

**Concentration and Risk in the OTC Markets for  
U.S. Dollar Interest Rate Options<sup>\*</sup>**

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### *Introduction*

This report evaluates concerns that concentration in the over-the-counter (OTC) markets for U.S. dollar interest rate options poses significant risks to participants, including Government Sponsored Enterprises (GSEs) and the leading bank and nonbank derivatives dealers. Those concerns, which have been expressed by Federal Reserve officials, foreign authorities, and private analysts, include: (1) the potential for exit of a leading dealer to result in options market illiquidity and the potential effects of illiquidity on the housing GSEs and other hedgers of mortgages and mortgage-backed securities (MBS); (2) market risks to dealers from meeting the demands for options by mortgage hedgers, including whether data indicating that the notional value of options sold by dealers significantly exceeds the notional value purchased are accurate and, if so, whether dealers are assuming significant risks; and (3) potential counterparty credit losses to market participants in the event of the failure of a leading dealer or one of the GSEs.

The extent to which these concerns are valid depends on how effectively market participants manage market risk and counterparty credit risk. To obtain information on their risk management practices, during the summer of 2004 staff interviewed Fannie Mae, Freddie Mac, several Federal Home Loan Banks (FHLBs) and the FHLB System's Office of Finance, a large mortgage servicer, and seven leading bank and nonbank OTC derivatives dealers. The interviews covered the firms' current policies and procedures and their experiences during the stressful market conditions of July and August 2003.

### *The Markets*

The best data on the size of the OTC U.S. dollar options markets are the semi-annual data collected by central banks and aggregated by the BIS. These data showed that as of December 31, 2003 the aggregate notional principal amount of options outstanding was \$8.7 trillion. Concentration was relatively high—the four largest dealers accounted for 48 percent of the total—but had been declining for the last couple of years. By comparison, the four largest dealers accounted for about 40 percent of the \$37.5 trillion market for U.S. dollar interest rate swaps and forward rate agreements at year-end 2003. As will be discussed, the intermediation process for options is considerably more complex than for swaps, which may make it more difficult for smaller dealers to expand their activity or for new dealers to enter the markets.

The most important source of demand for these options is from mortgage investors who purchase options to hedge mortgage prepayment risk. According to dealers, Fannie Mae and Freddie Mac together account for more than half of options demand when measured in terms of the sensitivity of the instruments to changes in interest rate volatility (rather than notional amounts). Mortgage servicers are the second most important source of demand, and their share reportedly has grown as consolidation among servicers has

placed a larger share of servicing rights in the hands of active hedgers. Both mortgage investors and mortgage servicers also dynamically hedge prepayment risk with interest rate swaps.<sup>1</sup> The more hedging they undertake through purchases of OTC options (or, in the case of the GSEs, through their own issuance of callable debt), the less they need to rely on dynamic hedging, which can be ineffective in volatile or illiquid markets.

The most important source of supply of interest rate options is investors in callable debt issued by the FHLBs, banks and insurers, nonfinancial corporations and local governments. Many callable debt issuers sell to dealers OTC call options with terms identical to the call options embedded in their debt. Several years ago FHLB System issues were an especially important source, but in recent years, some FHLBs have been selling fewer options because they are using their callable debt to hedge their own growing holdings of mortgages. Investors in structured notes (bonds with embedded options such as caps on floating interest rates) are a second important source. These investors include retail investors, banks, and insurers, mostly in Asia and Europe. A third source of option supply is U.S. financial institutions that fund themselves with option-embedded liabilities, such as FHLB convertible advances. With low interest rates holding down the demand for such advances, they currently are a small part of the total. Hedge funds have become an important source of supply and market liquidity, especially when increases in interest rate volatility have caused spikes in option prices. Market participants interviewed by staff describe hedge funds as a significant stabilizing force in the options markets.

OTC derivatives dealers intermediate between options buyers and sellers. However, the terms of the options they purchase often differ from the terms of the options they sell. As discussed below, these mismatches leave dealers exposed to basis risk. The short-dated options markets generally are the most liquid and continuous, whereas the supply of longer-dated options is illiquid and essentially episodic.

The dealer market is divided into two tiers. Only the first tier of half a dozen or so dealers has direct access to ample supply from the issuers of callable debt and the investors in structured notes. A second tier of fifteen or so dealers relies heavily on the first tier for supply via the inter-dealer market. Both tiers of dealers sell options to mortgage hedgers, including Fannie Mae and Freddie Mac.

