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The Impact of the GNMA Pass-through Program on FHA Mortgage Costs

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I. Introduction

THE YIELD ON A TREASURY DEBT SECURITY whose coupon and principal payments match an investor's future cash requirements measures the riskless rate of return for that investor. Alternative investments expose the investor to risk. For example, the principal value of a security with a shorter maturity must be reinvested, at presently uncertain rates, giving rise to reinvestment risk. Conversely, a longer maturity instrument must be liquidated prior to maturity, at a price which depends on the level of interest rates at the time of sale and on the marketability of the instrument, giving rise to market risk and marketability risk, respectively.

Residential mortgages are debt instruments with a peculiarly interesting set of characteristics compared to Treasury securities. Although a mortgagor may be contractually obligated to amortize his indebtedness over, say, 30 years, prepayments of principal are common. Moreover, some mortgagors prepay more quickly than others, so an investor cannot be certain that actual payments will correspond even to an expected accelerated amortization schedule. Thus, the investor bears *both* reinvestment risk (because the mortgage may be paid off faster than expected) *and* market and marketability risks (because the mortgage may be paid off slower than expected). The combination of reinvestment and market risks stemming from uncertain cash flows on a mortgage will be called "timing risk" in the remainder of this paper.

There are differences between Treasury securities and mortgages other than timing risk. In general, a mortgage bears credit risk because the mortgagor may not make payments as promised and because the liquidated value of the collateral property may be less than the remaining principal balance if default occurs. Even when a mortgage is insured, as in the Federal Housing Administration (FHA) program, an investor suffers losses from default when his claim for the remaining principal is not satisfied promptly. To guard against such losses, an investor must evaluate each individual mortgage he buys. The cost of such investigation impairs secondary market transfers of mortgages, implying the instruments bear greater marketability risk relative to Treasury securities. Finally, the costs of servicing mortgages, that is, obtaining and recording the payments of interest and amortization of principal, are substantially greater than the costs of servicing an investment in Treasury securities. The presence of timing risk, credit risk, and

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marketability risk, and the existence of servicing costs, are the reasons that yields on mortgages exceed yields on Treasury securities.

In 1970, the Government National Mortgage Association (GNMA), a division of the Department of Housing and Urban Development, innovated a modified pass-through program for FHA mortgages. The program sought primarily to reduce yields on FHA mortgages by improving their marketability. More specifically, GNMA sponsored the issuance of relatively homogeneous pass-through securities, that is, claims on interest and principal payments given off by pools of specific FHA mortgages, modified by a guarantee that payments on those mortgages would be made promptly, even in the event of mortgagor delay or default. It was hoped that non-traditional mortgage investors would be willing to hold the GNMA pass-throughs because of their marketability (stemming from the reduced need for credit evaluation and from greater homogeneity of the instrument). This would, in turn, reduce the cost of credit for FHA mortgages.

This paper examines whether improvement in the marketability of GNMA pass-throughs during the 1970s has, in fact, reduced the yield on FHA mortgages. Section 2 briefly describes the nature of the GNMA program and the structure of yields in the mortgage market. Section 3 sets forth a partial equilibrium model of yields on FHA whole mortgages and GNMA pass-throughs, focusing especially on the activities of issuers of pass-throughs and on the marketability of those securities. Section 4 presents our empirical results.

We find that the GNMA pass-through program has, in fact, led to a lower cost of credit on FHA mortgages. Over the period from 1971 to 1978, each $10 billion increase in the principal value of outstanding GNMAs reduced the yield on FHA mortgages by about 2 percent of the contemporaneous yield on Treasury securities. Thus, if the yield on Treasury securities were 8 percent per annum, each $10 billion increase in outstanding GNMAs led to a reduction in FHA yields of about 16 basis points.

2. The Nature of the GNMA Program

The simplest way to describe the GNMA pass-through program is to highlight the differences between Treasury securities, GNMAs, and whole mortgages, and then to describe the position of a GNMA issuer. Over the interval from December, 1971 to June, 1978, the yield on an FHA mortgage was, on average, 172 basis points greater than the contemporaneous yield on a comparable portfolio of Treasury securities.[1] This 172 basis point yield premium compensated an FHA holder for bearing timing, credit and marketability risks, and for the cost of servicing his mortgage holdings. It is useful to decompose this 172 basis point spread between FHAs and Treasuries into two components: an average FHA-GNMA spread of 65 basis points and an average GNMA-Treasury spread of 107 basis points.

