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Exhibit 1

Prepayment Assumptions

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Valuing Conjectural Government Guarantees of FNMA Liabilities

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In principle, debt which is perfectly guaranteed by the U.S. Treasury should sell at virtually the same yields as direct Treasury debt. This equality should hold irrespective of the debt-servicing capacity of the debt-issuer. This is because a guarantor puts its credit behind that of the debt-issuer. If the issuer fails to service its obligations under a guaranteed debt contract, the guarantor is obliged to make up any and all shortfalls.

The Federal National Mortgage Association (FNMA) is a government-sponsored, but privately owned corporation, whose stock trades on the New York Stock Exchange. Except for statutory authority to purchase up to $2.25 billion of FNMA debt obligations, Treasury guarantees of FNMA debt are informal and nonstatutory. The imperfect nature of these guarantees largely explains why a positive differential exists between the yields FNMA pays and yields on comparable Treasury securities. Far from being legally enforceable, these guarantees are merely conjectural. They reflect a rational expectation that federal officials would prefer to shut off the unpleasant political, economic, and legal difficulties that would be generated by a developing FNMA default. In effect, the premium over Treasury yields that FNMA pays compensates lenders for Treasury (and Fed) officials retaining an option not to deliver the bailout that the market confidently expects of them.

This paper explains the economics of financial guarantees and develops a method for finding the market value of aggregate Treasury guarantees of FNMA debt during the period, 1978 to 1985. Exploiting an analogy between FNMA and a federally insured S&L, our analysis identifies incentive problems inherent in the Treasury's

*This paper updates and condenses research supported by a HUD contract. The authors are Reese Professor of Banking and Monetary Economics, The Ohio State University and Senior Economist, Financial Research Department, Federal Home Loan Mortgage Corporation. For valuable comments on an earlier draft, the authors wish to thank Robert Buckley, Arthur Corrazini, George Kaufman, J. Huston McCulloch, Robert Van Order, and participants in seminars at Southern Methodist University and the General Accounting Office.
failure to monitor and price adequately its exposure to loss and its susceptibility to bailout pressures. Our figures underscore the unfairness to the taxpayer of the policies of regulatory "forbearance" built into government-sponsored methods of "cosmetic accounting" that were applied to FNMA and S&Ls in the 1970s and are being applied today to zombie S&Ls, to agricultural and energy banks, and to LDC lenders.

Although the paper focuses specifically on measuring subsidies to risk-bearing received by FNMA, it is also a demonstration project. It provides a concrete illustration of the feasibility of conducting market-value accounting for financial institutions.

Our deeper goal is to create taxpayer demand for market-value accounting at financial institutions, so as to reduce the imperfection of markets for politicians and regulators by limiting these parties' option to deny and cover up unpleasant facts when politically sensitive institutions experience crippling economic losses. Putting these data on the record sets up the possibility of a later test of the efficiency of the market for regulatory services. The issue is whether market-value accounting can be used to open the eyes of regulators, politicians, and taxpayers to the costs of offering under-priced and insufficiently covenanted guarantees to troubled financial institutions.

1. Economic Analysis of A Financial Guarantee

A. Basic Asymmetry in Guarantor and Debt-Issuer Economic Interests

In obligating itself to guarantee a firm's debt, the Treasury (and through it the federal taxpayer) enters into a zero-sum side game with the debt-issuer. This game establishes an asymmetric mechanism for sharing unanticipated fluctuations in that firm's future income. The sharing is asymmetric because a guarantor absorbs a larger portion of the firm's unanticipated losses than the share it is able to capture of its unanticipated gains. A guarantor gains whenever the value of its guarantee declines (i.e., whenever the firm's prospects of servicing its debt improve). At any time, a guarantor's maximal gain is limited to the current market value of the guarantee. The implicit price for unwinding a given guarantee cannot fall below zero. However, this "buyout price" could, in the absence of actual or potential contractual controls on the debt-issuer, rise without limit.

This asymmetry establishes an incentive for a debt-issuer to take risks that maximize the value of the guarantee it enjoys. However, three important types of counterincentives exist. These serve to limit the degree of effective asymmetry that applies. The first flows from the ability of the guarantor to monitor the condition of the debt-issuer and intervene in its affairs. Depending on contractual arrangements, such intervention may range from forcing the firm to adjust its behavior in specific ways to taking over ownership of the firm. As long as the firm's managers believe that the guarantor can and will impose ex post penalties on them for excessive risk-taking, the guarantor's monitoring and response systems function as implicitly risk-rated guarantee fees. A second counterincentive flows from the market value of stockholders' investment in the firm, net of the external guarantee. Because liquidation losses in excess of a firm's net worth are borne by the guarantor, the asymmetry with which returns are shared decreases with the stockholder-contributed capital of the debt-issuer. Finally, the third counterincentive flows from the extent to which the firm's managers perceive that their careers might be harmed by leading their firm into economic or legal insolvency. In practice, for financial firms, legal insolvency focuses on a firm's liquidity (i.e., its ability to service its obligations as they come due or accrue). Economic insolvency denotes a condition in which, after subtracting the market value of external guarantees, the market value of a firm's assets (both on and off the balance sheet) falls short of the value of its nonownership liabilities. As the financial condition of the firm declines, the last two incentives deteriorate rapidly. As a firm approaches the brink of insolvency, its managers look for ways to prove their managerial skill by restoring the firm's health in a hurry.

