



GSE Risks

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Almost two years ago, in a speech at a conference hosted by the Office of Federal Housing Enterprise Oversight (OFHEO), I argued that government-sponsored enterprises (GSEs) specializing in the mortgage market, especially Fannie Mae and Freddie Mac, exposed the U.S. economy to substantial risk, primarily because their capital positions are thin relative to the risks these firms assume (Poole, 2003). I had a number of specific risks in mind, but did not elaborate the nature of these risks. My purpose here is to provide that elaboration. I will concentrate on risks facing Fannie Mae and Freddie Mac, but it should be understood that the Federal Home Loan Banks raise many of the same issues.

An understanding of the risks facing Fannie Mae and Freddie Mac—which I will sometimes refer to as “F-F” to simplify the exposition—is important from two perspectives. First, investors should be aware of these risks. Although many investors assume that F-F obligations are effectively guaranteed by the U.S. government, the fact is that the guarantee is implicit only. I will not attempt to forecast what would happen should either firm face a solvency crisis, because I just do not know. What I do know is that the issue is a political one, and political winds change in unpredictable ways.

A second reason to understand the risks is that sound public policy decisions depend on such understanding. To reduce the potential for a financial crisis, risks need to be mitigated.

Fannie Mae and Freddie Mac face five major sources of business risk: credit risk, prepayment risk, interest rate risk from mismatched duration of assets and liabilities, liquidity risk, and operational risk. A sixth risk, so-called political risk, arises from the possibility of regulatory or statutory revisions that could adversely affect those who hold the firms’ debt or equity. I’ll discuss these risks in turn, devoting much more time to some than others. Along the way, I will also discuss an extremely important point concerning the frequency of occurrence of large interest rate changes. This issue is critical to understanding the risks of any strategy involving incomplete hedging.

CREDIT RISK

Credit risk occurs because homeowners can and do default on mortgage loans. Even though default rates on mortgages in the United States are low, in recent years less than 1 percent, they are not zero and vary considerably across regions. Credit risk on mortgages can be handled, as in fact Fannie and Freddie do very effectively, through a policy of geographic diversification and of not

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buying a significant number of high loan-to-value mortgages, as well as through the use of mortgage insurance and guarantees.

In assessing credit risk, it is important not to focus just on national average conditions. For example, although average house prices in the United States have not declined year to year since the Great Depression,¹ prices have declined in particular significant markets. Some examples would be Boston 1989-92, Los Angeles 1991-96, San Francisco 1991-95, and Texas 1987-88. More formally, the dispersion of changes in house prices and not just the national average is relevant for judging mortgage default risk.

Given that house prices do sometimes decline in particular markets, it is possible that a geographically diversified portfolio of mortgages could suffer significant losses. Therefore, to determine the capital a firm needs to hold against credit risk requires not only analysis of the geographical diversification in the portfolio but also an analysis of risks and likely losses given foreclosure in various housing markets. From everything I know, Fannie and Freddie do a fine job of managing credit risks, but I am not one who believes credit risks can be ignored.

PREPAYMENT RISK

Fannie Mae and Freddie Mac issue mortgage-backed securities (MBS) against pools of conforming mortgages—mortgages with dollar value at or below the conforming limit that qualifies the mortgages for F-F operations. All such mortgages have no prepayment penalties and are therefore subject to prepayment risk.

In finance lingo, these fixed-rate mortgages carry a call option. In the event that interest rates fall during the life of the mortgage, the homeowner can exercise the option to refinance the mortgage, effectively calling the outstanding high interest rate mortgage and replacing it with a new lower

interest rate obligation. Historically, the exercise of this option was constrained by relatively high transaction costs. In recent years, however, transaction costs have fallen considerably so that the call option in the typical fixed rate mortgage instrument comes in-the-money with relatively small declines in mortgage rates. Such refi activity has been substantial in recent years.

When Fannie and Freddie issue MBSs to be held by the investing public, buyers of the bonds assume the prepayment risk. Fannie and Freddie service the MBSs and guarantee them, thus assuming the credit risk.

However, for many years F-F have been accumulating a portfolio of their own MBSs and directly owned individual mortgages. For the two firms together, these portfolios are very large, amounting to over \$1.5 trillion at the end of 2003. Thus, F-F assume prepayment risk by holding these assets.

