

**The GSE Implicit Subsidy  
and Value of Government Ambiguity**

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**Abstract**

The housing-related government-sponsored enterprises Fannie Mae and Freddie Mac (the “GSEs”) have an ambiguous relationship with the federal government. Most purchasers of the GSEs’ debt securities believe that this debt is implicitly backed by the U.S. government despite the lack of a legal basis for such a belief. In this paper, I estimate how much GSE shareholders gain from this ambiguous government relationship. I find that (1) the federal government’s implicit subsidy of Fannie Mae and Freddie Mac has resulted in a funding advantage for the GSEs over private sector institutions, (2) the actions of GSEs result in slightly lower mortgage rates for some homeowners, (3) the government’s ambiguous relationship with Fannie Mae and Freddie Mac imparts a substantial implicit subsidy to GSE shareholders, (4) the implicit government subsidy accounts for much of the GSEs’ market value, (5) the GSEs would hold far fewer of their mortgage-backed securities in portfolio and their capital-to-asset ratios would be higher if they were purely private, and (6) the GSEs’ implicit subsidy does not appear to have substantially increased homeownership or homebuilding.

## **The GSE Implicit Subsidy and Value of Government Ambiguity**

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### **Introduction and Summary**

The housing-related government-sponsored enterprises Fannie Mae and Freddie Mac (the “GSEs”) have an ambiguous relationship with the federal government. Most purchasers of the GSEs’ debt securities believe that this debt is implicitly backed by the U.S. government despite the lack of a legal basis for such a belief and despite the fact that the prospectus for each GSE security clearly states that GSE debt is not backed by the government.

The markets’ impression that the government implicitly backs Fannie Mae and Freddie Mac is based on the GSEs’ history, on the size of their portfolios, on the fact that the government mandates housing goals for these firms, and on the many indicia of explicit government support. For example, the government provides the GSEs with a line of credit from the Department of the Treasury, fiscal agency services through the Federal Reserve, U.S. agency status for GSE securities, exemptions from securities registration requirements, exemptions from bank regulations on security holdings, and tax exemptions. The result is an ambiguous relationship between the GSEs and the federal

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1. The opinions, analysis and conclusions of this paper are solely mine and do not necessarily reflect those of the Board of Governors of the Federal Reserve System. I wish to thank Gillian Burgess, Mary DiCarlantonio, and Paul Landefeld for their excellent research assistance. I also wish to thank my colleagues at the Federal Reserve Board for their useful and constructive comments.

government in which investors infer government support while government officials deny it.<sup>2</sup>

In this paper, I estimate how much GSE shareholders gain from this ambiguous government relationship. In particular, I use a standard discounted earnings model to estimate the proportion of Fannie Mae's and Freddie Mac's market value that can be attributed to their GSE status. I refer to this estimated amount as their implicit government subsidy.<sup>3,4</sup>

I draw six conclusions from my study:

- The perception that the federal government backs the obligations of Fannie Mae and Freddie Mac has resulted in a funding advantage for the GSEs over private sector institutions; this advantage has averaged roughly 40 basis points from 1998 through the first half of 2003.
- The actions of GSEs result in slightly lower mortgage rates for some homeowners; my best estimate suggests a reduction of around 7 basis points.

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2. During his recent testimonies before Congress, Secretary of the Treasury John Snow explicitly denied there was any implicit government guarantee of the GSEs (September 10, 2003, and October 16, 2003). There have been a variety of legislative proposals to reform the GSEs, although they generally do not deal with the subsidy directly (see Nott and Jickling, 2003).

3. The Congressional Budget Office calculated the GSE subsidy in a similar manner (CBO, 1996 and 2001), although they calculated the net present value of the implicit subsidy embedded in recent debt issuance during a given year, not the value embedded in all debt outstanding. Some critics of their studies have argued that, since the GSEs do not receive a direct appropriation from the government, the term "subsidy" is inappropriate. I have tried to be more precise about the implicit nature of the GSE subsidy. Also note that both my technique and CBO's technique understate the value of the implicit subsidy to Fannie Mae and Freddie Mac because they ignore the reduced size of the GSEs that would result from removal of this ambiguous relationship. Without this relationship, the GSEs could no longer hold some assets profitably at market interest rates.