B. Benefits and Costs of Debt Issuers and Guarantors

In the absence of a third-party guarantee, the interest rate that creditors require a debt-issuer to pay rises with the issuer's debt-to-assets ratio (i.e., its leverage) and with the riskiness of its operations. It is convenient to term the interest rate at which a firm's existing debt structure could be funded without external guarantees as its "warranted" rate of return, $R_W$. The value of FNMA's $R_W$ should be sensitive to its leverage, asset quality, and duration gap. This sensitivity exists because willing creditors must exact compensation for anything that increases the chance that FNMA may prove unable to repay their claims in full.

One way to measure the gross annualized benefits FNMA stockholders receive from Treasury guarantees ex ante is to compare $R_W$ with the interest cost FNMA pays for funds when its debts enjoy a Conjectural Treasury guarantee. In perfect markets, an imperfectly guaranteed institution can borrow unlimited amounts at the riskless or Treasury interest rate, $R_r$, plus an allowance $d$ for the degree of imperfection market participants perceive to exist in the extent of the Treasury's bailout propensities. Although $R_r$ is independent of both the degree of FNMA's leverage and the riskiness of the portfolio it holds, $d$ ought to vary with these and other determinants of $R_W$.

In this conception, the interest-rate differential $R_W-R_r-d$ represents the warranted risk premium the firm earns each year by placing into a leveraged portfolio of risky assets the funds it raises by issuing guaranteed obligations. If the firm's funds were invested in riskless assets of the same average life as its equity and nonequity liabilities, the firm's capital would not be exposed to risk. In these circum-
stances, \( d \) would shrink to zero and \( R_W \) would equal \( R_t \), so that the prospective (or ex ante) gross annualized benefits of the guarantee would be zero.

From an ex ante point of view, to find the net annualized benefits of a guarantee, we must subtract out all forms of annualized per-dollar fees (or premiums) that the guarantor collects in exchange for its monitoring and backstopping services. To denote the equivalent dollar value of annualized fees, we use the symbol \( R_t \).

Clearly, the guaranteed institution's annualized profits per dollar of guaranteed liabilities equals the difference between the warranted risk premium and the per annum guarantee fee:

\[
(R_W - R_t - d) - R_t.
\]

For any given \( R_W \), unless \( R_t \) equals the ex ante risk premium \( R_W - R_t - d \), the guaranteed institution is effectively taxed or subsidized. When \( R_t \) exceeds the warranted risk premium, the debtor-issuer is being taxed and managers may be expected to look for ways to shed its guarantees. On the other hand, when the inequality is reversed, a subsidy exists. Given the almost complete lack of guarantee fees facing FNMA today, stockholders benefit from preserving and extending the firm's guarantees.

The capitalized value of the warranted risk premium established by federal bailout propensities is in principle a capital asset. The discounted present value of the lower default premium FNMA has to pay on its debt belongs on the asset side of FNMA's balance sheet and on the liability side of the Treasury's.

Some FNMA officials refuse to acknowledge that FNMA's de facto insolvency imposes an implicit liability on the U.S. Treasury. Focusing only on explicit cash flows, they claim that "FNMA has never cost the Treasury a cent." But to ignore the implicit flow of Treasury financing is economically fallacious. This misleading claim exploits a conceptual confusion in the way the value of governmental guarantees are measured in the federal budget. Contemporary financial accounting for government credit programs and governmentally guaranteed enterprises measures the cost of guarantees in terms of cash flows they occasion during a given period rather than in terms of the contingent cash flows these commitments threaten to occasion in the future [6]. Under this accounting system, it always seems profitable in a given period for an agency or government-sponsored corporation to sell a new guarantee for the price the market will pay it for issuing that guarantee. A guarantee occasions no cash flows from the guarantor until and unless the guaranteed party fails to fulfill one or more contractual obligations. For this reason, a guarantor should in principle equate the current value of its guarantee to that of a fund of reserves sufficient to cover the expected present value of these future flows and to provide appropriate compensation for the volatility of these contingent cash flows.

Even if it is only implicit, this fund of reserves imposes important opportunity costs on the guarantor. Let us suppose that an insolvent gambler strong-arms us into guaranteeing an unsecured loan he is about to take out. Whether or not the lender ever asks him or us for repayment, we are bound to fret about our financial exposure. The frequency and strength of our discomfort may be especially great if the borrower continues to lose in the gambling casino and we elect to leave the resulting obligation unfunded. Even if we never actually pay out a cent, we surrender control over the state of our future finances and considerable peace of mind.

The Treasury's dilemma may be underscored by noting that it is only the imperfection of Treasury guarantees that imparts default risk to FNMA bonds and makes a FNMA bankruptcy even conceivable. Anything that makes a federal bailout less likely is bound to make it harder for FNMA to roll over its debt. If in the face of FNMA insolvency, the government did not reassure doubters as to its willingness to keep FNMA afloat, bondholders and stockholders would begin to absorb more of the firm's unbooked losses. If the Treasury remained adamant as various creditors scrambled to improve their positions, the firm would be driven inexorably into bankruptcy. If instead the government undertook to firm up its guarantees, more of FNMA's unbooked losses would be drawn into the value of Treasury guarantees and the subsidization of future risk-taking by FNMA would be intensified.

Continued subsidization of FNMA activity is inefficient and unfair. It is inefficient because it crowds out marginal investment projects that would otherwise be undertaken by unsubsidized firms [6]. It is unfair because these and other unsubsidized parties unintentionally contribute their collective credit to keeping FNMA out of bankruptcy.

