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A Survey

By
Fung-Shine Pan

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On the Ginnie Mae: A Survey

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Abstract

This paper investigates the theoretical and empirical concerns on the GNMA securities. At first, the characteristics and institutional aspects of GNMAAs are introduced. Then, previous studies on the pricing and investment performance of GNMAAs are reviewed. With respect to GNMA futures markets, the specification of the GNMA futures contracts are described. Several empirical studies on: the impact of futures trading upon the GNMA spot prices, pricing efficiency, hedging performance, and delivery procedures, are summarized.
This paper reviews the major issues in the literature of the GNMA (Government National Mortgage Association) mortgage-backed pass-through securities. Section 1 introduces the history and characteristics of GNMA pass-through securities. Several institutional aspects are described. Section 2 discusses the previous studies on the GNMA securities. Section 3 describes the invention and features of GNMA futures contracts. In section 4 previous studies on the GNMA futures are reviewed.

1. Introduction of GNMA Pass-Through Securities

The Government National Mortgage Association (GNMA) was created in 1968 as a Government corporation within the Department of Housing and Urban Development to administer mortgage support programs which could not be carried out in the private market. The major activity of the association is the Mortgage-Backed Security (MBS) program. Its purpose is to increase liquidity in the secondary mortgage market and to attract new sources of financing for residential loans. Through the MBS program, GNMA guarantees the investors the timely payment of principal and interest on securities which are backed by pools of federally-underwritten mortgages and issued by private mortgage lending institutions. The GNMA mortgage-backed pass-through securities are popularly known as "Ginnie Maes" or "GNMAs."

Since GNMA was authorized to guarantee mortgage-backed securities, it has guaranteed over $140 billion in Ginnie Maes by the end of 1982. More than $115 billion of the aggregate principal balances are still outstanding. There are more than 1,000 approved GNMA securities issuers who originate and service over 55,000 mortgage pools and some 90 securities dealers who market the securities. The majority of the issuers are mortgage bankers, though many savings and loan associations, commercial banks and other financial institutions have also been approved as issuers.

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1 Commitment authority is granted to GNMA by a Congressional appropriation. This is not a grant of funds from the Treasury, but a limit to the aggregate amount of new securities that GNMA can guarantee in any given year. In the 1983 fiscal year, this limit was set at $66.25 billion. See GNMA [1982], p.2.


3 In order to become an approved issuer of GNMA securities, a firm must be in the business of originating or servicing mortgage loans. It must be an FHA-approved mortgagee in good standing, and have a net worth that assures GNMA of the firm's financial capacity to pay security holders when mortgagors fail to make their mortgage payments on time. An issuer is responsible for acquiring eligible mortgages, creating a pool of mortgages to be held by a custodian, issuing the securities backed by the pool of mortgages, arranging for the marketing of the securities, servicing the mortgages in the pool, administering the securities outstanding, and making the full and timely payment of all amounts due to securities holders. See GNMA [1980], ch. 2.
There are six types of mortgage pools and guaranteed securities: (1) single family level payment mortgages; (2) single family graduated payment mortgages; (3) single family buydown mortgages; (4) mobile home loans; (5) project construction loans; and (6) project (permanent) loans. Since most issues of mortgage-backed securities involve single family level payment home loans, the contents of this study pertain to single family level payment securities issues.

The GNMA fully-modified mortgage-backed pass-through certificates were first issued by mortgage bankers on February 19, 1970. The GNMA pass-through certificate represents an undivided interest on a package or pool of mortgages. The characteristics of single-family fully modified pass-through certificates are: (1) minimum pool size of $1 million; (2) all mortgages in a pool must bear the same interest rate; (3) minimum certificate amount of $25,000, with increments of $5,000; (4) each pool issued by a specific FHA-approved mortgagee; and (5) maturity generally 30 years, dated on the first of the issue month and maturing on the 15th.

The underlying mortgages must be insured against default by either the Federal Housing Administration (FHA) or the Farmers Home Administration (FmHA) or guaranteed by the Veterans Administration (VA) and may not have been more than one year old on the date GNMA issues its commitment to guarantee the pool involved. Since Ginnie Mae holders are entitled to a full recovery of all unpaid principal balances of the securities, in the event of foreclosures, the issuer must pay (using its own fund) those amounts that are not reimbursed through FHA, VA or FmHA claim settlements. All FHA and VA mortgages can be prepaid or called by the mortgagors at any time without a prepayment penalty and the loans are assumable. Prepayments are distributed on a pro rata basis to all registered certificate holders.

