An Empirical Note on Hedging Mortgages with Puts

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Due to the existence of prepayment options, hedging fixed-rate mortgages against interest-rate risk represents a complex problem (Batlin (1987)). For instance, Sandor and Mains (1985) have explained that, due to basis and liquidity problems relating to prepayment uncertainty, GNMA futures contracts can not be used to effectively hedge spot GNMA positions.[1] In addition, Jones and Jain (1987) have shown that, because of the change in price convexity caused by prepayment options, mortgages can not be hedged by merely taking static short futures positions on other contracts.

To solve the problem, Batlin (1987) has suggested using a complex T-bond futures trading strategy that used dynamic hedge ratios which are similar to the construction of synthetic put options in portfolio insurance schemes (Etzioni (1986)). However, Jones and Jain (1987) and Murphy (1989) have hypothesized that mortgages can be hedged more simply with actual put positions on T-bond or T-note futures contracts whose value equals that of the mortgages being hedged. Both Jones and Jain (1987) and Murphy (1989) have provided isolated empirical examples that support their hypothesis. In addition, Murphy (1989) has supplied supporting evidence using a subjective probability distribution.

This note examines the hypothesis that simple put positions can hedge mortgage portfolios against interest-rate risk.[2] End-of-the-quarter prices on the second nearest T-note and T-bond futures contracts, the nearest-to-the-money put options on these contracts, and 11 GNMA coupons for the interval June 1985 through June 1988 are obtained from Data Resources, Inc. (DRI) and are used in this evaluation. Using one-to-one hedge ratios as suggested by both Jones and Jain (1987) and Murphy (1989), two separate put hedges using T-note and T-bond futures are constructed along with, for comparison, two short futures hedges on separate T-note and T-bond contracts. In each strategy, the market value of the GNMAs are hedged with short futures contracts (T-notes or T-bonds) of

[1]With volume of only a few hundred contracts a day one month after its initiation in June 1989, the CBT's newest GNMA contract does not seem to have resolved these problems.

[2]A previous study of using futures and options to hedge GNMAs has been undertaken by Lacey and Chambers (1989). The authors found that use of options in hedging strategies did not materially improve hedging performance in reducing portfolio variation. However, the authors did not examine any downside risk parameter. In addition, GNMA futures prices were used as proxies for cash GNMAs, and the prices of these contracts are subject to bizarre and erratic swings due to uncertainty over the optimal coupon pool that will be delivered, as well as due to illiquidity distortions (Sandor and Mains (1985)). Thus, serious doubt must be cast on the validity of their results. In the conclusion, the authors suggested that a separate study of hedging true cash GNMAs be conducted.

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equal value or with long futures puts on an equivalent number of futures contracts. The results of the four separate hedging strategies are evaluated for each GNMA coupon as well as for an equal-weighted portfolio investment in all 11 coupons. Because the maximum downside risk as well as overall variation is important to hedgers, the strategies are compared on both maximum value loss and value standard deviation criteria.

The results are shown in Table I. The performance of the two put hedges is fairly similar, with both consistently having much lower maximum losses over the sample interval than either short futures strategy and with both having fairly low standard deviations. For an equal-weighted portfolio of GNMAs, the put strategies have the lowest standard deviation and lowest possible maximum loss. However, it is important to note that the relative performance of the put strategies is better for the higher coupons than for the low coupon mortgages whose prepayment options are out-of-the-money, are less valuable, and are not necessarily optimally hedged using near-the-money puts. For the lower coupon mortgages, whose durations or weighted-average maturities are typically longer, deep-in-the-money puts on T-bond futures contracts might represent more effective hedges (Jones and Jain (1989)).

A further experiment was conducted to determine the performance of each hedge if the *ex-post* optimal hedge ratio had been known *ex-ante*. Using Ordinary Least Squares (OLS), the regression coefficient that minimized the summed squared errors was used as the hedge ratio for the equal-weighted portfolio of GNMAs (Benninga, Eldor and Zilcha (1984)). The results at the bottom of Table I indicate that short T-note hedges could have minimized the portfolio standard deviation, but put hedges continued to minimize the maximum loss by a substantial margin while having only a slightly higher standard deviation. It is interesting to observe that use of *ex-post* optimal hedge ratios did not materially improve the put hedging strategy performance, and that use of the simple one-to-one put hedge ratios yielded far lower maximum possible loss levels than the short futures hedges using even *ex-post* optimal hedge ratios.