The subsidies that conjectural guarantees confer on FNMA stockholders and bondholders may be interpreted as gifts of time -- time for FNMA management to work its way out of economic insolvency. The key point to recognize is that workout time has substantial market value to an insolvent firm and that this value grows with the extent of the firm's insolvency. In unsubsidized transactions, lenders typically either sell workout time to managers of troubled firms in exchange for warrants and other forms of equity claims or sell their debt holdings to more optimistic parties at a mere fraction of these debts' scheduled values.

C. Perverse Incentives for FNMA Managers

In the special case where \( R_t \) is virtually zero, the underpricing creates strong incentives for issuers of guaranteed debt to undertake an adverse selection of risks that serves to expand the risks of their operations (i.e., increase \( R_W - d \)) while shifting the burden of supporting these risks onto their guarantor. From an ex ante point of view, the absence of creditor insistence on appropriate risk premiums makes the risks taken by FNMA appear both more profitable and less risky to FNMA's managers than they are for society as a whole. With a zero premium, managers of FNMA can maximize the value of the subsidy their stockholders receive by using dividends to push stockholder-contributed capital as close to zero as the Treasury and its
FNMA managers to lower capital ratios and to take other risks that creditors permit, while energetically pursuing risk in its asset, funding, product-line innovations, and other business choices. The attractiveness of this value-maximizing strategy to an individual manager declines with three factors: (1) the federal government's ability to control FNMA risk-taking, (2) the net capital FNMA stockholders have contributed, and (3) the degree of discomfort the manager feels with the career risks associated with leading a firm into failure.

Any institution maintains a nonzero capital account to buffer business risks. Increases in capital lower a firm's warranted financing rate, \( R_w \), by making credible the firm's capacity to absorb the risks inherent in its operations. When guarantees are perfect and guarantee fees are not risk-rated in any way, capital may be decreased even to zero without affecting the cost of deposits. The absence of adequate user fees for Treasury guarantees establishes incentives for FNMA managers to lower capital ratios and to take other risks that increase the institution's warranted funding rate.

In responding to these incentives, FNMA's managers no more intend for their firm to fail than a driver who is perfectly insured against losses from theft would intend for his car to be stolen. The parallel point is that, when drivers that install burglar alarms and secondary locking devices are offered no compensating reduction in their insurance premiums, their natural interest in installing alarm systems and back-up locks is curtailed.

HUD is to a limited degree formally responsible for controlling FNMA risk-taking (Comptroller General of the United States, 1983). However, and especially under historical-cost accounting, many forms of FNMA risk-taking are easy for management to conceal.

Not only does the Treasury charge no explicit fee, it also imposes few implicit fees. The result is a series of strong arbitrage incentives, in which --especially during a period such as 1979-84 when stockholder-contributed FNMA net worth was exhausted -- the main effective constraints on FNMA risk-taking are the need to serve a countercyclical stabilization policy mission that makes it a quasi-agency and the fear that too-aggressive pursuit of subsidized guarantees would induce massive administrative controls on its future risk-taking. FNMA stockholders want the firm's managers to reach out for as much leverage, default, and interest-rate risk as they can grab without provoking elected officials into imposing actuarially fair user fees or direct restraints on the firm's capacity to take portfolio risk. Although FNMA managers have additional public-policy responsibilities, it would be unethical for them to ignore their stockholders' clear economic interests.

The basic asymmetry in stockholder-guarantor sharing of unanticipated gains and losses traces to stockholders' limited liability for the guaranteed firm's losses. While a government guarantor's liability is potentially unlimited, stockholder liability cannot exceed the value of the firm's accumulated capital. This asymmetry is increased by informational advantages that FNMA managers have over Treasury and HUD officials which make it difficult for these officials to monitor and respond adequately to FNMA risk-taking. The asymmetry is reduced by the size of the firm's capital account. Along with legal and political constraints on the Treasury's right to close or sell off an economically insolvent FNMA, these asymmetries constitute the heart of the problem of developing appropriate user fees. FNMA stockholders can lock in a sure return by selecting a diversified portfolio of other assets designed to insulate their wealth against the risk that FNMA itself might fail. Such stockholders effectively arbitrage the price of risk-bearing services between markets for loanable funds and the market for guarantee services.

FNMA exemplifies three problems in microcosm:

1. The difficulties of bringing unintended federal subsidies to financial-institution risk-bearing back under administrative control
2. The ways in which market-value accounting can contribute to solving this problem by lessening informational asymmetries and establishing a theoretically satisfying criterion by which to guide regulatory triage
3. How to conduct deposit-insurance reform. A pointed analogy exists between FNMA and insured deposit institutions. FNMA may be regarded as a giant S&L or reregulated S&L may be viewed as midget FNMA.

The annualized value of Treasury guarantees to FNMA stockholders may be measured ex post (i.e., at the end of the period of insurance coverage) as well as ex ante. Ex post measurement centers on observed changes in the net value of the continuing guarantee. For expositional convenience, we define \( F_t \) as the discounted present value of the expected flow of future net taxes or subsidies from Treasury guarantees. In any year \( t \), the ex post flow of benefits to FNMA from Treasury guarantees is the sum of two components: an interest component and a capital-gains component. Over any accounting period, the interest component records the average interest cost to the federal government of supporting (i.e., financing) the capitalized value of the guarantee. To a first approximation, this implicit interest cost may be conceived as the product of the average interest rate on FNMA debt, \( i \), times the intrayear average market value of the guarantee the institution enjoys: \( i_t F_t \). The capital-gains component represents the change in the value of \( F_t \) during year \( t \) (i.e., \( F_{t+1} - F_t \)), reflecting changes in the value of the Treasury's
risk exposure in the firm. When managerial decisions or environmental change reduce the value of the guarantor's risk exposure, the change in $F_r$ can be negative. Whenever the decline in $F_r$ is larger in magnitude than the interest component, the flow of ex post benefits in a given period may actually be negative.

