coupon. For example, if the new-issue coupon exceeds that on the existing pools, then both existing pools will trade below par, with the slower paying pool being further below par.

The fact that the terminations rate is not known a priori would not be of concern if these rates were unrelated to economic variables and investors were indifferent to this uncertainty. One could simply project the "most likely" rates from past experience and calculate the value of mortgage pools from equation (1.5) based on these rates.[6] Unfortunately, mortgage terminations reflect the exercise of the borrower's option which is generally related to the observed course of interest rates.[7] Moreover, as we will indicate in the following section, the systematic relationship between interest rates and termination experience causes investors to care about the uncertainty of termination rates.

[6]This is the procedure followed in some studies, e.g., Cater and Lloyd (1980).

[7]For evidence on this point, see Curley and Guttentag (1974).

The dependency of mortgage terminations on interest rates operates through three channels. First, the willingness of homeowners to sell their houses depends on current mortgage rates relative to the rate on their existing mortgages. For example, if rates are currently high, then homeowners will be reluctant to forego the implicit capital gains they have on their existing mortgages. Reduced mobility means fewer mortgage terminations. Second, even if homeowners do sell, in some cases the mortgage will be assumed by the new buyer. All FHA/VA mortgages are assumable, and, while the standard deed of trust for conventional mortgages generally does not allow assumptions, some obviously occur.[8] More assumptions imply fewer terminations. Third, even when no house sale occurs, the existing mortgage can be terminated. If mortgage rates decline below the coupon rates on existing mortgages by enough to outweigh the costs of refinancing, including closing costs, repayment penalties and additional points charged the borrower, then mortgages will be terminated and refinanced at the current existing low rates.

The data in Table 1 support dependency of termination rates on the spread between past and current mortgage coupon rates. These data are termination rates for mortgages issued in particular years (endorsement years) cummulated through the third and sixth years after issue (the policy years less one). The two sections in the table distinguish between periods when early termination is less likely (mortgage rates in subsequent

[8] Consumers have used a variety of devices such as "wrap around" mortgages and land sales contracts to assume. The economics of due on sale clauses is described in detail in an April 1981 HUD report to Congress; the legality of these and other creative financing mechanisms will eventually be ruled on by the Supreme Court. Also, variable rate mortgage contracts typically allow assumptions.

years rose relative to the issue rate) and more likely (the reverse). The selection of years does not, of course, hold the expost pattern of mortgage rates precisely constant relative to the issue rates, but it is close enough to reveal the expected pattern of slower terminations of mortgages originated during the troughs of the interest rate cycle (upper half of table) and faster terminations of mortgages originated during the peaks of the interest rate cycle (lower half of table).[9]

III. Uncertain Inflation and Mortgage Coupon Rates

While the most likely terminations schedule is a useful concept, the above discussion suggests that there is a large array of schedules that might occur with significant probability, at least one for every inflation-interest rate senario. Moreover, each senario implies a different set of discount rates (y's). Assume that there are N viable inflation-interest rate senarios that are expected to occur with probabilities p_1, p_2, ... p_N, where $\sum_{j=1}^{N} p_j = 1$. Denote the total mortgage payment and discount rate vectors associated with the jth senario (and its terminations schedule) by TMPAY(j) and y(j), respectively. Then, the value of a pool of mortgages in the uncertainty case can be expressed as

[9] The few apparent anomalies in the table are explained by differences in subsequent movements in interest rates. For example, the acceleration between the third and sixth years in terminations of mortgages issued in 1957-58 is likely due to the decline in mortgage rates in the early 1960s relative to the level existing in 1957-58, and the slow early termination of 1974 issues relative to 1970 issues is due to the minor decline in mortgage rates in 1975-76 versus the sharp decline in 1971-72.

Table 1

Cummulative Mortgage Terminations
for Section 203(b) 30-Year Home Mortgages %

Policy Year Less One	Year of Endorsement (Should Terminate Late) 1957-58	1964-65	1971-72	1977
3	4.7	6.3	9.7	16.2
6	19.7	15.0	30.4	

	Year of Endorsement (Should Terminate Early) 1960-61	1970	1974
3	8.6	19.5	16.2
6	25.9	37.4	40.7

$$(3.1) \qquad {}_kV^u = \sum_{j=1}^{N} p_j \sum_{t=k+1}^{M} \frac{{}_k\text{TMPAY}(j)_t}{[1+y(j)_{t-k}]^{t-k}} .$$

By substituting ${}_kV^u$ from equation (3.1) into equation (1.6), we obtain an expression for the efficient market price of mortgage contracts. Conceptually, one could test for market efficiency by comparing this to observed prices. Empirically, this requires knowledge of the market's subjective probabilities of various interest rate scenarios (the y(j)'s) and the relationship between ex post interest rates and cash flows (the ${}_k$TMPAY(j)'s). Because we do not currently have such information, such a test is beyond the scope of the current paper.