[1] The term "comparable portfolio" means a portfolio of Treasury securities whose future cash payments, including both interest and principal payments, matches the timing and amount of the *expected* future payments on an FHA mortgage, including interest, scheduled amortization of principal, and accelerated prepayments of principal. The construction of comparable portfolios is described in Garbade [1980], which is available on request.

From an investor's point of view, the FHA-GNMA yield spread is the "cost" of switching from an investment in whole mortgages to an investment in GNMAs. Because GNMAs are pass-through securities, the holder of a GNMA (the investor) bears the same timing risk as a holder of a diversified portfolio of FHA mortgages. However, to the extent that GNMAs are more readily marketable than whole mortgages, a GNMA holder will bear less marketability risk than a holder of whole mortgages. Also, GNMA investors incur no significant servicing costs and receive promptly their scheduled interest and principal payments, even if mortgagors or FHA make delayed payments. Thus, GNMA investors have received an average of 65 basis points less than FHA investors, because GNMAs bear no servicing costs, are more marketable and have less credit risk relative to FHAs.

Of course, somebody has to service and bear the credit risk on the whole mortgages in a GNMA pool. These costs are borne by the issuer, typically a mortgage banker or savings and loan association. Under the rules and regulations of the Government National Mortgage Association, approved GNMA issuers originate FHA mortgages, and then place those mortgages in a pool against which they sell GNMA pass-through securities. Issuers are required to service the underlying mortgages throughout the life of those mortgages. In addition, should a mortgage in a particular pool go into default, the issuer is required to make prompt payment of the principal balance remaining on the mortgage to investors who hold pass-throughs on that pool, even though the issuer may not recover that principal from FHA for some time. Issuers are also required to pay out scheduled interest and amortization payments to GNMA holders, even if mortgagors delay in making those payments to the issuers.[2] In the event of a default by a GNMA issuer, the Government National Mortgage Association makes the scheduled interest and principal payments to GNMA investors.[3]

The description in the preceding paragraph suggests that the observed 65 basis point yield spread of FHAs over GNMAs can also be viewed as compensation to GNMA issuers for incurring the costs of servicing the whole mortgages in GNMA

[2] Mortgagors are typically required to make monthly payments on the first day of the month, but delays are not uncommon. GNMAs pay on the fifteenth of the month, even if mortgagors delay past that time. Our computation of yields took into account the *scheduled* 15 day delay in GNMA payments, but did not take into account the uncertain delays in payments on the underlying mortgages.

[3] The discussion in the text can be summarized as follows: GNMA issuers bear credit risk because they do not receive any compensation from the Federal Housing Administration when mortgagors *delay* their payments. GNMA issuers also bear credit risk in the event of foreclosure since FHA makes payment to mortgagees on a delayed schedule. The holder of a GNMA security, however, is insured against any delay in payments made by the GNMA issuer. In the event of such a delay (or default) by the mortgage banker or the S&L, the Government National Mortgage Association makes timely payment to GNMA investors directly. The insurance fee is 6 basis points that goes to the Government National Mortgage Association from the payment stream on the underlying FHA mortgages. The institutional arrangements are as follows. The coupon on a GNMA security is set 50 basis points below the coupon on the underlying FHA mortgages. Of this 50 basis points, 6 go to the Government National Mortgage Association as an insurance fee and 44 basis points go to the GNMA issuer as compensation for servicing costs and credit risk. The equilibrium yield differential between FHAs and GNMAs will be determined by market forces, to be discussed below, and not by these coupon specifications.

pools and for bearing the risk of receiving delayed payments from mortgagors (or, in the event of default, from FHA). It should be noted, however, that GNMA issuers bear no marketability or timing risks stemming from mortgage prepayments, since issuers must pay out on their GNMAs only what they actually receive on the underlying whole mortgages (except, of course, for the obligation to make prompt payment even when a mortgagor or FHA makes a delayed payment, an obligation which creates credit risk). Thus, the FHA-GNMA yield spread should not vary with changes in timing uncertainty or variations in the marketability of either whole mortgages or GNMA pass-throughs.