The coupon interest rate on a GNMA certificate is the interest rate on the mortgages in the pool less 0.50 percent. This deduction includes an annual GNMA guaranty fee of 0.06 percent (0.005% monthly) of the remaining principal balance of the loans in pool and the annual issuer's servicing fee of

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4 According to the GNMA 1981 annual report, single family loans (level payment) accounts for 82.20% of mortgage-backed securities issued.

5 One certificate in each issuance may be in an amount which is not a multiple of $5,000 in order to make the total amount of securities equal the aggregate outstanding principal balance of the mortgages comprising the pool.

0.44 percent (0.0367% monthly) of the remaining principal balance. Hence, without consideration of prepayment, the monthly cash flows to certificate holder combines the amortization of principal on the underlying mortgage rate with the scheduled interest payment on the coupon interest rate.

Although the GNMA bears a government guarantee, the supply of securities is determined in the private sector. The issuer is the primary obligor to perform a series of administrative functions of servicing the pooled mortgages. For each pool, there can be only one issuer. The mortgage loans which back GNMA securities are fully amortizing. Each month the issuer must pass through the scheduled interest and principal payments as well as any additional loan prepayments and early recoveries of principal to the certificate holder. Under the "modified" pass-through approach, if borrowers fail to make timely payment on the mortgage, the securities issuers must make timely payments to the registered holders, using their own resources. In the event that an issuer fails to make timely payment, or otherwise defaults in the discharge of its responsibilities, GNMA will continue such payments to registered security holders. According to GNMA [1982]:

"As part of packaging of the pool, the issuer executes documents that assign all the mortgages to GNMA. These documents are deposited with the custodian and are not recorded unless there is a default and GNMA must take possession of the pool. Defaulted payments have amounted to a very small fraction of one percent of payments due under the program. Though billions of dollars are passed through every year, only $10,000,000 has had to be written off over the life of the MBS program."

Since the GNMA guaranty is backed by the full faith and credit of the U.S. government, GNMA certificate combines the nature of residential mortgages with those of fixed-income securities and provides the safety with some of the characteristics of an agency bond.

GNMA certificates are issued and available only in registered form in accordance with U.S. Treasury Department regulations. However, they are freely transferable and assignable. They are negotiable securities which can be bought and sold in same manner as other registered securities, such as common stocks or corporate bonds. The record date for the certificate is the last business day of the

7 Servicing of the pooled mortgages may be carried out on behalf of the issuer by another servicer, which must also be a GNMA-approved issuer. The sub-contract servicer may be allowed to supply funds to make advances to securities holders and to cover losses on foreclosures.


9 Each month GNMA receives the guaranty fee from issuers. Out of these funds, GNMA pays all it expenses and invests the remainder in Treasury securities as a reserve in the event of defaults by issuers. Besides these reserves that could be liquidated if needed, GNMA has the statutory right to borrow without limit from the U.S. Treasury, if this should ever be necessary in order to make payments to security holders.
month. Monthly payments are made to registered GNMA certificate holders by the issuer. Interest and principal are paid on the 15th of each month for debt due from the prior month. For example, interest and principal due on the mortgages January 1 are paid to the security holder on February 15. Hence, GNMA pass-throughs have a stated delay of 45 days on principal and interest payments.

A Ginnie Mae pool matures when payments of the last remaining mortgage(s) in the pool are due and made. Such final payments to holders shall be made only upon surrender of the outstanding securities to the issuer. The issuer must then transmit the matured certificates to GNMA\(^{10}\). A pool can be terminated prior to the final maturity date of the outstanding securities, provided that the issuer and all security holders agree to the termination. But the issuer may not terminate a pool unilaterally. Unless formal notification and evidence of mutual agreement are presented, GNMA won’t cancel its guaranty. All outstanding pool certificates must be returned to GNMA in order to obtain cancellation. The GNMA guaranty-fee requirements will cease in the month following the cancellation date\(^{11}\).

There are four markets for trading on GNMA securities: primary, secondary, forward and futures markets. The primary market is the market in which newly issued GNMA certificates are sold by mortgage bankers to investors. Thus, the volume of primary transactions are directly related to the volume of newly issued securities. Primary offerings are purchased from issuers. Newly issued securities are usually marketed by dealer, although the issuer may directly place the securities with a buyer. In practice, primary transactions can be made on either a cash or a delayed-delivery basis such as immediate settlement or up to six-month delivery. "Immediates" are usually offered by dealers rather than issuers. The immediate transaction for GNMA certificates is considered to be for settlement within the calendar month\(^{12}\).

The secondary market comprises all GNMA transactions except those done on a primary basis by the issuers. It is a decentralized dealer market, a relatively small number of large dealers makes the

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\(^{10}\) GNMA [1980], chapter 11.

\(^{11}\) GNMA [1980], chapter 13.