Under the most conservative financial strategy, Fannie and Freddie could mitigate completely their prepayment risk by issuing long-term callable bonds to finance their holdings of long-term mortgage assets. With such a strategy, the cash inflow from the assets matches exactly the cash outflow required to service the liabilities, and interest rate and prepayment risk are perfectly hedged.

A DIGRESSION ON FINANCIAL ENGINEERING

In practice, both Fannie and Freddie make limited use of long-term callable bonds. Rather, they issue non-callable long-term bonds and a significant amount of short-term debt. Doing so exposes F-F to prepayment risk and interest rate risk from a mismatch of duration of assets and liabilities. They then use various devices to manage the risks created.

Before discussing the ways F-F manage prepayment and interest rate risk, it is worth noting that the more elaborate portfolio policy has nothing whatsoever to do with the mortgage market per se. Consider this analogy: An investment company could own a portfolio of long-term corporate bonds, most of which become callable at

¹ This statement may or may not be strictly accurate. Annual data on national average new home prices from the U.S. Census start in 1963 and show small declines in the late 1960s and early 1990s. Annual data for the median sales price of existing single-family homes from the National Association of Realtors start in 1968 and do not exhibit any annual declines.

some point before maturity. When interest rates fall, corporations call such bonds and refinance with lower-rate bonds. The phenomenon is exactly the same as that observed in the mortgage market, except that corporate bonds have a certain number of years of call protection when issued and pay a call premium when called.

As far as I know, there are no closed-end investment companies that hold a portfolio of corporate bonds, financed by their own issues of short and long debt. The reason, I conjecture, is that there is no implied federal guarantee on such obligations, which means that an investment company could not earn a satisfactory spread from holding a portfolio of marketable corporate bonds financed by its own obligations.

The GSEs, however, have the benefit of the implied federal guarantee, which makes their financial engineering profitable. Because of the implied guarantee, F-F can operate with a small capital position and issue their own obligations at rates that are little above those paid by the U.S. Treasury. The spread over Treasuries is smaller at the short end of the maturity structure than at the long end, which is why F-F issue large amounts of short-term debt. This financial engineering has little to do with the mortgage market, except that F-F are authorized to hold mortgages rather than corporate bonds in their portfolio. The financial engineering has nothing to do with the mortgage market per se and everything to do with the implied federal guarantee.

INTEREST RATE RISK

Fannie and Freddie create interest rate risk for themselves by financing their portfolio through a mixture of long-term non-callable bonds and short-term obligations. Both firms have obligations due within one year in the neighborhood of 50 percent of total liabilities.

Having created prepayment and interest rate risk by not matching the characteristics of their obligations to the characteristics of their mortgage assets, F-F must then pursue sophisticated hedging strategies. They employ debt and interest rate swaps to create synthetic long-term obligations—a short-term obligation plus a fixed-pay swap effec-

tively creates a cash flow obligation that mimics that of a long-term bond. They also use options—in particular, swaptions—to hedge the prepayment risk.

Finally, like many large financial firms, Fannie Mae and Freddie Mac employ a strategy of *imperfect dynamic hedging*, which involves three steps: “(1) Maintain very complete hedges against the likely, near-term, interest rate shocks; (2) Use less complete hedges or even no hedges for longer-term and less likely rate shocks; (3) Implement additional hedges as interest rate levels change, and the unlikely becomes likely” (Jaffee, 2003, pp. 16-17). The term “dynamic hedge” refers to a strategy that involves continuous rebalancing of the firm’s portfolio in an attempt to maintain acceptable risk exposures. A dynamic hedging strategy can be quite successful when prices move continuously, in small steps, but is increasingly ineffective the larger are price discontinuities, or price jumps.

The advantage of using derivatives and imperfect dynamic hedging to manage interest rate risk is that these strategies are less costly than the perfect hedge and perform equally well when the interest rate volatility is moderate. The disadvantage is that potential losses associated with the unlikely risks can be very large.