The yield spread of GNMAs over a comparable portfolio of Treasury securities averaged 107 basis points over the 1971–1978 period. This yield differential stems from two differences between Treasuries and GNMAs. Investors in GNMAs bear timing risk, because unanticipated prepayments on underlying FHAs make the cash flow on a GNMA uncertain. Moreover, GNMAs and Treasuries have different degrees of marketability, with Treasury securities considered the most liquid of all assets. The observed 107 basis point spread between GNMAs and a comparable portfolio of Treasury securities during the 1971–1978 period compensated GNMA holders for these timing and marketability risk differences.

This analysis suggests that the GNMA program can be viewed as decomposing the yield spread between whole mortgages and Treasury securities into two components. One component is the FHA-GNMA yield spread, which compensates GNMA *issuers* for their servicing expenses and for bearing the credit risk on whole mortgages. The second component is the GNMA-Treasury yield spread, which compensates GNMA *holders* for bearing timing and marketability risks relative to Treasury securities. There is no reason to believe that the GNMA program reduced servicing costs, or credit risk, or timing risk on FHA mortgages, and hence there is no reason to believe that the innovation of the GNMA program reduced those components of the yield premium of FHAs over Treasury securities. However, there is reason to believe that, as the GNMA program expanded during the 1970s, the marketability of GNMAs improved. As shown in the next section, the GNMA-Treasury yield spread should decline as the marketability of GNMAs improves. Since the FHA-GNMA yield spread does not depend on the marketability of either GNMAs or whole mortgages, the FHA-Treasury yield spread should also decline with improvements in the marketability of GNMAs.

3. A Framework for Analyzing the Effect of the GNMA Program

One way to analyze the effect of the GNMA pass-through program on FHA yields is to consider a partial equilibrium model of the mortgage market, and to derive the impact on yields of an exogenous increase in the marketability of GNMAs. The preliminary steps in the analysis are (1) to specify the demand for whole mortgages and GNMAs, (2) to specify the activities of GNMA issuers, and (3) to characterize the nature of a market in equilibrium.

Demand. The demand schedules of investors for FHA mortgages and GNMA pass-throughs, as a function of the yields on FHAs (R_F) and GNMAs (R_G), and

as a function of an exogenous marketability parameter (M), are:

$$D_F = D_F(\overset{+}{R}_F, \overset{-}{R}_G, \overset{-}{M}) \tag{1a}$$

$$D_G = D_G(\overset{-}{R}_F, \overset{+}{R}_G, \overset{+}{M}) \tag{1b}$$

The yields on Treasury and other debt securities are *implicit* arguments of equations (1a, 1b) which have been suppressed for notational convenience.

The signs above the arguments of the demand functions denote the direction of change in demand which would accompany an increase in an argument, holding constant all other variables (including yields on Treasury securities). The demand for a security is an increasing function of its own yield, (e.g., $\partial D_G/\partial R_G > 0$), and a decreasing function of yields on other securities, (e.g., $\partial D_G/\partial R_F < 0$). The parameter M is a measure of the marketability of GNMAs. An improvement in GNMA marketability should, *ceteris paribus*, increase investor demand for GNMAs ($\partial D_G/\partial M > 0$) and reduce investor demand for FHAs ($\partial D_F/\partial M < 0$).

Following Brainard and Tobin [1968], we assume that a change in the yield on one security does not alter the aggregate demand for all securities. Assuming securities are gross substitutes, this implies:

$$\frac{\partial D_F}{\partial R_F} + \frac{\partial D_G}{\partial R_F} > 0 \tag{2a}$$

$$\frac{\partial D_F}{\partial R_G} + \frac{\partial D_G}{\partial R_G} > 0 \tag{2b}$$

Equation (2a) says that an increase in FHA yields will increase the demand for FHAs, and that this increase will come partly at the expense of a reduced demand for securities other than GNMAs and FHAs (so that the positive effect on the demand for FHAs exceeds in magnitude the negative effect on the demand for GNMAs). Equation (2b) has a similar interpretation.

We also assume that a change in the marketability of GNMAs does not alter the aggregate demand for all securities. Assuming securities are gross substitutes, this implies:

$$\frac{\partial D_G}{\partial M} + \frac{\partial D_F}{\partial M} > 0 \tag{3}$$

Equation (3) says that an increase in the demand for GNMAs due to improved marketability ($\partial D_G/\partial M > 0$) comes partly at the expense of a reduced demand for securities other than GNMAs and FHAs (so that the positive effect on the demand for GNMAs exceeds in magnitude the negative effect on the demand for FHAs).