\(^{12}\) Settlement refers to an arrangement between buyers and sellers for payment of cash or receipt of securities. It represents the final consummation of a securities transaction on the delivery date. Suppose circumstances beyond the control of the seller make it impossible to make delivery of the securities on the specified delivery date, it is customary to make settlement on the earliest possible business day thereafter. In such case, the delayed settlement is made on the original figures for accrued interest. See *The Ginnie Mae Manual*. 
market. The principal amount of a secondary-market transaction will differ from the face amount of the certificate by the amount which has been amortized and prepaid since the issuance of the certificate. Trades are handled on a net basis of remaining principal plus accrued interest. Generally, institutional investors prefer to buy and trade securities which enjoy large secondary markets. They tend to avoid thin markets in which a large purchase or sale of securities will cause violent price fluctuations. Though the volume of GNMA secondary-market transactions is not kept, a volume figure can be estimated on the basis of reregistration. According to the GNMA 1981 Annual report, during the fiscal year (ending September 30, 1981), there are $50.7 billion of securities transferred among registered holders. However, it does not include securities traded without re-registration in the new holder’s name.

The forward market is a non-regulated market in which participants agree to trade GNMA certificates (usually primary issues) for delivery at some future date. Most new issues of GNMA are first offered for sale 15 to 60 days before the delivery date. Dealers will execute buy orders for new issues with a specific delivery date. For those not settled within the calendar month, it is said that GNMA securities are sold for forward delivery and commitment. A forward commitment (also quoted as firm commitment) is an arrangement requiring the seller to deliver the securities at a stated price. Dealers issue firm commitments to purchase or sell securities with stated certificate rate for delivery one to six months or more in the future. Prices on delayed delivery generally fluctuate with short-term interest rates. The price differential for forward deliveries depends upon the negative or positive interest carry. If short-term interest rates are lower than the available current yield of GNMA, forwards will probably be priced lower than immediates to offset the current return differential not earned due to delayed delivery. On the other hand, when short-term rates exceed those available on GNMA, a delayed delivery would sell higher than immediates.

Some dealers also offer standby commitments. Under a standby commitment, delivery is optional at the seller’s discretion. Standby commitments are usually associated with more distant delivery horizons (often 12 months). The purchaser or investor is paid a nonrefundable fee in return for a standby agreement to take delivery of the securities on a given date at a specific yield or price. The holder of a standby commitment has the right, but not the obligation, to make delivery. In essence, standby com-
mitments are "put" options traded over the counter\textsuperscript{13}. Some of these commitments contain a yield maintenance clause that allows the seller to deliver any GNMA coupon to the buyer, but only at the yield specified in the original commitment. The standby price or striking price, the yield, the time period and the commitment fee are negotiated between the purchaser (investor) and the seller (dealer) of the option. The striking price is generally set at a discount with respect to immediates. Unless interest rate rises substantially the option will not be exercised.

To summarize, the GNMA cash (also called "immediate" or "spot") market refers to the market in which transactions for purchase and sale of the physical commodity (as distinguished from futures contracts) are made for immediate delivery and payments. When "forwards" become "immediately" in the delivery month, the purchase and sale of these forward contracts are viewed as cash-market transactions.

The GNMA futures market is a central market in which standardized contracts for delivery up to two years in the future are bought and sold on a federally regulated exchange. Price is established by open-outcry auction. The details of the development and features of GNMA futures contracts are described in Section 3.

2. Literature Review on GNMA Securities

Much of the concern has focused on the pricing of GNMA mortgage-backed securities. The main subject is the propensity of mortgagors to prepay their loans prior to maturity which results in uncertain cash flows. For GNMA holders, prepayment means an unscheduled principal payment made because of mortgage default and/or early paybacks. The market convention is the 12-year prepayment assumption which posits that a 30-year mortgage will be prepaid in full at the end of the twelfth year while there are no prepayments for the first twelve years\textsuperscript{14}. However, actual prepayment experience on GNMA

\textsuperscript{13} The Chicago Board Option Exchange(CBOE) has proposed to open a new market for put and call options on GNMA. The schedule of opening this market is affected by the dispute over whether the Securities and Exchange Commission(SEC) or the Commodity Futures Trading Commission(CFTC) has regulatory jurisdiction over GNMA option. Besides, the Chicago Board of Trade(CBT) has worked on a plan for a market in options on GNMA futures contracts for submission to the CFTC. See Sullivan[1981] and Sinquefield[1982].