With TMPAY and y based on the m (most likely) inflation-interest rate outcome and $p_m = 1$, equation (3.1) reduces to (1.5). Comparison of these expressions is instructive. A higher than most-likely inflation rate lowers the present value of a given payment stream relative to the most-likely rate by raising the discount factors, while a lower than most-likely inflation rate raises the present value. When the payment stream is independent of the inflation-interest rate outcome, one would expect ${}_kV^u = {}_kV^c$ for the same mortgage coupon rate. That is, mortgage values -- like security values generally -- would be affected by deviations in observed inflation-interest rate outcomes from those originally expected, but not by changes in the degree of uncertainty regarding these outcomes. However, the payment stream and thus mortgage values are not independent of these outcomes. A higher than most-likely inflation rate reduces mobility by creating capital gains on existing mortgages and increases the assumption of existing mortgages by buyers when moves do occur. The lower termination rate magnifies the decline in present value caused by higher discount rates. A lower than most-likely inflation rate increases mobility by reducing existing capital gains and encourages refinancing of existing mortgages. Now, however, the higher termination rate mitigates the rise in present value caused by lower discount rates. Because of the asymmetric variation in termination rates, ${}_kV^u < {}_kV^c$ for mortgage pools based on the same mortgage coupon rate.[10] Further, ${}_kV^c - {}_kV^u$ will be disproportionately greater the larger is the variability of expectations regarding inflation and thus the greater both the likelihood of and resultant loss from adverse terminations.[11]

The terminations option allows borrowers to repay at faster (refinancings) or slower (assumptions) rates, depending upon which is to their economic advantage (and thus to the lender's disadvantage). Borrowers will have to pay for this option either once in the form of a front-end fee when the mortgage is issued or annually in a higher coupon. When the front-end fee is employed, the price of the option is

[10] Dunn and McConnell (1981a) have calculated ${}_kV^c$ and ${}_kV^u$ under some hypothetical assumptions regarding interest rates. First, a yield curve generating function is posited and a level of interest rate (yield curve) uncertainty is specified. Then (3.1) is evaluated under the assumption that the mortgage pool will be terminated if the new issue mortgage rate falls below the coupon rate of the pool. For the certainty case, no "optimal" terminations are allowed (suboptimal terminations are assumed to follow 100 or 200% FHA experience.)

[11] Conceptually, the difference in price should be the present value of the expected losses. In our earlier paper (1980), we provided several models to determine both the probability that the option will be exercised at a given point in time and the magnitude of the loss if it is.

known. When the higher coupon method is utilized, computation of the annual premium would seem to be a straight-forward application of equations (1.5) and (3.1) for the case of newly-issued mortgage pools (k = 0). Equation (3.1) is solved for ${}_{o}V^{u}$, and then equation (1.5) is employed to determine the coupon rate that would equate ${}_{o}V^{c}$ to ${}_{o}V^{u}$. This is the coupon that is required in the certainty case. The difference between the actual coupon and the certainty coupon is the annual premium of the terminations option.[12] Unfortunately, there are no mortgages with certain termination rates, i.e., equation (1.5) cannot be utilized.

Nevertheless, it is possible with one key assumption to obtain estimates of the terminations premium in GNMA coupon rates. The assumption is that the only difference in the eyes of investors between a GNMA pool and a comparable maturity portfolio of U.S. government bonds is the uncertainty regarding the timing of the cash flows (the termination schedule) of the pool. Given that the incomes from the pool and the portfolio are taxed similarly and are subject to the same zero default risk, this assumption would seem to be a reasonable working hypothesis. With this assumption, the bond portfolio is equivalent to a mortgage pool with a certain terminations schedule, and the difference between the actual coupon rate on the pool and the "effective" coupon on the bond portfolio is the terminations premium.