GNMA Issuers. Nothing in equations (1a) and (1b) suggests that GNMA pass-throughs are closely related to the underlying FHA mortgages. The necessary link is provided by specifying the activities of GNMA issuers. We assume issuers supply GNMAs to (and remove FHAs from) the market according to the spread between FHA and GNMA yields:

$$\text{supply of GNMAs} = V_G(R_F - R_G) \qquad V'_G > 0 \tag{4}$$

As noted in equation (4), the greater the yield spread $R_F - R_G$, the greater will be the volume of GNMAs issued, and FHAs absorbed, by GNMA issuers.

The activities of issuers are likely to be very sensitive to yield spreads greater (or less) than their servicing costs and exposure to credit risk. For example, if servicing costs are equivalent to 50 basis points of yield, and if credit risk is competitively compensated by an additional 25 basis point yield premium, then GNMA issuers would aggressively expand their activities if the gross FHA-GNMA yield spread were 95 basis points. In that case the issuers could capture for themselves a 20 basis point "net spread." If the gross yield spread were only 55 basis points, however, GNMA issuers would have no incentive to pool FHA mortgages and issue GNMAs.

In an extreme case, GNMA issuers might make the supply of GNMAs infinitely elastic at a yield spread equal to their servicing costs and credit risk (denoted Δ), so that $V'_G(\Delta) = \infty$. This important case is considered in more detail below.

Equilibrium. Assuming a fixed stock of FHA mortgages (Q_F), the markets will be in equilibrium when:

$$Q_F - V_G(R_F - R_G) = D_F(R_F, R_G, M) \tag{5a}$$

$$V_G(R_F - R_G) = D_G(R_F, R_G, M) \tag{5b}$$

Equation (5a) equates investor demand for whole mortgages to the supply of those mortgages *net* of what is taken by GNMA issuers. Equation (5b) equates the demand for GNMAs to the quantity of pass-throughs supplied by issuers.

If GNMA issuers are extremely sensitive to FHA-GNMA yield spreads greater (or less) than the sum of their servicing costs and exposure to credit risk (Δ) then, in equilibrium, the spread between the FHA yield and the GNMA yield must be $R_F - R_G = \Delta$. In this case, GNMA issuers "lock" the FHA-GNMA yield spread, and the market equilibrium of equations (5a, 5b) can be replaced with:

$$Q_F = D_F(R_F, R_F - \Delta, M) + D_G(R_F, R_F - \Delta, M) \tag{6}$$

Equation (6) equates the supply of FHA mortgages to the sum of the direct demand for those mortgages (D_F) and an indirect demand (D_G). The latter demand comes from investor demand for GNMAs, which is elastically satisfied by GNMA issuers at a yield Δ below the yield on FHA mortgages.

Note that our two equilibrium equations in (5) are reduced to one equation in (6). This does not create a problem, because the behavior of GNMA issuers in (6) permits only one of the rates, R_F or R_G, to vary independently. Once R_G is determined, for example, R_F is determined implicitly as $R_F = R_G + \Delta$.

Comparative Static Analysis. Having specified the nature of demand, supply, and equilibrium in the FHA and GNMA markets, we are now ready to analyze the effect of an exogenous change in the marketability of GNMAs on FHA yields. That effect can be found by computing the full differential of equation (6) for a small change in M:

$$0 = \left[\frac{\partial D_F}{\partial R_F} + \frac{\partial D_F}{\partial R_G} + \frac{\partial D_G}{\partial R_F} + \frac{\partial D_G}{\partial R_G}\right] dR_F + \left[\frac{\partial D_F}{\partial M} + \frac{\partial D_G}{\partial M}\right] dM \tag{7}$$

The first term in brackets in equation (7) is the aggregate increase (decrease) in

the direct and indirect demand for FHA mortgages per unit increase (decrease) in FHA and GNMA yields. The second term in brackets is the aggregate increase in the direct and indirect demand for FHAs per unit increase in the marketability of GNMAs. Equation (7) says that the change in yield, dR_F, associated with a change in marketability, dM, must keep aggregate demand unchanged. The change in yield per unit change in marketability can be computed by solving equation (7) for dR_F/dM:

$$\frac{dR_F}{dM} = \frac{-\left[\dfrac{\partial D_G}{\partial M} + \dfrac{\partial D_F}{\partial M}\right]}{\dfrac{\partial D_F}{\partial R_F} + \dfrac{\partial D_F}{\partial R_G} + \dfrac{\partial D_G}{\partial R_F} + \dfrac{\partial D_G}{\partial R_G}} \tag{8}$$