\textsuperscript{14} For 30-year single-family pools, 12-year is often referred to as the "half-life" of the pool which implies that half of the original principal amount is expected to be repaid at the end of the 12th year. Sometimes the term "12-year half-life" is also referred to as "12-year average-life." However, as Senft[1978] points out, average-life and half-life are not interchangeable terms. Average life is the weighted average of the principal payback periods, using the principal amounts as weights. Half-life is a function of the first half of the principal payments while average life is affected by all principal payments. Based on the 12-year
pools varies widely. Various studies of GNMA prepayment experience have shown that the average life has been significantly less than 12 years. Also, experience in recent years has shown that the higher coupon GNMAs are prepaying at a much faster rate than lower coupon GNMAs. (See Lamle[1981], Senft[1980] and Senft[1978].)

The issue of the 12-year prepayment assumption (or the so-called "rule-of-thumb") is first addressed by Curley and Guttentag [1977]:

"...we have started to study the GNMA pass-through program, which provides hard data on pricing errors in the form of dealer quotations on prices and yields. We find that errors are very sizable indeed, growing more sizable as the stock of pass-throughs ages and the range of contract rates widens. If this market is not reconstructed in some fundamental ways, it will eventually become a market for relatively new instruments only in which rule-of-thumb pricing errors are acceptable to lenders. This would of course mirror the experience of the mortgage market itself...."

They propose a method for estimating the value of an outstanding residential mortgage in which estimates of the prepayment probabilities are incorporated to determine expected future cash flows. It is emphasized that the entire distribution of termination possibilities and the reinvestment of prepaid balances must be included to calculate mortgage yield correctly. Brealey [1977] suggests that in an effort to value mortgages with termination provisions, one should explicitly consider the value of the borrower's repayment option.

Accordingly, Dunn and McConnell [June 1981] develop a contingent-claims model for pricing GNMA securities in which prepayment is treated as exercising a call option. Based upon a general equilibrium theory of term structure of interest rates under uncertainty, the contingent-claims model specifies the value of the borrower's call option attached to the underlying mortgage loans and allows different assumptions as to the term structure of interest rates. The contribution of their model is to specify two types of prepayment behavior in terms of current market interest rate. When mortgagors can refinance their existing loan with a similar loan bearing a lower contract interest rate, the call option (or prepayment of the original loan) will be exercised. This is referred to as "the optimal call" policy. However, it is observed that many mortgagors prepay their loans even when the market interest rate is

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prepayment assumption, the resulting average life is approximately 11.2 years.

above the contract rate on their existing loans\textsuperscript{16}. This type of prepayment is referred to as "suboptimal prepayments" in the sense that it occurs when the market value of the loan is less than the call price. The value of call option is assumed to depend solely on the interest rate and the suboptimal prepayments are assumed to follow a Poisson process within the continuous-time framework. Consequently, the value of a GNMA security is structured as a function of two state variables (interest rate and the Poisson variable) and its remaining term to maturity.

Furthermore, Dunn and McConnell [May 1981] use simulation and sensitivity analysis to compare alternative models for the pricing of GNMA mortgage-backed securities. The contingent-claims model is compared with the traditional 12-year average-life method and what they called "a variation of the Curley-Guttentag model" which is the percent of FHA method\textsuperscript{17}. The comparison of prices generated by these models indicates that differences in prices shown are significant. This is partly because different assumptions have been made for these models. Contrast to the yield-based models (i.e., the average-life method and the Curley-Guttentag model) which are discrete-time and certainty models with implicit assumption of a flat term structure, the contingent-claims model is a continuous-time and uncertainty model constructing upon a general equilibrium theory of term structure. It should be noted that under the assumption of a flat term structure the loan would never be called optimally.

Empirical concern has focused on the investment performance of GNMA certificates. With respect to the risk-return relationship, Garbade [1981] suggests the yield (or the internal rate of return) as the measure of the rate of return on GNMA security and the duration of a GNMA certificate as the measure of risk. Regarding the relative performance, it is suggested that yield spreads on pass-through securities are best measured by comparing pass-through yields to yields on comparable portfolios of Treasury securities, where comparability is defined in terms of equivalent future cash flows. However,

\textsuperscript{16} For example, the house is sold but the underlying mortgage is prepaid instead of being assumed by the new house owner regardless that market interest rate is higher than the original mortgage rate. When old mortgages are not assumed, they result in prepayments that flow directly to the pool participants.