July and August 2003 was a stressful time in U.S. fixed income markets, including the options markets. Indeed, options dealers interviewed by staff said it was the most stressful period in their experience. Some trading continued to take place in the options market throughout the stress period, but at higher-than-usual bid-ask spreads. Contrary to market commentary at the time, demand for options during the stress period came not from the GSEs but from mortgage servicers and from dealers. Earlier in 2003 dealers had accommodated significant demands from the GSEs and other hedgers and some had not yet rebalanced their books. On the supply side, dealers identified the willingness of hedge

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<sup>1</sup> While the bulk of the dynamic hedging is done using swaps, some is done with Treasuries or mortgage-backed securities.

funds to sell options following spikes in implied volatility as a key stabilizing force in the market.

### *Evaluation of Concerns*

Options Market Illiquidity. The degree of dealer concentration in the options markets indicated by the BIS data raised concerns that in the event of a sudden exit of a leading dealer (for example, an involuntary exit as a result of a ratings downgrade) market liquidity might be impaired and mortgage hedgers (especially Fannie Mae and Freddie Mac) might have difficulty managing prepayment risk. For their part, the GSEs see little risk that exit of a leading dealer would impair market liquidity. Measured by notional values, the GSEs purchase anywhere from 40 to 55 percent of their options from the largest four dealers. Each purchases options from around 20 dealers, including significant purchases from a second group of six to eight dealers.

The GSEs believe that in most dealer exit scenarios the second group of dealers would step up their activity if one of the top tier were to exit. However, they understand that the ability of second-tier dealers to provide liquidity, either from the interdealer market or by tapping the ultimate sources of options supply, will depend on the circumstances surrounding the dealer exit. For example, without established client relationships, second-tier dealers might find it difficult to tap the ultimate sources directly, and the exit of a top tier dealer might reduce liquidity in the inter-dealer market. Indeed, dealers have disparate views of the potential effects of the exit of a top tier dealer; some believe that the remaining top tier dealers would promptly expand their activity while others believe that they would scale back their activity in such an event. Which view is correct is likely to depend on the reason for the exit. If a dealer were forced to exit because of a credit problem unrelated to its options dealing, other dealers are likely to quickly take its place. If the exit were the result of losses from options dealing, possibly in difficult market conditions, other dealers with similar positions are likely to be pulling back as well.

In any event, even if exit of a leading dealer temporarily impaired market liquidity, the GSEs do not see themselves as dependent on continuous access to liquidity in the options markets. They purchase long expiry options periodically and opportunistically, with a view to limiting their reliance on dynamic hedging of their MBS portfolio in the interest rate swaps markets. Provided that options market illiquidity was not protracted (say more than a month), they could postpone transacting in those markets until liquidity returned, without exceeding their internal risk limits.

It is the liquidity of the swaps market, where they conduct their dynamic hedging, that the GSEs depend on. The swaps markets are less concentrated and easier to intermediate than the options markets. Still, as the GSEs are aware, dealers' internal risk limits ultimately limit the GSEs' capacity to hedge dynamically. Fannie significantly increased its use of options hedges following the summer of 2002, when its duration gap substantially exceeded its target range of  $\pm 6$  months. Going into the summer of 2002, Freddie had made significantly greater use of options hedges than Fannie.

During the July and August 2003 stress episode, both GSEs reported that they were able to stay within their risk tolerances despite the relative lack of liquidity in the options market and the illiquidity in the swaps market. During the episode, the GSEs did not actively buy options, but waited until the fall, when market conditions had settled, to re-enter the options market. The GSEs and other hedgers of mortgage convexity risk did engage in some additional dynamic hedging with swaps during July and August. This increase in one-directional trading was one factor contributing to the reduced liquidity and wider spreads in the swaps market during that period.

Market Risks to Dealers. Articles that appeared in the financial press in early 2004 called attention to the fact that the BIS data show that the notional value of U.S. dollar interest rate options sold by OTC derivatives dealers exceeds the notional value of options purchased. This difference has been growing as the options markets have grown and reached \$829 billion in notional value (15 percent of options purchased) as of year-end 2003. Although data on notional values of options purchased and sold are not by themselves sufficient to make reliable assessments of dealers' market risks, the disparity between options sold and purchased certainly warrants further analysis.