II. Estimating the Market Value and Duration of FNMA's Assets and Liabilities, December 1978 to December 1985

Table 1 presents market-value estimates of FNMA assets, liabilities, and duration gap. This section loosely summarizes the methods used to construct these figures.

A. ASSETS

FNMA's assets are almost entirely mortgage loans — 96 percent of December 1985 total assets of $99.1 billion are mortgages. FNMA reports its mortgage portfolio in several categories. For home mortgages, FNMA distinguishes holdings of Government-insured (FHA/VA mortgages), conventional fixed-rate mortgages, second mortgages, and adjustable-rate mortgages. Similar groupings are reported for project mortgages. Our analysis translates these into three groups: (1) long-term fixed-rate mortgages (FRMs), (2) shorter-term (15-year maximum) second mortgages, and (3) adjustable-rate mortgage (ARMs).

The 1978 portfolio serves as the base portfolio from which subsequent end-of-year portfolios are constructed. To generate these estimates, we estimate interest-rate categories and terms to maturity for all purchases and sales in each successive year.

1. Fixed-Rate Mortgages

Amortization and prepayments are also interpolated for each class. The method used to obtain interest-rate classes for FRM purchases assigns contract interest rates to purchases made after 1978. Aggregate data on loan purchases are available from FNMA; it also reports yields on these loans. Because FNMA purchased FHA/VA loans in volume through 1981, FHA/VA maximum interest rates (lagged three months to account for the lag between commitment and purchase) are used to approximate contract rates for loans purchased through that year.

In 1982, FNMA reduced its purchases of FHA/VA loans sharply, to less than 6 percent of their purchases and purchased adjustable-rate mortgages (ARMs) in volume. Also, FNMA relied more heavily in 1982 on purchases made at its posted yield than at its biweekly auction. FNMA's posted gross yield (including servicing) is used to estimate contract rates for each month's purchases starting in 1982. The contract rate for any given month is the previous month's 60-day posted yield for conventional loans rounded downward to the next-lowest one-half percentage point.

Starting in 1981, FNMA began purchasing second trusts. Contract rates for the second trusts are developed in the same manner as first-mortgage rates except that they are set one-half percentage point higher. Because only a small proportion of the second trusts purchased by FNMA have terms to maturity less than 15 years, we assume all are 15-year mortgages. All first-trust mortgages purchased are assigned 30-year terms to maturity. Finally, all loans are treated as originating in the middle of the year purchased.

Estimates of prepayments (which also include defaults) employ a nonlinear model developed from prepayment data on GNMA MBSs published by the Financial Publishing Company. Prepayments include all repayments of principal except for regular amortization. In addition to full and voluntary prepayment of principal, the data include partial prepayments and repayments that result from foreclosure and other default terminations. The data cover 30-year MBS pools and are reported by coupon rate and year of origination.

The model was fit to GNMA MBS prepayment rates for 1983 and 1984. Yields used to calculate market values were average yields for those two years from the Mortgage Company Weekly Opinion Poll of Mortgage Market Conditions conducted by the Financial Policy Division of HUD's Office of Housing. The model was estimated using a nonlinear least-squares algorithm. All coefficients proved highly significant and the model explained over 95 percent of the variance in prepayment ($R^2 = .952$). This model draws heavily on research reported in [2] and [3].

The final procedure needed to estimate the composition of the end-of-year fixed-rate portfolio is the composition (by contract rate and remaining term) of the loans FNMA sells from its portfolio during each year. Through 1981, sales of mortgages from FNMA's portfolio were small, so that they could simply be ratio-adjusted out of the end-of-year portfolio.

According to FNMA, however, loans sold since 1981 were not necessarily out of current production, but could be several years old. Virtually all of the loan sales occurred through FNMA's regular MBS program. We have to delete loans sold from the portfolio so that the average mortgage rate becomes consistent with the yields reported on FNMA sales. This means constructing a reasonable distribution of sales by contract rate and remaining term. FNMA reports an estimated net yield for loans sold, but according to FNMA these loans have included a wide range of contact interest rates. To make these estimates, only groups with a remaining term to maturity of more than 25 years are considered. This assures that recently originated loans are considered and eliminates shorter-term second mortgages. These groups are next split between: (1) loans with contract rates above the estimated net yield of loans sold during the period, and (2) loans with contract rates lower than that yield. The distribution of sales is found by applying different weights to the two groups so that the weighted-average contract rate lies just below the estimated net yield. This distribution is then used to distribute sales by contract rate and remaining term, so that sales for each group can be
subtracted from corresponding categories to obtain the detail for the yearend portfolio.

Estimating Monthly Payments and Servicing Costs. Once the end-of-the-year portfolio is estimated, future unpaid principal balances can be calculated using the prepayment model and amortizing each group of loans. Servicing costs are calculated simply by multiplying the monthly rate for servicing by the unpaid principal each month. Servicing fees for single-family loans are set at three-eighths of a percentage point.