\textsuperscript{17} The FHA experience is an updated set of statistics of prepayment and default patterns on single family mortgages assembled by the Actuarial Division of the Department of Housing and Urban Development. A pool with 100% experience is expected to prepay at the same rate as shown in FHA's mortality table. A pool having 200% FHA experience is assumed to be prepaid twice as fast as the FHA standard. But Curley [1981] claims that the "percent of FHA" method is a poor representation of the probabilistic model which they have suggested. It is argued that the percent of FHA method uses aggregate FHA data, while disaggregate data are used in their regression model. Specifically, the termination rate for a mortgage cohort in any year is explained by the contract rate relative to the rate on new mortgages, market discount on new mortgages and the relationship between the original maturity and the age of the cohort. Peters [1979] has extended their model to estimate prepayment rate and default rate separately.
the limitations of the yield concept and yield comparisons are well-known. The objections to the use of the yield as an investment criterion are based on the fact that yields depend on the coupon or payoff pattern. Given the same maturity, due to coupon effect, payments made by bonds with different coupons at the same point in time are not discounted at the same rate. Yields of bonds with different coupons generally will not lie along a smooth curve. Hence it is difficult to draw conclusion from the direct comparison of yields. Moreover, the yield to maturity is a derived number which is obtained from the market price, coupon and term to maturity. Yield to maturity does not determine price. Since payments made by the same bond at different points in time are all discounted at the same rate, yield is not an accurate measure of value. Nevertheless, many studies have used the yield-spread as a measure of relative investment performance for GNMA. (See Black, Garbade and Silber[1981], Connolly[1977], Haney[1978], Haney and Crenwelge[1979], Norgaard[1978].)

Dunn and McConnell [Winter 1981] construct monthly nominal rate of return for GNMA 8% securities over the period January 1971 through June 1978. The monthly return consists of four elements: the change in the security’s price, the coupon interest payment, the scheduled principal payments and the unscheduled principal prepayments. Both equally-weighted and value-weighted indices for all GNMA 8’s are constructed. The relative investment performance of GNMA over this period is indicated by comparing their returns with those earned on U.S. Treasury Bills and long-term government bonds. Over the period of study, the arithmetic mean annual return for the equally-weighted GNMA series was 6.70%, the annual average return for the value-weighted series was 0.012% higher. As for Treasury bills and long term government bonds, the mean annual returns were 5.05% and 5.93% respectively. In terms of the standard deviation of the monthly returns, they are 1.836% for the equally-weighted GNMA index, 1.837% for the value-weighted GNMA index, 0.122% for Treasury bill and 2.047% for long-term Treasury bond:

Observing that the mutual savings banks have increasingly introduced GNMA into their asset portfolios over the 1970’s, Wachtel [1981] develops a model of the demand for GNMA securities by the mutual savings banks. An analysis of portfolio substitutability indicates that the mutual savings

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18 See Brealey[1977], Fama and Miller[1972], Hirschleifer[1958], and Schaefer[1977].
banks speed up or down their accumulation of GNMA$s in response to the spread between short-term and long-term yields. He shows that while there is little indication of substitutability with long term yields (i.e., mortgages or corporate bonds), estimation of the model suggests strong substitution between GNMA$s and short-term assets (Treasury bills).

3. GNMA Futures Markets

Following the rapid growth of GNMA cash market and in response to rising interest rates during the early 1970s, the GNMA futures market emerged. In October 1975, the Chicago Board of Trade introduced the first interest-rate related financial futures, the GNMA futures contract. This futures market offers protection against interest rate risk inherent in the residential mortgage market. It also provides speculative opportunities for those with venture capital and the willingness to accept risk in the hope of profit\(^\text{19}\).

Although the cash GNMA market already permitted hedging and risk transfer through forward contract, there are several differences between the GNMA forward and futures markets. The differences are: (1) futures contracts are trading in a centralized market while forward contracts are made by individual dealers; (2) a futures contract is standardized while a forward contract is negotiated between buyer and seller; (3) futures trading requires an initial margin deposit and "marking to the market" daily and a maintenance margin is required to cover paper losses, while forward contracts are generally made without these requirements\(^\text{20}\); and (4) price limits on the extent to which futures prices are allowed to vary from day to day are placed on futures trading while there is no limit on daily price fluctuation for forward contracts.

There are two different contracts existing, the GNMA Collateralized Depository Receipt (CDR) contract and the Certificate Delivery (CD) GNMA futures contract. The GNMA-CDR contract was initiated by the Chicago Board of Trade (CBT) on October 22, 1975. Both the Amex Commodity

\(^{19}\) For the development and economic functions of GNMA futures, see Sandor (1975) and Stevens (1976).

\(^{20}\) Several financial fails have occurred in the GNMA forward market. See for example Garbade (1982), p. 304, footnote 6. Some dealers now request initial margin and mark outstanding contract to market associated with maintenance margins to cover accumulated losses.
Exchange (ACE) and the CBT began trading the GNMA-CD contracts on September 12, 1978. Later, the Commodity Exchange (COMEX) opened the GNMA-CD futures market on November 13, 1979. However, trading on the GNMA-CD contract is not active. There is no open interest for GNMA-CD contract since April 1982. At present, only the GNMA-CDR contracts are traded on the CBT. The open interest for the GNMA-CDR contract is 34,928 at the end of January 1983.