A comparable maturity bond portfolio has cash flows that are equal to those on a mortgage pool (based on the most likely terminations schedule) after netting out the terminations option premium in the mortgage coupon.

[12] The default premium in the coupon rate can be calculated similarly. First, equation (3.1) is solved for ${}_{o}V^{u}$ on the assumption that all payments will be made on schedule. Second, the ϕ's are altered to reflect expected defaults; the left-side of (3.1) is set equal to the value obtained assuming no default; and the coupon, i^{d}, is solved for. This is the coupon including the default premium. The premium is $i^{d} - i$.

Define a new-issue bond portfolio of value ${}_kP$ as

$$B = {}_kP \sum_{j=k+1}^{M} \gamma_j \, ,$$

where γ_j is the portion of the portfolio maturing in period j and $\Sigma\gamma_j = 1$. The total (principal plus interest) payment on the portfolio in period t, assuming zero default and call risk, is

$$(3.2) \qquad TBPAY_t = (\gamma_t + \sum_{j=t}^{M} \gamma_j y^j)\,{}_kP,$$

where y^j is the coupon rate in period o on a par bond with maturity j. Note that $y^j \neq y_j$, the yield on a pure discount security of maturity j. The most likely payment on a mortgage in period t, after netting out the options price in the mortgage coupon, ρ, is obtained from substitution of (1.1) and (1.2) into (1.3):

$$(3.3) \qquad TMPAY_t^m = \frac{(\phi_t^m - s)[(1+i-\rho)^M - (1+i-\rho)^t] + (1-\phi_T^m)(i-\rho)(1+i-\rho)^M}{(1+i-\rho)^M - 1} Q_k NX,$$

where the most likely terminations rates (ϕ_t^m) have replaced the certain terminations rates (ϕ_t^c). A bond portfolio that is comparable to a mortgage pool with expected net payments $TMPAY_t^m$ is one in which the γ_t are chosen such that

$$(3.4) \qquad TBPAY_t = TMPAY_t^m (1+y_t^1)^{1/3}$$

for all t. The $(1+y_t^1)^{1/3}$ factor adjusts for the fact that mortgage payments accrue roughly 1/3 of a semi-annual period prior to the payments on the bonds;[13] y_t^1 is the one-period rate expected to exist in the t^{th} period.[14] Equation (3.4) represents M-k equations that, along with the identity $\Sigma \gamma_t = 1$, determine M-k γ's and ρ for the given ϕ's, y's, s, ${}_kP/Q_k NX$, and i.

Actually, it is possible to solve for ρ without determining the γ's. Substitution of (3.3) into (1.5) and the result into (1.6) yields, after canceling $PRIN_k^s$ and X which are equal for newly issued pools ($k \sim 0$) and incorporating the mortgage payment timing adjustment,

$$(3.5) \quad {}_kP = \sum_{t=k+1}^{M} \frac{\{(\phi_t^m - s)[(1+i-\rho)^M - (1+i-\rho)^t] + (1-\phi_T^m)(i-\rho)(1+i-\rho)^M\}/[(1+i-\rho)^M - 1]}{(1+y_t)^{t-k}(1+y_t^1)^{-1/3}} .$$

Given the ϕ^m's, s, i, the y's, and ${}_kP$, this equation can be solved for ρ. We note here that the appropriate discount rates are still the yields on risk-free pure discount securities of the matching maturity because the cash-flows are, after adjusting for terminations uncertainty, risk-free equivalents (recall that GNMA securities are default free). The terminations premium approach avoids the "coupon bias" problem inherent in alternative treatments [see Kaufman and Morgan (1980)].

[13] In general, mortgage payments are received at the end of the month. Thus the total payments for a six-month period are received, on average, $3\frac{1}{2}$ months into the period, not at the end. Because GNMA pools pay on the 15th day of the following month, "the" semi-annual payment can be viewed as occurring 1/3 of a period prior to the payments on the bonds.

[14] y_t^1 is determined from the yields on pure discount bonds as $(1+y_t)^t/(1+y_{t-1})^{t-1} - 1$.

IV. Calculation of the Terminations Premium

Before reporting the results, a few words about the sources and measurement of the data are in order. The period investigated is the 40 month span covering January 1978 to April 1981. The discount rates are the yields on pure discount bonds calculated from the decompounded point yields computed by McCulloch (1975).[15] The mortgage prices and coupons are those on GNMA pools trading closest to par.[16] The time interval employed is six months; thus M = 60 for 30 year mortgages. The premia are calculated by solving equation (3.5).