Mortgage Yields Used to Value the FNMA Portfolio. The value of the mortgages held is calculated by discounting the projected net cash flow by the market interest rate. We use a weighted average of FHA/VA mortgage yields and conventional mortgage yields. Yields on GNMA MBSs were used for the FHA/VA rates, because GNMA MBS pools are made up almost exclusively of FHA/VA mortgages and are actively traded in a large market. For conventional yields, we use FNMA auction yields through 1980 and FNMA's posted 60-day mandatory-delivery yield thereafter. In 1981, FNMA shifted from their free-market auction as a means of purchasing loans to a posted mandatory-delivery process. Through 1980, we use the net yield from the last biweekly auction in the year. From 1981 on, the 60-day mandatory delivery yield for the last working day in the year is used.

2. Adjustable-Rate Mortgages

From 1981 through December 1984, FNMA purchased almost $13 billion in ARMs. According to FNMA, until the last half of 1984, although these loans did not have interest-rate caps, many had payment caps. We set the value of the ARM portfolio at par and its duration at 12 months.

While not published data exist on the type of ARMs in FNMA's portfolio, we assume that 3-to-5-year ARMs dominate. The duration of a new 5-year ARM is about 3-1/2 years, assuming no prepayments and no interest-rate caps. However, the average time to conversion for a portfolio of one-year ARMs should tend to be about six months. Considering that 5-year ARMs are probably prepaying quite rapidly because of high initial rates, and most are a year to two closer to conversion, it seems unlikely that our assumed one-year duration can err by more than a few months. In any case, the overall portfolio duration is unlikely to be changed significantly by such an assumption.

3. Value of FNMA Mortgage-Backed Securities

The MBSs that FNMA guarantees generate fee income much as mortgage servicing generates income for a mortgage banker. FNMA typically charges 25 basis points for guaranteeing an MBS.

Calculating the market value of MBS guarantees requires estimates that parallel those made in valuing servicing costs for FNMA's fixed-rate mortgages. Almost three-fourths of FNMA MBSs are swaps, and most of these are seasoned loans. Scattered information on MBS interest rates shows a wide dispersion of rates, not dissimilar to the distribution of FNMA's fixed-rate portfolio. Exploiting this similarity, we use FNMA's fixed-rate portfolio, extracting all loans with terms to maturity of less than 15 years. This eliminates all second-trust and very old loans. We assume that 80 percent of the guarantee fee is net income. The value of this income is discounted to present value at the same rates used to calculate the value of the fixed-rate portfolio. Lacking reliable information on the program's operating costs and on the timing of monthly payments, our calculations set the duration of MBS guarantee fee income at zero.
calculated assuming these securities would not be called. Exchangeable debentures that can be converted to adjustable-rate preferred stock at the option of FNMA are treated in the same manner. In the last half of 1984, FNMA issued two zero-coupon long-term debentures (30 and 35 years). For these two securities, we use the value stated in the FNMA "Investor/Analyst Report" for 1984. In 1985, the securities are valued using the average yield on three long-term FNMA Debentures maturing in 2013 to 2015. For these securities, duration equals the remaining term to maturity.

FNMA has engaged in swap agreements that effectively extend the maturity of shorter-term debt. According to the FNMA Guide to Debt Securities, swaps were $1.3 billion in amount and had terms averaging five and one-half years. Swaps cannot be factored into duration estimates because the details of these transactions are not available. However, the maximum possible effect on overall duration of liabilities could not exceed a month.

2. Short-Term Borrowing

Besides describing debentures, the FNMA report contains information on the month of maturity for short-term notes. Discount rates are derived from the yields reported for debentures maturing during the next 12 months. We assume that notes mature in the middle of the month of reported maturity. Master notes are assumed to be worth par (rates change weekly for these) and to have a zero duration. Duration of discount notes, of course, equals the time to maturity.

Investment notes (or investment agreements) are a special type of borrowing instituted by FNMA in 1984 and are valued as reported in the financial statements. Under investment agreements, FNMA agrees to pay a fixed rate of interest (although sometimes variable-rate agreements are negotiated) on funds invested for a specific term. These agreements are usually used by servicer/issuers of Collateralized Mortgage Obligations (CMOs). Payments to CMO security holders are made semiannually, while payments on the underlying mortgages are made monthly. The investment agreement provides a convenient way to invest the monthly cash flow until the semiannual payouts are made. According to FNMA, the average maturity of these agreements at the end of December 1985 was three years and one month. Since the average maturity of all of FNMA’s debt on this date was only three months longer, we assign these agreements the same duration as all debt instruments.

C. VALUE OF FNMA'S STOCK

The first three columns of Table 2 shows the number of stock shares outstanding, average stock price, and FNMA's market value for each period. Stock prices come from the Wall Street Journal and reflect the closing price for the date shown.
We derive the value of the guarantees that FNMA enjoys from the first principles of corporate finance. The balance-sheet identity tells us that the market value of FNMA stock, MV(S), may be conceived as the sum of the market value of its bookable and unbookable assets, A and A', less the value of its bookable and unbookable nonequity liabilities, L and L':

\[
MV(S) = MV(A) + MV(A') - MV(L) - MV(L').
\]

Letting \( O \) represent the net market value of off-balance sheet items, this equation tells us that we may estimate \( O \) as the difference between the market value of FNMA's outstanding stock and its bookable net worth:

\[
O = MV(S) - MV(NWB).
\]

By applying this equation at regular intervals to data on FNMA balance sheets and assuming a zero net value for unbooked assets and liabilities whose values we do not assess, it is possible to track the value of Treasury guarantees over time.