4. Applying standard equity valuation formulas to the GSEs is complicated by the fact that, historically, GSE earnings growth rates often exceed most reasonable estimates of the discount rate, suggesting that investors should plow all their earnings back into these firms. I, like many others, assume in my projections of GSE earnings that GSE growth eventually will be capped by the growth of the overall mortgage market.

- Fannie Mae’s and Freddie Mac’s ambiguous relationship to the government imparts an implicit subsidy to GSE shareholders and homeowners. In dollar terms, the gross value of this subsidy is estimated to be between \$119 billion and \$164 billion, of which the shareholders retain between \$50 billion and \$97 billion. Under my “middle-of-the-road” assumptions, the GSE shareholders retain roughly 52 percent of the gains from their ambiguous government relationship or about \$72 billion.
- My calculation also suggests that roughly 42 percent to 81 percent of the GSEs’ market value is due to their implicit government subsidy. Of course, if the GSEs’ implicit subsidy is eliminated, their market value may not fall as much as suggested by these estimates because they would reorganize themselves. Indeed, without the “political risk” of changes in their GSE status, their price-to-earnings ratios might actually rise.
- If the GSEs were purely private, in the sense that their returns on equity and their returns on assets were similar to those of other large financial institutions, they would hold far fewer of their own mortgage-backed securities in portfolio and, as a consequence, would be much smaller organizations. Their capital-to-asset ratios would be more than double their current capital-to-asset ratios.
- The GSEs’ implicit subsidy does not appear to have substantially increased homeownership or homebuilding because the estimated effect of the GSEs on mortgage rates is small.

My estimates span a wide range because the data that are currently available do not allow more precise estimates. However, while better data on mortgage rates and agency debt spreads would yield a more precise estimate of the GSEs’ implicit subsidy, even on the basis of current data I conclude that the value of the federal government’s ambiguous relationship to GSE shareholders is positive, very large, and does not seem to

result in either a substantial reduction in mortgage rates or an increase in homeownership.<sup>5</sup>

### **A Discounted Earnings Model of GSEs' Implicit Subsidy**

The Federal National Mortgage Corporation (“Fannie Mae”) and the Federal Home Loan Mortgage Corporation (“Freddie Mac”) are government-sponsored enterprises (GSEs) chartered by Congress. The discounted present value of the gross implicit subsidy to GSE shareholders ( $S_0$ ) is :

$$S_0 = \sum_{t=1}^n \frac{(r_t^{private} - r_t^{GSE})D_t + f_t^{GSE} MBS_t + Ex}{(1 + d_t^e)^t} \quad (1)$$

where  $r$  is the weighted-average yield (weighted across maturities) on debt (with a superscript for either private corporations or GSEs),  $d^e$  is the equity discount rate (using the Treasury yield curve and an estimate of the equity premium<sup>6</sup>),  $D$  is the outstanding GSE debt,  $f^{GSE}$  is the portion of the fee on mortgage-backed securities earned as a result of the special status of the GSEs,  $MBS$  is the stock of mortgage-backed securities,  $n$  is the investor’s time horizon for discounting, and  $Ex$  is the value of tax exemptions and other explicit advantages.<sup>7</sup>

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5. Fannie Mae and Freddie Mac have sponsored a number of studies criticizing the type of analysis undertaken by CBO and, by implication, the analysis undertaken here. In particular, see Gross (2003), Fannie Mae (2001), Pearce and Miller (2001), and Toevs (2001).

6. My measure of the equity premium is constructed with equity analyst earnings forecasts, employing an approach similar to that used in Sharpe (2002).