Three different terminations schedules are tested. The first two are simply 100 and 200% experience on FHA mortgages originated since 1957 (Herzog, 1981, p. 21). The third attempts to incorporate the impact of differences between pool coupon rates and new issue coupon rates on the most likely terminations schedule.
Specifically, the schedule varies between 100 and 200% FHA over time, depending on the difference between par (unity) and the price of the pool.[17] When the pool is at par, investors are assumed to expect the pool to terminate at 200% FHA. When the pool is at 0.9 (the lowest price in our sample is 0.911), investors are assumed to expect 100% FHA terminations.

[15] Because the point yields are instantaneous decompounded, $(1+y_t)^{t-k}(1+y_t^1)^{-1/3}$ in equation (3.5) is replaced by $e^{(t-k)y_t - y_t^1/3}$. We thank Huston McCulloch for supplying us with these data.

[16] The prices are averages of the bid and ask quotes from the Wall Street Journal for the first day of the month that the prices appeared in the Journal.

[17] In one calculation Dunn and McConnell (1981b) assume that the prepayment probabilities $[\phi_t/(1-\phi_T)]$ "decay exponentially as the riskless interest rate at that time rises above the security's coupon rate." (p. 18)

More precisely, we determine x in equation (2.1) from

$$x = 1000_k P - 800.$$

Figure 1 contains plots of ρ based upon the three terminations schedules, denoted 100, 200 and VAR (for variable). Because the three series are closely related we shall discuss the VAR series only. The ρ's are very low for the January 1978-September 1978 period, averaging only 5 basis points. They rise to an average of 25 basis points in the October 1978-May 1979 period, to 47 basis points in the June-September 1979 period, and on to 97 basis points in the October 1979-April 1980 interval. A final increase, to an average of 124 basis points, occurs in the July-October 1980 period, with a high of 154 basis points in August. The last six observations show a decrease to 102 basis points.

We argued above that the primary determinant of changes in the terminations premium is changes in uncertainty regarding future interest rates. Given the well-established relationship between inflation rates and interest rates since 1951, the future course of interest rates is heavily dependent on future inflation rates, as well as monetary policy and other factors that influence real interest rates.[18] In the introduction to this paper, two pieces of evidence were given for the belief that interest-rate uncertainty had risen, namely the recent increase in inflation uncertainty and the reduction in October 1979 in the importance the Federal Reserve attaches to interest rate stability.

[18] Fama (1975) and (1977) is most closely associated with the view that movements in nominal interest rates have largely been due to changes in the inflation rate. Hendershott (1981) indicates that this was not the case in the quarter century prior to 1951. For evidence that real interest rates have varied significantly since 1951, see Wilcox (1981).