Table 2 brings FNMA's accumulated losses on assets and gains on debt together with data on the value of outstanding FNMA stock. The second-last column of the table inserts the market value of net assets into equation (2) to calculate the value of Treasury guarantees. The final column estimates the annual cost to the Treasury of supporting these guarantees as the sum of carrying costs on the average value of outstanding guarantees in each year and the ex-post price appreciation or depreciation of the guarantees themselves. This cost ran roughly $4 billion a year in 1979, 1980, and 1981, but because of mortgage appreciation has been negative ever since.

Valuing the truncation of interest-induced decreases that is implicit in the price of FNMA stock, our data indicate that, on average between 1979 and 1984, the Treasury's concessional guarantees exceeded even the $2.25 billion maximum value of the Treasury's statutory authority to purchase FNMA debt. Although FNMA's limited access to Treasury credit helps to reassure lenders, the size of the maximum wealth transfer associated with this loose credit line is too small either to explain creditors' failure to press FNMA to strengthen its deteriorating balance sheet or to justify the substantial aggregate market value of FNMA stock.

Our figures show that the negative value of FNMA's bookable net worth proves extremely interest-sensitive and, in six of the last eight years, clearly exceeded the Treasury's maximum lending authority. The good will or going-concern values associated with FNMA's record of past service to mortgage bankers may be an additional source of unbookable value. However, unlike the value of
a guarantee, this value should not be particularly sensitive to the level and volatility of market interest rates. The relatively low value our estimate shows in the cyclically low interest-rate years of 1978 and 1983 and secularly increasing competition in secondary mortgage markets suggest that FNMA's net going-concern value cannot currently be very large. Mortgage-backed securities (especially collateralized mortgage obligations and builder bonds) and electronic mortgage networks have largely wrung any oligopolistic profits out of the mortgage banking business [4]. In fact, FNMA's growing involvement with mortgage-backed securities might well have rendered the net value of unbooked assets other than Treasury guarantee negative in the 1980s. This is because FNMA guarantees the timeliness of many of the scheduled payments generated by the mortgage pools that underlie its mortgage-backed securities. This means that our estimates of the value of Treasury guarantees might actually be too low. In any case, even if we were to designate all of the value of FNMA stock as net other unbooked assets, the implied magnitude of the unbooked values would still be dominated by the value of Treasury guarantees.

Selecting a value for net other unbooked values permits us to use data from competitive stock and bond markets to construct an indirect estimate of what market participants think the Treasury's conjectural guarantees are worth to FNMA stock and bondholders. This lets us finesse the difficult task of modelling explicitly the stochastic process governing past and future FNMA losses. Assuming that net other unbooked values are zero makes the value of conjectural Treasury guarantees the algebraic difference between the market value of FNMA's outstanding stock and the market value of its bookable net worth. If \( MV(NW) = -$10 \) billion and the value of FNMA shares is $1 billion, the guarantees would be worth $11 billion.

In failing to require FNMA either to reduce its risk-taking or to pay for these guarantees, the Treasury implicitly forces the general taxpayer to subsidize FNMA in this amount. Moreover, as the market value of \( NW \) becomes more and more negative, the distribution of future gains and losses becomes increasingly asymmetric. Additional losses accrue mainly to the guarantor, because FNMA stockholders have less and less of their own funds left at risk. Incurred further losses increases the value of the guarantee far more than it reduces the value of outstanding FNMA stock. Gains that develop are also shared in unequal proportions. As the magnitude of the firm's negative capital diminishes, a larger portion of subsequent gains accrue to stockholders. In effect, the general taxpayer is made to supply FNMA with implicit equity funds that FNMA bets on the course of future interest rates. These bets raise a policy problem for two reasons. First, the taxpayer does not receive an appropriately balanced claim on the profits the firm generates. Unless FNMA is made to hedge some of its outstanding interest-rate bets, the taxpayer's credit promises to remain on the line for a very long time. Second, government policymakers have failed to introduce explicit controls on voluntary risk-taking by FNMA.

Decomposing the values underlying FNMA stock prices in this way clarifies how misleading it is for FNMA managers to claim that their firm has yet to cost the government a penny. The Treasury has lost money on FNMA because the market has made the Treasury, as a conjectural guarantor, absorb the ultimate responsibility for most of the losses that this leveraged firm's lenders would otherwise have had to absorb. Voluntary increases in FNMA risk-taking spread the tails of the probability distribution of the firm's future value. Because stockholders enjoy limited liability, any such spread serves to increase the value of an entity whose debt is conjecturally or explicitly guaranteed for less than the true cost of guaranteeing the incremental risk. Voluntary client risk-taking may take several forms, including increases in a firm's portfolio size, portfolio leverage, credit risk, and size of unhedged positions. When a guaranteed institution's portfolio is under water, such risk-taking is often defended as maneuvering "to grow out of its problems." Such maneuvering imposes important costs on the guarantor.

Voluntary Pursuit of Interest-Rate Risk by a Guaranteed Institution

Beginning in 1983, declines in asset quality have posed growing risks to FNMA. The danger of borrower defaults has grown as the outlook for housing prices has deteriorated and as graduated-payment and adjustable-rate elements were incorporated into new mortgage contracts without adequate adjustment in procedures for screening and qualifying potential borrowers [4]. Historically, however, FNMA's risk exposure has come mainly from interest volatility and its high degree of leverage.