Our interviews (and bank dealers' internal risk management reports) indicate that dealers run fairly well-balanced books in terms of risk sensitivities, despite the fact that they write more options than they purchase. Dealers limit their exposure to changes in implied volatilities (the "vega" of their trading book). They also limit their exposure to sudden, discrete changes in the level of interest rates (the "gamma" or "convexity" of their trading book), either explicitly or implicitly through trading limits based on value-at-risk (VAR) and stress tests. However, the limits on gamma do not appear to be as pervasive across the industry as those on vega.

The notional mismatch arises because of differences in the types of options bought and sold by dealers. In general, the risk sensitivities (vega and gamma) of an option per dollar of notional value vary dramatically depending on its terms, including the maturity and "moneyness," that is, the extent to which an option is into or out of the money. To accommodate their customers' needs, dealers tend to buy longer-term at-the-money options, which have more vega (that is, more sensitivity to changes in implied volatility) per dollar of notional value than the shorter-term out-of-the-money options they sell. The preferred hedges for MBS are short-to-medium-dated options with strike rates 50 to 100 basis points above or below current rates. The options that dealers purchase from sellers of callable debt tend to be longer-term, especially those purchased from issuers of callable trust preferred securities, and have strikes set at current rates. To limit the overall vega of their trading books, dealers must sell a larger notional amount of options than they buy.

Nonetheless, the complexity of the intermediation process leaves dealers with several significant risks that are difficult to hedge. First, because the options that dealers purchase have different maturities and moneyness than the options they sell, dealers are exposed to basis risk, that is, the risk that implied volatilities could move in a non-parallel way across maturity or moneyness. Second, because the terms of options purchased and

options sold differ in important ways, a change in interest rates or implied volatilities will cause the risk sensitivities of options purchased and options sold to move away from each other. In response, dealers would need to buy or sell additional options to rebalance their books, leaving the dealers vulnerable to options market illiquidity. Third, the options that dealers purchase tend to be more exotic and include early-exercise features (American-style options), while the options they sell tend to be more plain vanilla and without early-exercise features (European options). The former tend to be less liquid and harder to value, thus dealers are exposed to liquidity risk and model risk.

Consistent with these observations, interviewed dealers reported taking only small losses during the July and August 2003 stress episode. The losses that they did incur had two sources. First, some dealers entered the stress episode with some exposure to upward movements in interest rate volatilities (negative vega), either as a result of meeting customer demand for options during the falling interest rate environment of May and June or because of a short-term trading view that markets were in for a quiet summer. After the stress episode began, these dealers were able to close their short positions out before losses became large by buying options from hedge funds. Second, dealers that had sold short-maturity options and bought long-maturity options took losses as short-dated implied volatility spiked during the stress episode. Here again, the willingness of hedge funds to sell short-maturity options greatly limited the losses to the dealers. Had no source of supply emerged, their losses could have been much larger but probably not so large as to jeopardize these very large diversified intermediaries.

Potential Credit Losses. Participants in the OTC derivatives markets typically manage their counterparty credit risks by transacting only with highly creditworthy counterparties, by entering into legal agreements with counterparties that provide for closeout netting of gains and losses and, with one important exception, by agreeing to collateralize net exposures above a threshold amount. The exception is that Triple-A counterparties often are not required to post collateral. All the major participants in the U.S. dollar interest rate options markets that we spoke with follow these practices. All are considered highly creditworthy: the GSEs are rated Triple-A, and all the GSEs' dealer counterparties are rated Single-A or higher. All transactions in options, swaps, and other OTC derivatives between the a GSE and a dealer and between two dealers are documented under master agreements that provide for cross-product netting (across options, swaps, and other OTC derivatives) and collateralization of unrealized gains and losses (with the exception noted above).

As a result, again with the exception of some exposures to the Triple-A-rated GSEs and dealers, current credit exposures on OTC derivatives (net exposures measured at current market rates), net of collateral held to offset those exposures, tend to be \$50 million or less. Fannie Mae and Freddie Mac historically have not posted collateral. As an alternative to collateralization, both GSEs have in the past been willing to reduce the exposures they represent to their dealer counterparties by "recouponing," that is, by conforming the terms of outstanding swap contracts to prevailing market rates and paying the dealer an amount equal to the present value of the changes.