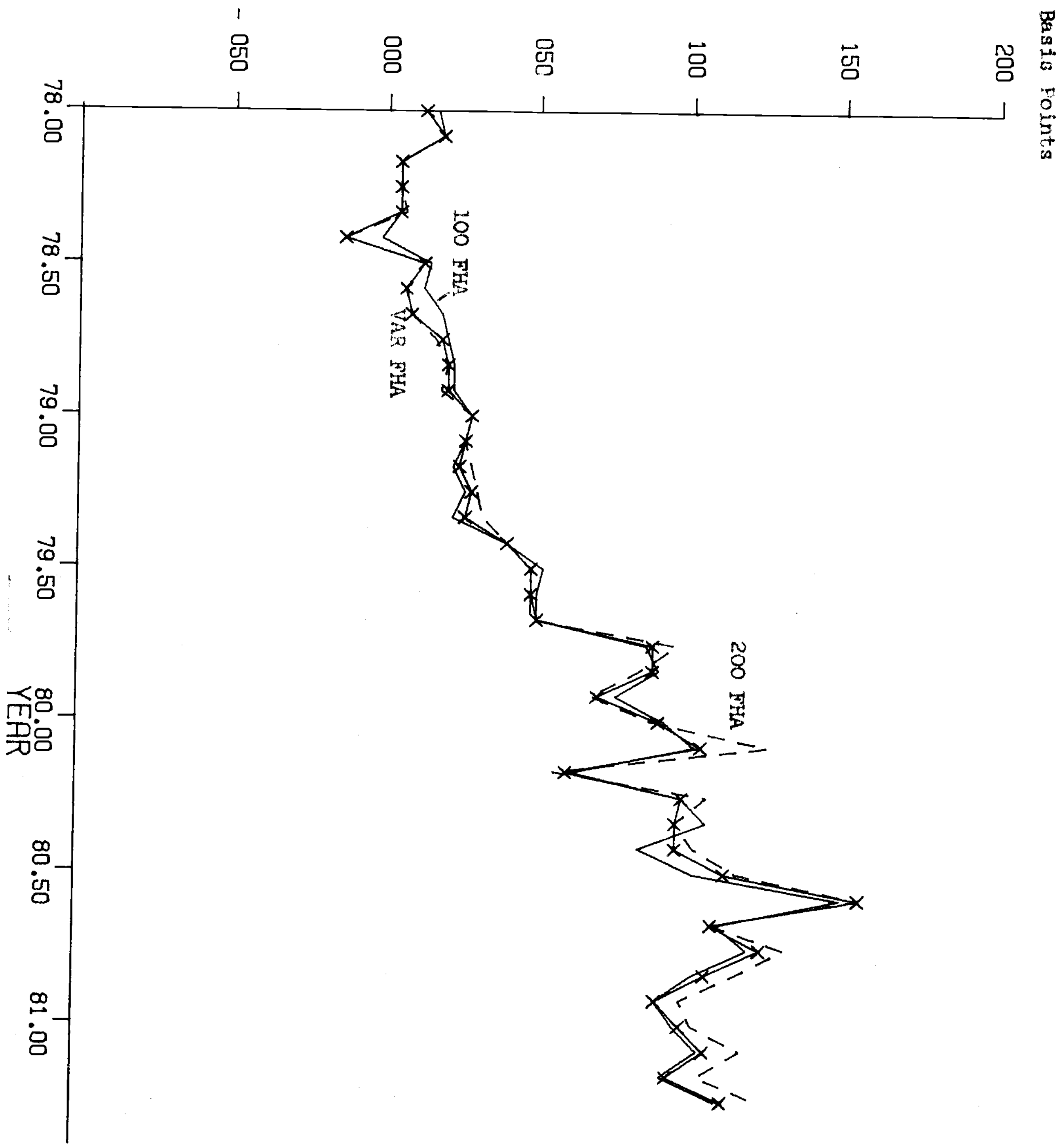

Figure 1: Calculated Terminations Premia in GNMA Coupon Rates

An available measure of inflation uncertainty is the standard deviation of one-year inflation forecasts of the participants in the Livingston investment survey. The one-year inflation forecasts are measured in early June and early December of each year. The standard deviation of these forecasts (in percentage points), beginning with December 1977 and proceeding through December 1980, are 1.15, 1.37, 1.39, 2.09, 1.79, 2.43, and 2.01. The values for June are assumed to hold until the next December, and the December values are assumed to be maintained until the next June.

Specification of a continuous variable to reflect the emphasis (perceived by market participants) the monetary authorities have placed on interest rate stability is difficult. Our basic procedure is to examine the width of the target range for the Federal funds rate stated in open market directives.[19] Unfortunately, the range is likely to reflect the authorities' perception of interest-rate uncertainty as well as the weight the authorities attach to interest-rate stability. For example, while the range of the targeted Federal funds rate varied only between 0.25 and 0.75 percentage points during the mid 1977 to September 18, 1979 period of relatively stable interest rates, the width of the range given at the March 18-19, 1974 open market meeting, when short-term rates were rising sharply, was a full 1.5 percentage points. Thus it would be a mistake to attribute every small change in the width of the band to a change in the weight given to interest-rate stability.

[19] The directives are published in the Federal Reserve Bulletin about 90 days after the open market committee meets.

Two major changes in the width of the band occurred in late 1979 and early 1980. On October 6, 1979, the band was raised from 0.5 to 4.0 percentage points. (The largest previous width was the 1.5 percentage points cited above.) Simultaneously the Chairman of the Federal Reserve Board announced a change in the implementation of monetary policy whereby stability in the growth of monetary aggregates, rather than nominal interest rates, would be emphasized. It seems apparent that the market's perception of interest rate uncertainty should have increased at this time.[20] The band stayed at 4.0 percentage points until March 18, 1980, when it was increased to 7.0. At the next meeting (April 22, 1980) the band was lowered to 6.0, and it varied between this and 5.0 percentage points through the end of our estimation period. Because interest rates were quite volatile around the March 18 meeting -- the weekly average funds rate increased by 3 percentage points between the weeks ending on March 1 and March 29, the increase in the band to 7.0 percentage points may not have reflected a change in policy. To test for the impact of the monetary policy shift, two dummy variables are tested. The first is zero before October 1979 and one thereafter; the second is zero before March 1980 and one thereafter.