Increases and decreases in market interest rates cause fixed-rate assets and liabilities to lose and gain value. In principle, net fluctuations in the value of an institution's individual assets and liabilities cause parallel fluctuations in the value of its net worth or capital account.

The market divides changes in the market value of a guaranteed firm's assets associated with movements in interest rates between its guarantor (i.e., the Treasury), the firm's bondholders, and its stockholders. Each party's share of these capital gains and losses depends critically on the size of the firm's duration gap, the breadth of the interest-rate movement, the perfection of applicable guarantees, and the extent to which the market value of the firm's bookable assets, \( MV(A) \), exceeds or falls short of the market value of its nonequity liabilities, \( MV(L) \).

Table 2 shows that interest-induced portfolio losses and gains have been shared asymmetrically between the Treasury and FNMA stockholders. Although the bulk of 1978-85 changes in the value of FNMA's portfolio accrued to the Treasury, the Treasury's share of FNMA's portfolio losses was typically greater than its share of portfolio gains. For example, between December 1978 and December 1981, while the value of FNMA stock decreased only 0.4 billion
dollars, the value of Treasury guarantees increased 10 billion dollars. When interest rates fell in 1982 and 1983, FNMA stock gained about 1.0 billion dollars, while the value of Treasury guarantees fell by about 4.9 billion dollars. During the downward portfolio revaluation, the Treasury took 96 percent of the hit. During the 1981-1983 portfolio appreciation, it was able to capture only 83 percent of the gain.

In 1983 and 1984, the value of FNMA stock and Treasury guarantees both declined. This reflects reductions in the firm's duration gap, undertaken (we believe) with an eye toward neutralizing political pressure for outside intervention. In 1985, the asymmetric pattern returned. As the value of the guarantee shrank to less than the value of the stock, FNMA stockholders managed to reap 19 percent of the firm's portfolio appreciation.

For a fixed collection of assets, a good measure of the exposure of FNMA net worth to interest-volatility risk is its weighted duration gap \( g \). Table 3 calculates this gap as the difference between the duration of FNMA assets and (1-\( w \)) times the duration of its borrowings. In turn, duration represents a specific measure of the interest sensitivity of a portfolio's scheduled cash flow and \( w \) equals the ratio of the market value of FNMA equity to the value of its assets.

As FNMA managers have carefully informed their critics, FNMA steadily reduced the duration of its asset holdings over 1978-1985. However, through 1983, the duration of FNMA liabilities declined as well and the firm's mortgage portfolio grew substantially, so that the net reduction in FNMA's exposure to interest-volatility risk was less than this asset-side adjustment would suggest.

Table 3 shows that FNMA management reduced the firm's duration gap by three-tenths of a year (or roughly 11 percent) during the 1979-1983 period. However, Table 1 shows that they simultaneously increased the size of the firm's guaranteed interest-rate bets (i.e., the market value of its mortgage holdings) by a much larger percentage ($28.1 billion or 68 percent). The net loss to the taxpayer from the combined adjustment is shown in the higher value implied for Treasury guarantees, which increased by $1.4 billion.

Another way to analyze the 1979-1983 adjustment is to treat the 1979 bet as remaining on the table and to solve for the incremental duration gap that would be consistent with this assumption. This approach ignores the fact that most of the assets and liabilities outstanding in 1979 had either matured or changed value by 1983. It portrays the 2.4-year 1983 duration gap as an average of a constant 2.7-year duration gap on a fund of $41.6 billion dollars carried over from 1979 and a smaller but positive "marginal gap" \( g_m \) on the $28.1 billion by which FNMA mortgage holdings expanded:

\[
\frac{41.6}{69.7} (2.7) + \frac{28.1}{69.7} (g_m) = 2.4
\]

Solving this equation for \( g_m \) gives a marginal gap of 1.96 years. Hence, far from reducing the firm's net exposure to interest-

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**TABLE 3**

Summary Measures of FNMA Exposure to Interest-Volatility Risk, 1978-1985

<table>
<thead>
<tr>
<th>Month</th>
<th>Duration of FNMA Assets (in years)</th>
<th>S/A Ratio of Stock Value to FNMA Assets (in percent)</th>
<th>Duration of Nonequity Liabilities (in years)</th>
<th>Weighted Gap in FNMA Duration (in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 1978</td>
<td>5.35</td>
<td>2.3</td>
<td>2.82</td>
<td>2.6</td>
</tr>
<tr>
<td>December 1979</td>
<td>5.16</td>
<td>2.1</td>
<td>2.47</td>
<td>2.7</td>
</tr>
<tr>
<td>December 1980</td>
<td>4.76</td>
<td>1.3</td>
<td>2.16</td>
<td>2.6</td>
</tr>
<tr>
<td>December 1981</td>
<td>4.50</td>
<td>1.1</td>
<td>1.83</td>
<td>2.7</td>
</tr>
<tr>
<td>December 1982</td>
<td>4.20</td>
<td>2.4</td>
<td>1.80</td>
<td>2.4</td>
</tr>
<tr>
<td>December 1983</td>
<td>4.16</td>
<td>2.1</td>
<td>1.83</td>
<td>2.4</td>
</tr>
<tr>
<td>December 1984</td>
<td>3.94</td>
<td>1.2</td>
<td>1.92</td>
<td>2.0</td>
</tr>
<tr>
<td>December 1985</td>
<td>3.85</td>
<td>1.8</td>
<td>2.39</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Source: The first three columns employ figures calculated by former HUD staff economist Chet Foster from published FNMA Balance Sheets for the indicated months.
volatility risk, FNMA management placed another (albeit more conservative) bet alongside the one inherited from 1979. In effect, when losses on existing bets drove its stockholder-contributed equity position more deeply underwater, FNMA's strategy was to increase its net exposure to losses from interest-rate increases by increasing its leverage and portfolio size faster than it reduced the degree of its short-funding.