The GNMA-CDR contract is the original GNMA contract devised by the CBT. The GNMA-CDR delivery instrument is a receipt issued by a CBT-approved originator and signed by an approved depository which verifies the deposit of $100,000 principal balance of GNMA 8% certificates. At settlement, the long is invoiced at 1,000 times the settlement price (which is expressed as percentage of par in the increment of 1/32) plus accrued interest. Although the futures contract calls for delivering $100,000 of certificates, there is a $2,500 principal tolerance band which is settled in cash. In other words, one can deliver certificates of between $97,500 and $102,500 face value with the deficiency or excess to be settled in cash. Besides, coupons other than 8% are permissible delivery. If other coupons are delivered, the price is adjusted to the equivalent of $100,000 in GNMA 8% coupons, calculated at par under the assumption of a 30-year certificate with prepayment at the end of 12th year. Hence, a seller delivering a GNMA with a coupon of less (greater) than 8% would be required to deliver more (less) than $100,000 in face value. Delivery is made by CDRs which can be surrendered in exchange of actual certificates.

The GNMA-CD delivery instrument is a specific batch of GNMA certificates. The GNMA-CD contract has a feature called the "par cap" provision. Seller is prohibited from delivering a unit at a price in excess of the par. Therefore, coupons which exceed the current FHA/VA ceiling rate less 0.50 percent are not eligible delivery vehicles. At settlement, the long is invoiced at 1,000 times the settlement price plus accrued interest. All deliverable coupons shall be adjusted in price to provide for the

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21 The ACE has terminated trading on GNMA-CD contract in 1980. See Silber [1981]. In fact, the American Commodities Exchange has been merged into the membership of the New York Futures Exchange, see Wall Street Journal (July 11, 1980).

22 Open interest is the total number of futures contracts that have not been offset by opposite futures transactions nor fulfilled by delivery. Each open transaction has a buyer and a seller, but for calculation of open interest, only one side of the contract is counted.

23 Accrued interest is calculated at a rate of $635 per month (actual days) and is paid on the second to last business day of
equivalent yield of the 8% coupon at settlement price under the assumption of a 30-year certificate repaid in the 12th year. Delivery is made by actual GNMA certificates.

4. Empirical Studies on GNMA Futures Market

Concerning the economic role of futures trading, Froewiss [1978] has initially addressed the question of whether futures trading in GNMA certificates has stabilized or destabilized GNMA spot price. Arguing that futures market provides more information, it is hypothesized that futures trading might reduce the short-run variability in spot prices. The behavior of the GNMA spot prices before and after the inception of trading in GNMA futures is examined. Regressing the weekly percentage changes in spot GNMA prices on the weekly percentage changes in the prices of ten-year U.S. Government bonds (for the period of May 30, 1973 through December 28, 1977), the regression coefficient is used as a measure of the variability of GNMA prices relative to the variability of bond prices. It is argued that an increase in the coefficient after the beginning of futures trading would indicate the destabilizing effect of futures trading on the spot prices. It is shown that the coefficient appears roughly constant in both the period before and the period after the beginning of futures trading. Further, the autocorrelation analysis of GNMA spot prices suggests that the series could be represented as a second-order autoregressive process. F-tests show no statistically significant difference between the coefficients in the two sub-periods, but standard error of the regression in the second period is significantly smaller. It is inferred that while the systematic movements of GNMA prices have followed the same pattern in the period after as in the period before futures trading, the random fluctuations in spot prices have been reduced significantly. In summary, it is concluded that GNMA futures trading has had a stabilizing influence on the GNMA spot prices.

In contrast, Figlewski [1981] presents the finding which indicates the destabilizing effect of GNMA futures trading on the GNMA spot prices. In his study, a model of daily volatility in GNMA cash prices is constructed. Four factors have been included in the model: volatility in related markets, breadth and liquidity of the cash market, the level of GNMA prices and futures market activity. The standard deviation of day-to-day price changes is used as the measure of price volatility. Using daily
data from January 1975 through February 1979, the empirical result shows that futures trading in GNMA has increased the volatility of the cash market.

Simpson and Ireland [1982] provide the additional evidence that trading in GNMA futures did not affect the volatility of cash prices for GNMA certificates, either on a daily or weekly basis. A regression analysis and a multivariate time series model are employed. Daily time series consisted of 150 observations before and after October 20, 1975 and weekly series consisted of 124 observations (62 before GNMA futures began trading and 62 after). Instead of prices, they used the yield data on GNMA 8% certificates, ten-year U.S. Treasury bonds, and 10-year FNMA (Federal National Mortgage Association) securities. Change in yield on GNMA certificates is used as the dependent variable, while a dummy variable representing the time period before and after the initiation of GNMA futures contracts, change in yield on Treasury bond and change in yield on FNMA securities are used as explanatory variables. Tests of structural change were employed on the regression coefficients. Empirical results indicate that neither the slope nor the intercept terms changed in period after GNMA futures trading began. The time-series analysis suggests that the intervention event (the trading of GNMA futures) did not produce alteration of the weekly or daily volatility of GNMA certificate rates (yields).