It is also important that the maximum quarterly loss of 1.6–1.9% for the portfolio hedges that use puts would be more than offset by the constant 2.625% quarterly coupon income from the GNMA portfolio. These results indicate that it is empirically possible to insure GNMA portfolios against negative total returns with put hedges.

For many GNMA investors, such as heavily leveraged financial institutions, the far superior performance of put strategies in reducing downside risk can be vital for survival. For instance, financial institutions with capital equal to only a few percent of assets can be severely hurt by losses on investments of only a few percent. This note therefore should be especially useful to mortgage investors and also to their regulators and federal deposit insurers.[3]

[3]As explained briefly in the text and by both Murphy (1989) and Jones and Jain (1987), the hedging performance of futures puts can be improved by use of more puts (and/or synthetic puts in the form of short futures positions combined with long calls) with different exercise prices. However, these results do not provide any evidence on the adequacy of the various hedges in reducing thrift equity risk. For instance, beside mortgage interest-rate risk, the equity values of thrift institutions are subject to many other factors such as: variation in operating costs, deposit rates and flows, and defaults on mortgage investments. In addition, stock market factors such as equity risk premiums (Merton (1980)) may vary widely and cause substantial variation in thrift equity values that are unrelated to mortgage values (for instance, during October 1987, GNMA prices soared while thrift equity values dropped substantially). Experiments using an equal-weighted index of all thrift stocks which traded on the NYSE over the sample interval and which were considered to be "low-risk investors in fixed-rate mortgages" (arbitrarily defined as having over 50% of assets invested in fixed-rate 1–4 family mortgages and mortgage-backed securities, having delinquency rates on mortgage investments below 5%, having default rates on mortgage investments below 1%, and having capital in excess of 3% of assets according to Generally Accepted Accounting Principals or GAAP) provided no evidence supporting the use of futures and options to hedge thrift equity risk. In particular, at the .05 level, no statistically significant correlation was found between thrift stock values and T-bond and T-note futures puts.

Table I
ANALYSIS OF PRICE CHANGES FOR DIFFERENT HEDGING STRATEGIES
(Quarterly Data, 1985–88)

GNMA Coupon	Standard Deviation for: No Hedge	T-Note Hedge Put	T-Note Hedge Futures	T-Bond Hedge Put	T-Bond Hedge Futures	Maximum Loss for: No Hedge	T-Note Hedge Put	T-Note Hedge Futures	T-Bond Hedge Put	T-Bond Hedge Futures
Using 1-1 Hedge Ratios										
8%	4.8%	3.0%	1.9%	2.7%	5.2%	−8.0%	−2.8%	−6.7%	−2.9%	−16.4%
8.5	4.7	2.8	1.9	2.5	5.2	−7.6	−2.5	−6.5	−2.3	−16.3
9	4.6	2.8	2.2	2.5	5.5	−7.1	−2.8	−7.6	−2.5	−17.3
9.5	4.3	2.6	2.4	2.4	5.7	−6.5	−2.3	−8.3	−2.1	−18.0
10	4.1	2.6	2.6	2.5	5.9	−5.9	−2.5	−8.7	−2.3	−18.4
10.5	3.7	2.4	2.7	2.4	6.1	−5.6	−3.3	−8.7	−2.9	−18.4
11	2.9	1.9	3.4	2.1	6.7	−4.5	−2.2	−9.8	−2.8	−19.5
11.5	2.2	1.9	4.0	2.2	7.4	−3.2	−1.7	−10.9	−3.0	−20.7
12	1.7	1.8	4.4	2.3	7.8	−2.3	−1.8	−11.1	−3.2	−20.9
12.5	1.3	1.9	4.8	2.4	8.2	−1.9	−1.7	−11.5	−2.9	−21.2
13	1.1	2.0	5.1	2.5	8.5	−1.7	−1.6	−11.7	−2.8	−21.5
All	3.1	1.8	3.0	1.8	6.5	−4.9	−1.8	−9.2	−1.9	−19.0
Using *Ex-Post* Optimal Hedge Ratios										
All	3.1%	1.8%	1.4%	1.7%	1.8%	−4.9%	−1.8%	−3.5%	−1.6%	−3.7%

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