The inequalities of equations (2a, 2b, 3) produce an unambiguous negative sign for dR_F/dM in equation (8). The fact that $R_G = R_F - \Delta$ in a locked market means that $dR_G/dM = dR_F/dM$. The intuitive explanation of these results is as follows. Improved marketability of GNMAs increases the demand for GNMAs ($\partial D_G/\partial M > 0$), and reduces the demand for FHAs ($\partial D_F/\partial M < 0$). However, because the increased demand for GNMAs comes partly at the expense of other securities, the net change in demand for both GNMAs and FHAs is positive ($\partial D_G/\partial M + \partial D_F/\partial M > 0$). This shift in the aggregate demand schedules means that the mortgage market will be in equilibrium only at some lower level of yields, so that $dR_F/dM = dR_G/dM < 0$.

It is also easy to see that the size of the decrease in R_F and R_G will be greatest when improved marketability of GNMAs does not reduce the direct demand for FHAs by more than a negligible amount, or when $\partial D_F/\partial M \approx 0$. Whether $\partial D_F/\partial M$ is, in fact, small depends on which assets investors sell when they buy GNMAs due to improved marketability. In other words, it depends on the degree of substitutability between FHAs, GNMAs, and all other securities. The crucial point, however, is that, in a locked market, this substitutability issue does not affect the qualitative conclusion that improved GNMA marketability will unambiguously lead to lower FHA yields.

Another implication of the behavior of GNMA issuers in the locked market model is that any reduction in servicing costs, or credit risk, will cause an identical reduction in the yield spread $R_F - R_G$. Analytically, if Δ falls, then issuers will buy FHAs and issue GNMAs until $R_F - R_G$ falls to the new value of Δ.

Our empirical work will now determine whether the locked market model is a reasonable approximation to reality. We test whether $d(R_F - R_G)/d\Delta = 1$, and we also estimate a value for dR_F/dM. From the cost-benefit perspective of the GNMA program, the size of dR_F/dM is quite important.

4. Empirical Analysis

The discussion in the previous section suggests that our empirical work should focus on yield spreads between FHAs and GNMAs, and between those securities and Treasuries. There have been a number of investigations into the structure of yields on debt securities. These studies fall into two categories: (1) a relative

supply focus (see Fair and Malkiel [1971] and Hendershott and Kidwell [1978]); and (2) a security characteristic focus (see Garbade and Hunt [1978] and Jaffee [1975]). Considering the overall objectives outlined above, a security characteristic approach seemed most appropriate. Thus, we relate FHA and GNMA yield spreads to measures of servicing costs, credit risk, and marketability risk.

First we specify the GNMA-Treasury yield relationship. As noted in Section 2, the holder of a GNMA pass-through bears timing risk and marketability risk, but does not bear credit risk or pay servicing costs. Thus, the spread between the yield on a GNMA (R_G) and the yield on a comparable portfolio of Treasury securities (R_T) should be positive (to compensate a GNMA holder for bearing timing and marketability risks) and a declining function of GNMA marketability. The marketability of GNMAs is denoted $\bar{M}$ and is proxied by the remaining aggregate principal balance (billions of dollars) on outstanding GNMAs, averaged over the six months *preceding but not including* the month of observation.[4]

Our functional form for the GNMA-Treasury spread is:

$$(R_G - R_T)/R_T = a_0 + a_1 \bar{M} + u \tag{9a}$$

$$u = \rho u_{-1} + e \tag{9b}$$

where $a_0 > 0$ and $a_1 < 0$. The yield spread *relative* to the Treasury rate is the dependent variable in equation (9a), because we expect that a doubling of the Treasury rate (due to, e.g. expected inflation) should lead to a doubling of the spread. As shown in equation (9b), the random residual of equation (9a) is likely to be serially correlated. This serial correlation can be attributed to transient departures from the long-run average yield premium ($a_0 + a_1 \bar{M}$) needed to compensate GNMA holders for bearing timing and marketability risks (as a result of transient changes in investor perceptions of the timing and marketability risks on a GNMA pass-through).