Culberston [1979] investigates the effects of GNMA futures trading on the residential mortgage market. He indicates that the introduction of GNMA futures markets has improved the process of geographical arbitrage mortgage credit. As a result, the geographical spread of mortgage interest is reduced and the allocation of the credit market resources is improved.

Meehan [1981] tests the hypothesis of pricing efficiency in the GNMA futures market. Regarding the ability of market participants to earn higher profits than would be anticipated given the riskiness of the transactions, he argues that pricing efficiency will imply the elimination of excessive profits. His study has focused on arbitrage between the cash and futures markets whereby one will make or take delivery of the commodity. Assuming that the arbitrageur finances a long position in GNMA cash by short selling T-bills, if futures contract is overpriced, it would be profitable to make delivery (i.e., short futures). On the other hand, if futures contract is underpriced, the trading strategy of short-spot and

each month to the registered holder of the CDR. See CBT[1981] for details.
long-futures would be profitable. In order to short the spot market, it is assumed that securities from
the same pool can be reacquired or that the lenders of the shorted securities does not perceive any
difference between pools. Using 30 months of data on GNMA's (October 1975 to March 1978), trading
rules are developed to test for the existence of arbitrage profits. The empirical result indicates that
arbitrage opportunities were available. Moreover, the time series causality analysis suggests a tendency
for the futures market to lead the cash market. But in practice, the cash market continues to trade for
about an hour after the futures market has closed. Hence, he claims that the finding supports the
hypothesis that the GNMA cash market is not efficient.

A number of studies has focused on the hedging performance of GNMA futures market. In
terms of investor's objective, there are four approaches of hedging: risk avoidance, risk minimization,
profit maximization and portfolio performance. The traditional risk avoidance approach assumes that
hedger will take a position in futures market which is the opposite of his position in the spot market.
The portfolio approach is a combination of risk minimization and profit maximization, which assumes
that investor hedges to obtain the best combination of risk and return.

Bacon and Williams [1976] explain the nature of the GNMA futures contract and indicate several
ways in which hedges can be initiated. Ederington [1979] applies the portfolio theory to evaluate the
GNMA futures market as instrument for hedging. He suggests that the futures market's potential for
risk reduction can be measured by comparing the risk on an unhedged portfolio with the minimum risk
on a portfolio containing both spot and forward securities. The measure of hedging effectiveness used
is the percent reduction in the variance. Using weekly data for the period of January 1976 through
December 1977, the hedging effectiveness of GNMA futures market in 6.50% and 9% are examined. It
is found that the effectiveness measure for 9% certificates is higher than for either 8% or 6.50%
certificates for all two-week hedges. It is also noted that the average change in the basis tended to vary
inversely with the length of the futures contract. The hypothesis that short-term hedges in nearby
(two-week) contracts are more effective than hedges in more distant (four-week) contracts did not hold
for the GNMA market. The GNMA market appears to be more effective in reducing the price change

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24 See CBOT[1975], Ederington[1979], Kolb, Corgel and Chiang[1982], Plant[1976], Punturieri[1980], Sandor[1975] and
Stevens[1976].
risk over four-week than over two-week periods.

One of the aspects of the risk reduction effectiveness in portfolio management is the utilization of the GNMA contracts for cross-hedging. McEnally and Rice [1979] distinguish three alternative hedging strategies: the naive one-to-one hedge, the duration hedge and the historically optimal hedge. Using weekly price change data and a corporate index sample of Salomon Brothers and Standard and Poor’s indices from December 1976 to March 1977, their study indicates the presence of significant risk reduction using GNMA futures. Hill and Schneeweis [1982] appraise the usefulness of the interest rate futures market for cross-hedging. Applying the minimum-variance technique to hedging corporate bonds, they find considerable hedging effectiveness for using GNMA futures. They demonstrate that the risk of a long or short position in corporate bonds can be significantly reduced by an offsetting position in a GNMA future.

Kolb, Corgel and Chiang [1982] present a derivation of the optimal hedge ratio for hedging interest rate risk with a GNMA futures contract, assuming a flat term structure and risk-free rate as single state variable. Regarding the issue of cross-hedging, they propose the strategy that accounts for differences in the maturities and coupon structures of the instruments involved. It is suggested that hedging performance will be improved by periodic rebalancing of the hedge. However, the frequency of rebalancing will depend upon transaction costs, the size of hedging position and the expected volatility of interest rates.