To be sure, in volatile markets net exposures can change rapidly and significant exposures can arise before collateral can be collected, so that potential future credit exposures, even net of collateral, can be much larger than current exposures. Estimates provided by the GSEs of their own exposures and those of their counterparties suggest that potential future exposures to individual counterparties are still small relative to the capital of market participants.

While these estimates seem reassuring, they do not take into account the potential effects on market prices and market liquidity of a market participant's failure and the subsequent efforts by its counterparties to replace their contracts with the failed participant. In the case of a dealer's failure those effects would be limited by the structure of dealers' portfolios, which, while quite large, generally do not feature large net open positions.

In the case of failure of a GSE, these effects could be quite significant but are likely to be offset by other factors. As noted above, the GSEs are large net purchasers of interest rate options. They also are large net fixed-rate payers on interest rate swaps. If a GSE failed, its counterparties would need to sell huge volumes of options (individually and especially in the aggregate) and receive fixed rates on a very large volume of swaps. Other things equal, these actions by dealers would send options prices and swap spreads tumbling. However, other things would not be equal; the failure of a GSE undoubtedly would create uncertainty and risk aversion, which would place considerable upward pressure on options prices and swap spreads. The net effect of these forces is not clear, so it is not clear that dealers' efforts to replace their contracts with a GSE would cause their credit exposures to the GSE to exceed their potential future exposure estimates. Nonetheless, we recommend that participants in the interest rate options markets make more of an effort to think about counterparty risk and market risk in an integrated way when evaluating counterparty credit exposures to large players. For example, market participants might consider stress tests that look at their exposure to market moves in a scenario where a large firm comes under stress. Such scenarios could jointly consider the effects of counterparty default, liquidation of the counterparty's portfolio, and subsequent market risks of their portfolio.

#### *Summary of Key Conclusions*

The OTC markets for U.S. dollar interest rate options clearly are playing a critical role in meeting demands for fixed-rate home mortgages. Without such instruments the GSEs and other mortgage holders that are unwilling to bear prepayment risks would either need to pare back their holdings or rely more heavily on dynamic hedging. Decreased supply of fixed-rate mortgages would be reflected in higher fixed rates, while increased dynamic hedging would be accompanied by greater interest rate volatility, especially at turning points in interest rate cycles.

Dealer concentration in the interest rate options markets is fairly high, but the risks resulting from that concentration seem to be reasonably well managed. Fannie and Freddie have about twenty dealers as options counterparties. However, only about five or six have access to the ultimate sources of options supply; the others must depend on the inter-dealer market for a substantial portion of their supply. The exit of a leading dealer

may or may not adversely affect market liquidity, depending on the reason for the exit and on how other dealers react. In any event, the risk management strategies of the GSEs and other mortgage hedgers rely on continuous liquidity in the swaps markets, not the options markets, and there is less concentration in the swaps markets. Both Fannie and Freddie have analyzed how much up-front options protection they need so as not to overwhelm the capacity of the dealer community to absorb their residual dynamic hedging needs in the swap markets.

Although the notional value of options sold by dealers greatly exceeds the notional value of options they purchase, the dealers limit their exposure to changes in implied volatilities (vega) and also limit their exposure to sudden, discrete interest rate changes (gamma), albeit less strictly than their vega. Dealers do assume significant basis risks and their hedging strategies are dependent on options market liquidity when rates and volatilities are changing rapidly. Hedge funds have been critical suppliers of liquidity during such periods. If the options markets were to become illiquid, dealers would suffer significant losses, but the losses probably would not be large enough to jeopardize such large diversified intermediaries.

Market participants generally seem to be managing their counterparty credit risks to the dealers fairly effectively, with widespread use of collateral agreements. Provided that counterparties do not assume large net positions in illiquid markets, collateral is a powerful means of limiting counterparty credit losses. The GSEs do assume very large net positions in the options and swaps markets. But the potential market impact of dealers' actions to close out and replace those positions following a GSE failure are likely to be substantially offset by the effects of the increases in uncertainty and risk aversion that would be certain to accompany a GSE's failure. Nonetheless, we recommend that participants in the interest rate options markets make more of an effort to think about counterparty risk and market risk in an integrated way when evaluating counterparty credit exposures to large players.