We now turn to the FHA-GNMA spread. Section 2 noted that a GNMA issuer bears credit risk and pays servicing costs, but does not bear timing or marketability risk. Thus, the FHA-GNMA differential is a function of credit risk and servicing costs. We measure credit risk as the spread between yields on BAA and AAA rated bonds, denoted CR.[5] Servicing costs on a yield equivalent basis, denoted SC, were set equal to 50 basis points prior to January 1975 and 37.5 basis points thereafter.[6]

[4] The work of Demsetz [1968] shows that the outstanding volume of a security is an important determinant of at least one dimension to a security's marketability: its bid-ask spread. Garbade and Silber [1976] show that the bid-ask spread is determined endogenously, along with other marketability characteristics (such as price dispersion and trading volume), by the volume outstanding of the security. Thus, marketability is best proxied by outstanding volume. The six month lagged averaging procedure is intended to capture adaptation over time to increased volume outstanding.

[5] CR was constructed as a three month moving average of the BAA-AAA spread (centered on the current month). The averaging procedure removes transient non-credit risk components from the BAA-AAA spread (e.g., it removes the temporary impacts of relative supplies). While some might prefer a direct measure of delinquencies on FHA's to reflect credit risk, we prefer the BAA-AAA spread since it represents the market's perceived prospective credit risk, rather than a historical series.

[6] The source for the shift in servicing cost is Salomon Brothers [1979].

The basic functional form for the FHA-GNMA spread is, therefore:

$$R_F - R_G = b_0 R_T + b_2 SC + b_3 CR + u \tag{10}$$

where we expect that $b_0 = 0$, $b_2 = 1$ and $0 < b_3 < 1$. We expect b_3 to be less than one because a 10 basis point increase in the BAA-AAA spread should lead to something less than a 10 basis point increase in the FHA-GNMA spread, because a GNMA issuer is largely, but not completely protected against loss by FHA insurance (see footnote 3 above). Note that the constant term in equation (10) is scaled by the level of Treasury yields for the same reason equation (9a) was specified as a relative spread. The other terms in equation (10) are measured directly in terms of yields or yield spreads and do not have to be scaled by R_T.

Equation (10) must be modified in one important respect before its coefficients can be estimated empirically. The Federal Housing Administration sets a ceiling on FHA interest rates, denoted R_C, which is almost always less than the equilibrium yield on FHA mortgages. This ceiling rate often has no impact on equilibrium FHA yields, because lenders can get a higher yield by extracting "points" from borrowers. These points are paid indirectly, because it is illegal to charge FHA borrowers discount points. The usual procedure is for the seller to charge a higher price for the home at the time of sale and then pay "points" to the lender. It has been argued, however, that it becomes increasingly difficult to pass on such discount points as the points become significant (see Colwell, Guntermann and Sirmans [1979]). For example, if $R_C = 8$ percent per annum, the points needed to make $R_F = 9$ percent per annum amount to 8.8 percent of the stated principal value of a 30 year mortgage. At such times, fewer FHA mortgages are originated, leaving the yield on new FHA mortgages below its equilibrium level as defined in equation (10). The yield on GNMAs would not be affected by this phenomenon.[7]

To account for the effect of very low FHA ceiling rates on FHA yields, we modified equation (10) to the form:

$$R_F - R_G = b_0 R_T + b_2 SC + b_3 CR + b_4 \text{Max}[0, R_F - R_C - K] + u \tag{11}$$

The new term, $\text{Max}[0, R_F - R_C - K]$, is zero as long as $R_F < R_C + K$, i.e., as long as the FHA yield is not greater than the ceiling rate plus some yield spread K. We anticipate $b_4 < 0$, so that increases in R_F above $R_C + K$ will depress the observed FHA-GNMA yield spread. K is a parameter to be estimated. It measures the yield spread $R_F - R_C$ beyond which it becomes difficult to extract points, as described above.[8]

Both sides of equation (11) were deflated by the yield on Treasury securities to obtain a form comparable to equation (9) and to reduce heteroscedasticity in the

[7] Note that the behavior of GNMA issuers is asymmetrical with respect to the FHA-GNMA spread. If the spread is greater than Δ, FHAs will be wrapped into GNMAs until the spread narrows to Δ. But if the spread falls below Δ, GNMA issuers do not buy back their GNMA securities and unwrap them even though that would appear profitable. The unbundling process is sluggish because most GNMA issuers prefer to maintain a steady stream of servicing fees.