Another concern is the problem associated with the delivery procedures25. It is noted that some uncertainty exists regarding the amount one would need to hold to make delivery. Since prepayment on these certificates might occur prior to delivery, the person in short position faces uncertainty about the quantity to be held at present in order to deliver $100,000 of certificate26. On the other hand, the person who accepts delivery of GNMA futures faces uncertainty regarding the type and relative market value of the certificates to be received. While trading is in 8% certificates, it may be cheaper to deliver some other coupons27. Consequently, those taking delivery may not receive $100,000 of 8% certificates.

26 In practice, the $2,500 tolerance in cash settlement alleviates the situation, but some uncertainty remains.
27 For example, in December 1978, GNMA 8's were selling at 90.83 percent of par and the 9's were at 95.47. In this case,
or their market equivalent.

Eckardt [1982] characterizes the delivery procedures in GNMA futures contracts. The explicit mathematical formula are provided to illustrate the delivery procedure mechanics. The existing "equivalent delivery" systems specify the market basket of acceptable securities for GNMA-CDR contract and GNMA-CD contract respectively. There will be a best coupon to deliver in the sense that seller of futures contract has the option to choose what to deliver. In his analysis, the GNMA-CDR futures short is considered as desiring to deliver the coupon that involves the minimum cost. As for GNMA-CD contract, the one in short position desires to deliver the coupon that minimizes the difference between the market price of $100,000 remaining principal balance and the adjusted settlement price. Assuming different shapes of term structure, he investigates the determination of the optimal deliverable security. He points out that the precise identity of the optimal coupon may also depend upon tax effects and prepayment assumptions (other than the conventional 12-year prepayment assumption).

Dealing with the same issue, Kilcollin [1982] analyzes the difference systems which allow substitution for the par grade of security to be delivered at premiums or discounts to the futures price. In his paper, futures market equilibrium with yield-based difference systems is characterized by maximizing the profit resulting from the spot market purchase of security for immediate delivery against an expiring futures contract. The decision variables are coupon and time to maturity of deliverable securities. Assuming no transaction costs together with the "no arbitrage" condition, futures market equilibrium is reached. There are two types of yield-based difference systems existing in futures market: the variable rate or yield maintenance pricing and the fixed rate or factor pricing. Yield maintenance pricing is in use for the GNMA-CD contract, whereas factor pricing is used for the GNMA-CDR contract. The difference system conversion factor is shown as a ratio of deliverable price of a security relative to the price of the par grade security where both are discounted at the rate specified by the difference system. Under factor pricing, the discount rate is the yield of the par security selling at par. For GNMA-CDR contract, GNMA 8's selling at par has the yield of 7.955% with 12-year prepayment assumption on the

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the conversion factor for delivering GNMA 9's is .991677 which means $93,167.70 is the required principal equivalency of $100,000 GNMA 8's. While the cost of delivering GNMA 8's is $90,830, it is cheaper to deliver GNMA 9's at the cost of $88,947.20. See Figlewski [1981], p. 451.
30-year mortgage. For GNMA-CD contract, the discount rate in the conversion factor is the yield of the par security selling at the futures price (the settlement price). Empirical result shows that in the period of January 1976 to June 1980 the GNMA-CD contract was always optimal to deliver the highest coupon, but this was not always the case for the factor pricing GNMA-CDR contracts. He concludes that generally both difference systems produce optimal (but not constant) delivery securities. Optimal delivery securities may be lower-coupon lower-maturity securities under factor pricing than under yield maintenance pricing\(^{28}\). Under both systems, the optimal securities to deliver depend on the term and coupon structures of interest rates, but factor pricing also depends on the general level of interest rates relative to the coupon rate on the par security. Therefore, there is greater uncertainty about the identity of the optimal delivery securities under factor pricing. Further, he indicates that the difference systems provides the explanation on the phenomenon of backwardation that futures price is systematically lower than the corresponding spot price of the par security, it can be shown that the magnitude is greater under yield maintenance pricing.

5. Conclusion

In an attempt to investigate issues been raised in the field of GNMA cash and futures markets, this paper has reviewed the relevant previous studies. The fundamental issue is the pricing problem. To this date, no empirical test is made on the pricing of GNMA securities due to the availability and quality of data. The valuation of futures contract involves the relative pricing of GNMA cash and futures. It is clear that the theory of term structure of interest rates plays an important role in valuing these instruments. The on-going development of option on GNMA securities and option on GNMA futures contract will enlarge the investment opportunity set of GNMA related instruments. The integration and interrelation of these GNMA instruments become a subject which needs much further work.

\(^{28}\) It should be noted that there is no specified maturity for GNMA securities due to the possibility of prepayment.
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