- Because of imperfect dynamic hedging, F-F may suffer a significant loss whenever there are unexpected and large interest rate movements in either direction. Formal models of dynamic hedging assume price continuity and do not work well when prices jump discretely by large amounts.
- Fannie Mae and Freddie Mac are exposed to the counterparty default risk in their derivative contracts. The counterparty default risk per se may be small because both firms require all counterparties to post collateral on a weekly basis. However, at a time of disrupted financial markets, it would be very costly to replace the swap positions of a defaulting counterparty because the other counterparties are likely to have similar problems.

JUDGING THE SCALE OF INTEREST RATE RISK

Without highly detailed information about the hedging strategies pursued by F-F, it is impossible to offer a quantitative assessment of the scale of interest rate risk to which the firms are exposed. However, the fact that hedging is incomplete raises warning flags. The reason is that standard hedging strategies rely on the assumption that changes in securities prices follow a normal distribution—the familiar bell-shaped curve. The Black-Scholes formula for pricing options assumes, for example, that asset prices follow a normal distribution.

To judge risk, we start by computing the standard deviation from a long history of price changes in some particular market. The normal distribution is the baseline case. What we in fact observe are “fat tails,” by which we mean that there are many more large price changes—changes out in the tails of the distribution—than expected with a normal distribution of the calculated standard deviation. Failure to take adequate account of fat tails is responsible for many failures of financial firms over the years, such as the 1998 failure of Long Term Capital Management.

A key security in the context of the mortgage market is the 10-year on-the-run Treasury bond. Long-term mortgages are priced off the 10-year Treasury, and Treasury bonds themselves, because they are traded in a highly liquid market, are employed extensively in hedging strategies. Price changes for the Treasury bond for about 25 years are shown in Figure 1. The vertical axis measures the daily percentage price change, and the dashed bands define a range plus and minus 3.5 standard deviations from the mean.

The first thing to note in this figure is the frequency of large changes. Roughly 0.75 percent of the Treasury bond price changes in the sample are greater in absolute value than 3.5 standard deviations, more than 16 times the number of such outliers that would be expected from a normal distribution of price changes. Let me repeat—there are 16 times more price changes in excess of 3.5 standard deviations than expected with the normal distribution. Assuming 250 trading days in a year, on average bond price changes of this

or greater magnitude in absolute value occur twice per year instead of once every 8 years. The normal distribution provides a grossly misleading picture of the risk of large price changes. Really large changes of 4.5 or more standard deviations—the ones that can break a highly leveraged company—occur only 7 times in a million under the normal distribution, but there are 11 such changes in the 6,573 daily observations in the figure.

A second point to note from the figure is that large changes tend to cluster together. It appears that markets go through periods of relative volatility and other periods of relative tranquility. Clustering is important because a firm may be rocked several times in quick succession by large, unanticipated price changes. Incomplete hedges against large price changes expose a firm to cascading failure.

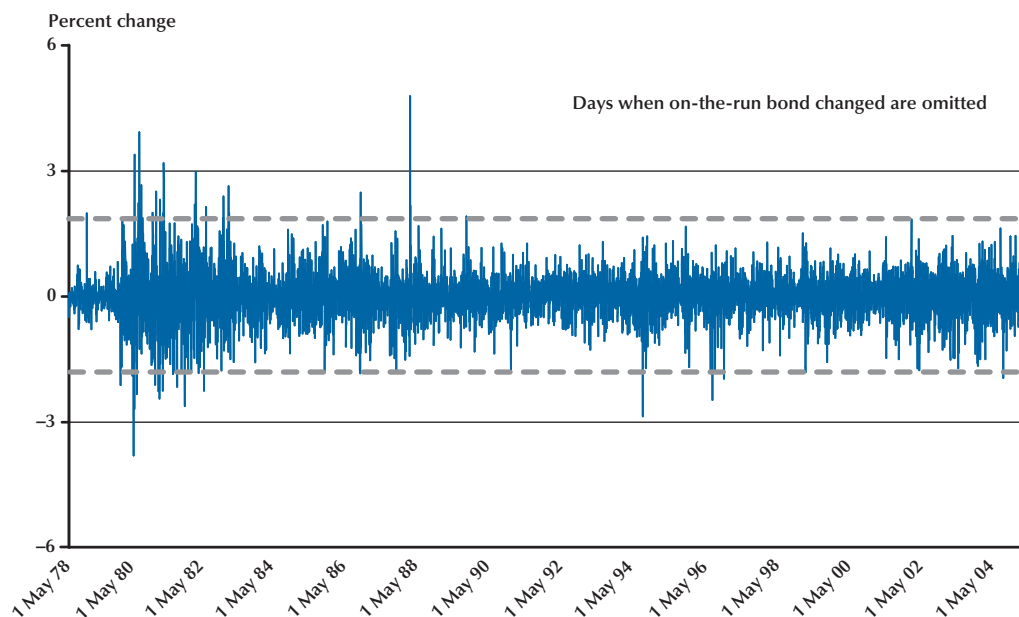
The fat tails phenomenon has been documented for a wide range of financial instruments over many different sample periods. Benoit Mandelbrot and Richard Hudson refer to these features as “wild randomness” (Mandelbrot and Hudson, 2004, p. 32). They conclude:

Extreme price swings are the norm in financial markets—not aberrations that can be ignored. Price movements do not follow the well-mannered bell curve assumed by modern finance; they follow a more violent curve that makes the investor’s ride much bumpier. A sound trading strategy or portfolio metric would build this cold, hard fact into its foundations.

Robert Engle characterizes returns in financial markets this way: “Returns are almost unpredictable, they have surprisingly large numbers of extreme values, and both the extremes and quiet periods are clustered in time. These features are often described as *unpredictability*, *fat tails*, and *volatility clustering*” (Engle, 2004, p. 407).

MANAGING INTEREST RATE RISK

In my speech to the OFHEO conference almost two years ago, I emphasized the risk of systemic, worldwide financial crisis should either

Figure 1**Trading Day Percentage Changes in On-the-Run 10-Year Treasury Note**

NOTE: Dashed lines show a range of ± 3.5 standard deviations.

Fannie Mae or Freddie Mac become insolvent. The argument was the same as that stated so clearly by Richard Posner in his recent *Wall Street Journal* op-ed article (Posner, 2005, p. A12) on the Indian Ocean tsunami. Posner writes:

The Indian Ocean tsunami illustrates a type of disaster to which policy makers pay too little attention—a disaster that has a very low or unknown probability of occurring, but if it does occur creates enormous losses...The fact that a catastrophe is very unlikely to occur is not a rational justification for ignoring the risk of its occurrence.

Of course, the loss of scores of thousands of lives in the tsunami is not to be compared to the losses from a financial crisis. Nevertheless, the two disaster cases illustrate another important point about risk management. In the case of the tsunami, nothing can be done about the probability of occurrence; loss mitigation depends on

installing warning systems. In the case of the risk of financial crisis, the key policy intervention is to reduce the probability of the event, by such methods as increasing the amount of capital firms hold.

I am also arguing that the risk of financial problems at Fannie Mae and/or Freddie Mac are not as remote as it might seem, because of the fat tails of the distribution of price changes in asset markets. These two observations—enormous potential costs and a probability of failure higher than commonly realized—imply that the risks of very large events must be identified and carefully analyzed through extensive “stress testing.” Then, adequate controls must be instituted to mitigate the identified risks.

This is exactly the approach that Mandelbrot and Hudson recommend: “So what is to be done? For starters, portfolio managers can more frequently resort to what is called stress testing. It means letting a computer simulate *everything* that could possibly go wrong, and seeing if any of the

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possible outcomes are so unbearable that you want to rethink the whole strategy” (Mandelbrot and Hudson, 2004, p. 267).

By this criterion, incomplete hedging of longer-term and less likely interest rate shocks is not an adequate risk management strategy for GSEs. Capital ratios that are not tested against extreme events do not adequately mitigate the interest rate risk faced by such institutions.

LIQUIDITY RISK

Fannie Mae and Freddie Mac must roll over roughly \$30 billion of maturing short-term obligations every week. At a time of disrupted financial markets, the credit markets might refuse to accept the F-F paper. “Fannie Mae and Freddie Mac recognize this risk and both firms indicate they maintain sufficient liquidity to survive for some time (3 months or longer) without access to rollover markets...[However,] the U.S. General Accounting Office (1998) has also pointed out that holding securities in their investment portfolios for liquidity purposes represents a highly profitable arbitrage for [both firms], since the return on the assets exceeds the cost of the agency bonds used to fund the positions” (Jaffee, 2003, p. 16). Therefore, if Fannie Mae and Freddie Mac are unable to sell new debt, then they may also be unable to carry out sales of the “liquid” securities from their investment portfolio.