The regression equations reported in Table 2 support our conjecture that changes in uncertainty regarding inflation and real interest rates determine the terminations premia. The equations explain 90 percent of

[20] It is noteworthy that the federal funds rate was not especially volatile at this time. The weekly average funds rate had increased by only 3/4 percentage points over the previous five weeks and increased by only 9 basis points the following week.

Table 2: Explanation of the Terminations Premia Based on Three Different Terminations Schedules, January 1978-April 1981

Terminations Schedule	Constant	Std. Dev. of Expected Inflation	Monetary Policy Shift, October 1979	Monetary Policy Shift, April 1980	$\bar{R}^2$	SEE	DW
100% FHA	-28.8	0.350	47.3	10.5	.919	11.9	2.15
	(10.2)	(6.8)	(6.2)	(6.2)			
200% FHA	-33.2	0.370	49.6	17.0	.905	14.4	2.21
	(12.4)	(8.2)	(7.5)	(7.5)			
Variable	-36.5	0.390	46.1	13.1	.919	12.5	2.07
	(10.7)	(7.1)	(6.5)	(6.5)			
Mean Values	1.0	176	0.48	0.33			

Note: The premia and standard deviation of expected inflation are measured in basis points. Standard errors of regression coefficients are reported in parentheses beneath the coefficients.

the variance in the calculated premia, which is somewhat surprising given both the crude proxies for the expected variances in inflation and in real interest rates and the potential errors in the measurement of the premia (errors in the measurement of the σ's and y's). All regressors enter with the expected positive signs and are significantly greater than zero at the 95 percent confidence level. The $\bar{R}^2$'s and the closeness of the Durbin-Watson ratios to 2 are consistent with the view that no major explanatory variables have been omitted.

The three equations tell basically the same story. When the standard deviation of expected inflation was just below unity, the terminations premia was roughly zero in the pre-October 1979 world. A percentage point increase in this standard deviation raises the premium by nearly 35 to 40 basis points. The October 1979 shift in monetary policy away from narrow interest rate targets raised the premia by nearly 50 basis points, and an apparent further downgrading of the importance of interest rate stability in April 1980 increased the premia by another 15 basis points.[21]

[21] Addition of the square of the standard deviation of expected inflation and the difference between the price of the pool and par did not raise the explanatory power of the relationship.

V. Conclusion

The cost of financing housing has risen relative to the cost of Treasury borrowing in recent years. The difference between the coupon rates on par value, government-insured GNMA mortgage pools and a portfolio of Treasury securities with identical expected cash flows rose from 5 basis points in the first half of 1978 to 125 basis points in the middle of 1980, declining only slightly to 100 basis points in early 1981. To some this might suggest excess profits to be made; to others, a need for the expansion of federal secondary mortgage market activities. Neither interpretation is necessarily correct.

Mortgage coupon rates include terminations premia to compensate lenders for expected reductions in effective yields owing to borrowers repaying faster when interest rates decline and slower when they rise. Both the likelihood of adverse (to the lender) terminations and the cost of them increase with uncertainty regarding future interest rates, and this uncertainty has risen in recent years. The rise reflects both greater uncertainty about the inflation premium in interest rates and a reduction in the importance the monetary authorities attach to interest rate stability. If the relative rise in mortgage coupon rates reflects solely an increase in the terminations premia in response to greater interest rate uncertainty, then there are neither extraordinary opportunities for profits nor substantial market imperfections for correction.

Differences between GNMA and Treasury coupon rates were calculated for three alternative mortgage termination schedules. If the mortgage market is fully integrated with bond markets, then these differences are simply terminations premia. The differences in coupon rates were then regressed on proxies developed for interest rate uncertainty. The results are consistent with the view that the measured premia are, indeed, terminations premia (up to a random measurement error), and thus that the market for GNMA pools is fully integrated with bond markets. If this is so, there are no extraordinary profit opportunities for lenders to exploit and no mortgage market inefficiencies for policymakers to correct.

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