[8] In testimony before Congress (see Hearings [May, 1979]), mortgage bankers suggest that 5 discount points seem to be relatively easy to recoup. After that it becomes difficult for sellers to raise housing prices and still stay competitive.

residuals. The final form of the FHA-GNMA yield spread is:

$$(R_F - R_G)/R_T = b_0 + b_2\, SC/R_T + b_3\, CR/R_T + b_4 \text{ Max } [0, (R_F - R_C - K)/R_T] + u \quad (12a)$$

$$u = \rho u_{-1} + e \quad (12b)$$

Principal Results

Lines 1 through 4 in Table 1 report regression results for equations (9) and (12). As shown in line 1, the GNMA-Treasury yield spread is inversely related to the marketability of GNMAs, where marketability is measured by the lagged volume of GNMA securities outstanding. Using a log likelihood test statistic to compare lines 1 and 2 shows that the joint hypotheses that the spread is independent of credit risk (CR/R_T), servicing costs (SC/R_T), and the FHA ceiling rate cannot be rejected at a 5% level of confidence. These results support the hypotheses regarding the GNMA-Treasury yield spread set forth in Sections 2 and 3.

Line 3 shows that the FHA-GNMA yield spread is positively related to servicing costs, credit risk, and the FHA ceiling rate (when the latter is more than 75 basis points below the FHA yield). Equation (12) was originally estimated in the form:

$$\begin{aligned}(R_F - R_G)/R_T = {} & SC/R_T + b_3\, CR/R_T \\ & + b_{4,1} \text{ Max}[0, (R_F - R_C)/R_T] \\ & + b_{4,2} \text{ Max}[0, (R_F - R_C - .25)/R_T] \\ & + b_{4,3} \text{ Max}[0, (R_F - R_C - .50)/R_T] \\ & + b_{4,4} \text{ Max}[0, (R_F - R_C - .75)/R_T] + u \end{aligned} \quad (13)$$

but the $b_{4,i}$ coefficients were not statistically significant for $i = 1, 2$ and 3. This suggests that the FHA ceiling rate has no effect on FHA yields as long as that ceiling rate is not more than 75 basis points below the FHA yield.[9]

Comparing lines 3 and 4 with a log likelihood statistic shows that the joint hypotheses that the FHA-GNMA spread is independent of the marketability of GNMAs and that $b_0 = 0$ and $b_2 = 1$ in equation (12) cannot be rejected at a 5% level of confidence. This result supports the hypotheses of Sections 2 and 3 that the FHA-GNMA spread is determined by GNMA issuers who are sensitive to the costs of servicing whole mortgages and to their exposure to credit risk, but who are indifferent to timing risk and to the marketability of GNMAs. In other words, GNMA issuers lock the FHA-GNMA spread at a level determined by servicing costs and credit risk (unless the FHA ceiling rate forces a smaller spread).

Some of the implications of our empirical results are as follows:

1) The spread between GNMA and Treasury yields has declined with im-

[9] A ceiling rate 75 basis points below the FHA yield corresponds to approximately 7½ points on mortgages with yields at the levels observed during the 1971–1978 observation period. Thus, the results conform *roughly* to the notion that below 5 points is relatively easy to recoup (see the previous footnote).

Table 1

Yield Spreads, Monthly, December 1971–June 1978

Line	Dependent Variable	constant	$\bar{M}$	SC/R_T	CR/R_T	Max[0, $(R_F - R_C - .75)/R_T$)]	ρ	s.e./d.f.	log likeli-hood
(1)	$(R_G - R_T)/R_T$	.183*	−.00192*	—	—	—	.693	.023	173.570[a]
		(.015)	(.00069)				(.084)	(72)	
(2)	$(R_G - R_T)/R_T$	.074	−.00102	.913	.236	.060	.686	.023	174.871[a]
		(.084)	(.00103)	(.904)	(.156)	(.266)	(.085)	(69)	
(3)	$(R_F - R_G)/R_T$	—	—	1.0	.261*	−1.023*	.755	.023	176.489[b]
					(.063)	(.244)	(.076)	(72)	
(4)	$(R_F - R_G)/R_T$	−.202	.00221	2.753*	.588*	−.889*	.791	.022	179.905[b]
		(.819)	(.11572)	(.915)	(.167)	(.241)	(.071)	(69)	
(5)	$(R_F - R_T)/R_T$	−.097	.00104	3.300*	.773*	−.823*	.7	.030	
		(.108)	(.00134)	(1.167)	(.203)	(.339)		(69)	

* Significant at 5% level of confidence

[a] Log-likelihood statistic on null hypothesis that SC/R_T, CR/R_T and Max[0, $(R_F - R_C - .75)/R_T$] have no effect on $(R_G - R_T)/R_T$ is 2.602 = 2. (174.871 − 173.570). Not significantly different from zero at 5% level of confidence.