IV. Policy Implications

This paper is conceived as a way to educate taxpayers about the extent to which they have an unguarded interest in FNMA affairs, and by extension in FSLIC and FDIC monitoring and insolvency resolution schemes. We believe that readers can place considerable confidence in the order of magnitude and policy implications of the numbers we report. The calculations incorporate conservative assumptions about the duration and market value of ARMs. The most vulnerable assumption in our model is probably the prepayment model, because the range of data from it as estimated does not include any interest-rate declines of the sharpness observed during 1985-1986. Still, in this model the interest-sensitivity of prepayments far exceeds that assumed by other models now in use.

The data show that the Treasury has failed to monitor and price adequately the taxpayer's exposure to losses in FNMA activities. Moreover, although past losses have been resolved (albeit asymmetrically), defective incentives remain in place. FNMA is still placing bets at the financial casino and the stakes of these bets could be magnified overnight if FNMA were to declare a substantial dividend that would increase its leverage again.

To underscore federal officials' obligation to do something about FNMA, let me recount a parable designed to clarify the implications this analysis has for the duties of federal officials. In this parable, a family-owned business undergoes a change of leadership. The new boss discovers that, although for years the firm has been supplying concrete buttresses to prop up a big building across town, the owners of the building have never paid a dime for the firm's services. At this moment, the new boss receives an urgent call to send over an additional buttress for the firm's south wall. Doesn't the new boss owe it to the family to bill the firm for the cost of installing the new buttress and for at least the opportunity costs of maintaining the old ones? Otherwise, he would become personally responsible for using family funds to subsidize the owners of the big building. Moreover, until he imposes the right level of charges, the owners of the big building face insufficient incentives to economize on their continuing use of the firm's buttressing services.

To square the family of taxpayers' ongoing account with FNMA, Treasury officials should present the managers of FNMA a bill for at least the value of the Treasury's current guarantee services. In fact, early in 1985 the Office of Management and Budget proposed that FNMA pay the Treasury a user fee of 5 to 8-1/3 basis points on every dollar of FNMA debt. FNMA's adverse reaction to this modest and poorly focused proposal indicates that FNMA would resist paying anything approaching the full value of the guarantee services it receives. This suggests that the Treasury needs to develop a workable schedule for phasing out its buttressing services. A longer version of this paper develops a framework for analyzing alternative ways of imposing effective disincentives on FNMA risk-taking and of suddenly or gradually eliminating implicit federal guarantees on existing FNMA debt.

The timing is right to price or phase out FNMA guarantees today. Because FNMA is temporarily solvent, now is an excellent time to eliminate the guarantees or to price and covenant them. Methods for doing this are discussed in the larger paper, which explains the particular advantages of tendering for FNMA stock or debt.

Just as with deposit insurance, effective reform is not just a matter of raising explicit premiums or capital requirements or even of making them more risk-sensitive. To counteract the moral hazard in the current situation, such reforms have to be accompanied by a better information system, effective monitoring of the information it produces, and timely and aggressive pursuit of options for managing the exposure that "clients" voluntary risk-taking imposes upon them. The touchstones have to be: (a) obtaining the same information that a private guarantor would require and (b) setting up procedures for responding to this information in the same way a private guarantor would. This means leaving the responsibility for rescuing insolvent individual institutions to the lender of last resort.

Reform proposals that federal regulators have placed before Congress today do not face up to the need for market-value accounting (or at least market-value reporting) or contemplate an objective market-value rule for defining institutional insolvency. Because such reforms do not transform authorities' incentives to deny and cover up emerging insolvencies, they can at best provide us only temporary and cosmetic relief from the ongoing process of substituting federal guarantees for stockholder-contributed equity at financial institutions and the creeping and unintended nationalization of U.S. financial intermediaries that this implies.

Footnotes

1Farmers Home Administration loans are also eligible, but make up a negligible portion of GNMA MBSs.

2Salomon Brothers (Modzelewski and Waldman (1984)) found that one-year rate capped ARMs had durations of 2-4 years. However, these estimates relate to newly originated loans not to a seasoned port-
and assume no prepayments prior to the 12th year. Also, much of FNMA's ARM portfolio has no interest-rate caps.

References


I. Introduction

There is no question that the last five years have been witness to many dramatic events affecting the banking industry. Deregulation of interest rates, increasing competition from nonbank sources, and increases in bank capital requirements have forced banks to seek profit opportunities in nontraditional activities. Prominent among these nontraditional activities are commitments and contingent liabilities. These activities are not booked on the balance sheet and therefore are not subject to capital requirements. Thus, banks have been able to generate fee income without formally setting aside a portion of capital for each activity.

As the volume of these instruments has grown, so has the perception of their riskiness. As a consequence, federal bank regulators have each released for public comment proposals for a "risk-adjusted-capital measure" that formally include these items. This paper sets the stage for the other three papers in this session and presents an overview of many off-balance-sheet activities ("OBSAs"), including their growth and development, risks and benefits, and proposals for their inclusion in the risk-adjusted-capital measures.

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