7. A different method of estimating the value of the GSE implicit subsidy is to value the implicit credit guarantee extended by the government using actuarial or option pricing methods. Gatti and Spahr (1997) take this approach when examining Freddie Mac and conclude that “Although FHLMC’s level of capital exceeds requirements, the federal government still bears a nontrivial portion of FHLMC’s risk.” For a discussion of different methods of GSE subsidy estimation, see Feldman (1999) and Kane (1999).

The GSEs may pass some of the subsidy on to homeowners in the form of lower mortgage rates. The present value of homeowner savings ( $H_0$ ) from the GSEs' perspective is:

$$H_0 = \sum_{t=1}^n \frac{(m_t^{nongse} - m_t^{conform}) M_t^{conform}}{(1 + d_t^e)^t} \quad (2)$$

where  $m$  is the mortgage rate (with a superscript indicating the rate either on a conforming mortgage or on a similar mortgage in a comparable, but hypothetical, non-GSE world) and  $M^{conform}$  is the stock of conventional, conforming mortgages purchased by the GSEs. (Conforming mortgages are mortgages that the GSEs are permitted to purchase under their charter.<sup>8</sup>)

The present value of the after-tax subsidy value of the GSE charter retained by the GSE shareholders is:

$$Net\ Subsidy = (S_0 - H_0)(1 - \tau_{GSE}) \quad (3)$$

where  $\tau$  is the average tax rate on GSE earnings.

In this paper, I simplify this calculation by assuming that GSEs influence mortgage rates in proportion to their yield advantage on debt. If this proportion is called  $\omega$ , then:

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8. The GSEs also hold non-mortgage securities in portfolio and the issuers of these securities might also benefit from the GSE implicit subsidy. However, I do not account for this benefit here because Congress's intent was for the GSEs to benefit homeowners and not other types of borrowers. In addition, the GSEs' purchases of mortgages may or may not affect the rates on conforming mortgages that are not purchased by the GSEs. However, given the GSEs' cost advantages, the GSEs probably purchase almost all of the truly conforming mortgages. In general, a broader social welfare calculation would include these as well as many additional components, including the tax effects associated with households' lower mortgage payments, the possible taxpayer costs if a GSE defaulted, the GSEs' effects on mortgage market efficiency and innovation, and the possible employment losses due to capital reallocation toward the GSEs and away from other business investments. In this paper, I focus on the factors that directly affect GSE earnings.

$$m_t^{nongse} - m_t^{conform} = \omega(r_t^{private} - r_t^{gse}), \quad (4)$$

and I can rewrite equation 3 as:

$$Net\ Subsidy = (1 - \tau_{GSE}) \sum_{t=1}^n \frac{(r_t^{private} - r_t^{GSE})(1 - \omega\delta)D_t + f_t^{GSE} MBS_t + Ex}{(1 + d_t^e)^t} \quad (5)$$

where  $\delta$  is the ratio of all mortgages purchased by the GSEs divided by GSE debt outstanding. The parameter  $\omega$  can be interpreted as the proportion of the funding advantage from the GSE implicit government guarantee that is passed through to mortgage rates. Equation (5) calculates the present value of GSE earnings due to the implicit subsidy; in an efficient market, this amount would be factored into the GSEs' stock prices.

To illustrate how this calculation works, I use the median values from the simulations described later in the paper, which assume a 25-year horizon and then discount the projected cash flows, and derive the net subsidy using equation (5). These results are shown in table 1.

The values in the table do not align exactly with the values of the more complete simulation analysis discussed later in this paper. That analysis also accounts for the covariance among variables, the variability in possible paths for GSE debt and mortgage growth, and the mean-reverting evolution of interest rates and growth rates. For example, the GSE debt advantage is highly correlated with long-run Treasury rates. This advantage increases when rates are low, particularly during “flights to quality” by investors in the bond market. A static analysis cannot capture this relationship. In addition, a dynamic analysis allows me to quantify the importance of imprecise measurements. Nonetheless, I illustrate this approach using the median values from the simulation, demonstrating its simple and straightforward nature.