I discussed liquidity risk at some length in a speech last spring (Poole, 2004). I won’t repeat that analysis, but the bottom line is simple: The Federal Reserve has adequate powers to prevent the spread of a liquidity crisis, but cannot prevent a solvency crisis should Fannie or Freddie exhaust their capital. In the event of a solvency crisis, the market would become unreceptive to Fannie and/or Freddie obligations; they would have difficulty rolling over their maturing debt. Moreover, their outstanding obligations would decline in price and their markets would become less liquid. Beyond that, it is hard to say exactly what else might happen.

OPERATIONAL RISK

In the past two years, there have been surprising news reports of accounting irregularities, first at Freddie and more recently at Fannie. In both cases senior executives have left the firms and audit attestations have been questioned. Both firms have been required to restate earnings for a number of years. Investigations by OFHEO, the SEC, and the Department of Justice are ongoing.

Accounting problems were not on my radar screen when I first became concerned about GSE risk. The recent revelations are another example of our inability to predict shocks that will impact our financial system. Even though the assets F-F hold are relatively simple—residential real estate mortgages and mortgage-backed securities—the firms themselves are complex organizations because of their scale and the financial engineering they employ. The accounting problems provide an example of operational risk; other aspects of F-F operations, such as the automated underwriting procedures, are also subject to operational risk. It remains to be seen how the accounting restatements will affect the market’s view of F-F earnings and capital adequacy. Clearly, though, F-F need to hold capital against operational risk.

POLITICAL AND REGULATORY RISK

From a narrow market perspective, a key issue is whether the federal government would bail out Fannie Mae and/or Freddie Mac should the solvency of either firm be threatened. But that is too narrow a perspective, even for a holder of F-F obligations.

If there were a solvency crisis, the outcome would certainly involve extensive changes in the powers and characteristics of the firms. Institutions holding F-F obligations, direct or guaranteed, would most likely have to alter their portfolio practices. Moreover, even if the federal government bailed out F-F, their obligations might be redeemed eventually but cease to trade actively in liquid markets. Finally, there is of course no guarantee that the federal government would in

fact bail out F-F. Many observers, myself included, believe that a bailout would not be a good idea.

The bottom line is that there is substantial uncertainty over the future regulatory structure that will apply to Fannie Mae and Freddie Mac and over the likely behavior of the government should the solvency of either firm come into question.

CONCLUDING REMARKS

My purpose has been to provide an outline of all the risks facing Fannie Mae and Freddie Mac. There are six risks to consider: credit risk, prepayment risk, interest rate risk from mismatched duration of assets and liabilities, liquidity risk, operational risk, and political risk. Much more could be said about each of these risks, but I thought it would be useful to discuss each of them briefly in order to have a complete catalog.

I've particularly emphasized the importance of facing up to the implications of low-probability events. A low probability must not be treated as if it were a zero probability. Moreover, extensive evidence from many different financial markets, reinforced by similar findings in commodity markets, indicates that price changes in asset markets are characterized by fat tails. The probability of large price changes is much higher than suggested by the familiar normal distribution. In the case of the 10-year Treasury bond, changes of 3.5 standard deviations or more are 16 times more frequent than expected under the normal distribution.

More generally, the probability of shocks of many sorts may be higher than one would think. The accounting problems that surfaced at both Fannie and Freddie would surely have been assigned a very low probability two years ago. Unlike the situation in financial markets, where a wealth of data permits some formal probability estimates, the probability of other sorts of events is much more difficult to judge. For this reason, I believe that the capital held by F-F should be at a level determined primarily by the cushion

required should an unlikely event occur rather than by an estimate of the probability itself. It may be that the highly volatile interest rate environment of the early 1980s is extremely unlikely to recur, but I would like to see F-F maintain capital positions that would enable the firms to withstand such an environment anyway.

One thing I think I know for sure is this: An investor who ignores the risks faced by Fannie Mae and Freddie Mac under the assumption that a federal bailout is certain should there be a problem is making a mistake.

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