[b] Log-likelihood statistic on null hypothesis that the constant term is zero, that $\bar{M}$ has no effect on $(R_F - R_G)/R_T$, and that SC/R_T has a coefficient of unity, is 6.832 = 2.(179.905 − 176.489). Not significantly different from zero at 5% level of confidence.

proved marketability of GNMAs. An increase in outstanding GNMAs of $10 billion is ultimately associated with a fall in the GNMA-Treasury spread of .0192 times the contemporaneous Treasury yield.

2) The spread between FHA and GNMA yields depends on servicing costs and credit risk, but not on the marketability of GNMAs.
3) The results under (1) and (2) imply that improved marketability of GNMA pass-throughs has led to a statistically significant reduction in the cost of credit to FHA mortgagors, on the order of .0192 times the Treasury yield per $10 billion expansion in the volume of outstanding GNMAs.

An Aggregated Test

A more direct test of the effect of the GNMA program on FHA yields can be constructed by summing up equations (9) and (12):

$$(R_F - R_T)/R_T = (a_0 + b_0) + a_1 \bar{M} + b_2\, SC/R_T + b_3\, CR/R_T + b_4\, \text{Max}[0, (R_F - R_C - K)/R_T] + u \quad (14)$$

and estimating the coefficients of equation (14) directly. The results of such a direct test are shown on line 5 of Table 1.

The results on line 5 suggest that a change in the marketability of GNMAs has no significant effect on the FHA-Treasury yield spread. This result is contrary to the conclusions just reached. The estimates in line 5 are inefficient, however, when compared with the estimates of lines 1 and 3. The regression on line 5 does not impose the constraints that changes in GNMA marketability affect $R_F - R_T$ through $R_G - R_T$ and *not* through $R_F - R_G$, and that servicing costs, credit risk and the FHA ceiling rate affect $R_F - R_T$ through $R_F - R_G$ and *not* through $R_G - R_T$. Specifically, the estimated coefficients in line 5 are approximately equal to the sum of the coefficients in the unconstrained regressions of lines 2 and 4. However, we have already found that we cannot reject the constraints imposed in lines 1 and 3, respectively. We conclude that the regression results in line 5 are inappropriate, because they do not include the theoretically motivated (and statistically significant) constraints imposed on the disaggregated regressions of lines 1 and 3.[10]

5. Conclusions

This paper analyzed the impact of the GNMA pass-through program on the structure of mortgage yields. A theoretical model of the relationship between yields on FHAs, GNMAs and Treasuries was specified from the risk characteristics of the securities and the behavior of public investors and GNMA issuers. The theoretical model suggested that GNMA issuers might lock the spread

[10] We tried estimating the parameters of line 5 by adding monthly data from the pre-1971 period and using $\bar{M} = 0$ for months prior to the innovation of the GNMA program. These results are not reported, because a Chow test led to rejecting the hypothesis that the regression coefficients were the same prior to and after 1971. Thus, the pre-1971 data cannot be used in conjunction with the post-1971 data.

between FHA and GNMA yields at a level determined by their servicing costs and exposure to credit risk. Improved marketability of GNMA securities as the GNMA pass-through program expanded would then lead to a reduction in FHA yields relative to Treasury yields.

The empirical estimates used monthly data from 1971–1978 to test these hypotheses. We find that the GNMA pass-through program has, in fact, led to a lower cost of funds on FHA mortgages. In particular, during our sample period the FHA yield falls by about 16 basis points for each $10 billion increase in GNMA pass-throughs when Treasuries yield 8%. The empirical results were also consistent with a theoretical model that views GNMA issuers as locking the FHA-GNMA yield spread at a level determined by servicing costs and credit risk. One exception to that relationship occurs when the FHA ceiling rate is more than 75 basis points below the equilibrium FHA yield. Under such circumstances, the FHA-GNMA spread falls below its equilibrium value.

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