**Table 1**  
**Net Subsidy Calculation Using Median Simulation Values over 25-Year**  
**Projection Periods**

<i>Concept</i>	<i>Equation Symbol</i>	<i>Median Value</i>
1. GSE Debt Advantage	$r^{Private} - r^{GSE}$	40 basis points
2. GSE Pass-Through	$\omega$	16.7 percent
3. Ratio of Mortgages and MBS to Debt	$\delta$	209 percent
4. Discounted Debt Outstanding (Averaged)	$(1/25) * \sum D_t / (1 + d_t^e)^t$	\$1.28 trillion
5. GSE MBS Advantage	$f^{GSE}$	2 basis points
6. Discounted MBS Outstanding (Averaged)	$(1/25) * \sum MBS_t / (1 + d_t^e)^t$	\$2.48 trillion
7. Discount Rate	$d_t^e$	8.9 percent
8. Gross Debt Subsidy	$(r^{Private} - r^{GSE}) \sum D_t / (1 + d_t^e)^t$	\$127 billion
9. Gross MBS Subsidy	$f^{GSE} * \sum MBS_t / (1 + d_t^e)^t$	\$12 billion
10. Exemptions Value	$\sum Ex / (1 + d_t^e)^t$	\$6 billion
11. Total Gross Subsidy	Sum of lines 8, 9, and 10	\$146 billion
12. Homeowners Savings	$\omega \delta (r^{Private} - r^{GSE}) \sum D_t / (1 + d_t^e)^t$	\$45 billion
13. Tax Rate	$\tau_{GSE}$	26 percent
14. Net Subsidy	$(1 - \tau_{GSE})(\text{line 11} - \text{line 12})$	\$77 billion

**The Subsidy Value of GSE Debt**

The GSEs have lower borrowing costs than other highly-rated institutions. These lower borrowing costs reflect the widespread belief that the government is unlikely to let a GSE fail. This perception results, in part, from the housing-related GSEs having been established as federal government entities to carry out specific government policies. In addition, despite their subsequent privatization, these institutions continue to have government missions. This confers upon the GSEs a special status in the eyes of many investors. Moreover, in a host of other ways, the GSEs are able to operate on more favorable terms than many other privately-owned entities. For example, they have a small line of credit from the Department of the Treasury, and their debt can be held in unlimited amounts by commercial banks.

Numerous efforts have been made to estimate the value of the GSEs' advantages when issuing debt. Ambrose and Warga (1996) compared GSE bonds to non-GSE corporate debt and concluded that the GSEs had about a 100 basis point yield advantage when issuing debt. CBO (1996) relied on Ambrose and Warga's work as well as conversations with market participants to develop their estimates of the subsidy; they argued that the GSEs had a 70 basis point advantage in debt issuance. Treasury (1996) undertook a similar calculation, collecting its own data on the debt advantage, and concluded that the GSEs had a 55 basis point advantage in debt issuance. When GAO (1996) undertook a similar exercise, it stressed the wide range of estimates that could be calculated when attempting to compare the yields on GSE debt.

More recently, CBO (2001) argued that the GSEs had a 15 basis point advantage on short-term debt (debt with less than one-year maturity and not synthetically extended using a swap) and a 47 basis point advantage on long-term debt, implying an overall funding advantage of 41 basis points on all GSE debt securities. Ambrose and Warga (2002) expanded and updated their work for CBO and, depending on the risk rating of the corporations used for comparisons, found that the GSE advantage varied from 25 basis

points to 80 basis points. A review of these and other similar studies can be found in Nothaft, Pearce, and Stevanovic (2002).

The wide range of debt subsidy estimates reflects the lack of data, the timing of the studies, and the difficulties of comparing GSE funding activities with those of other corporations. Data on corporate and GSE debt yields and amounts of debt outstanding prior to the mid-1990s are limited and of questionable quality. As for timing, the size of the GSE advantage varies with the value that investors place on very safe, quasi-government assets. Around the time of the 1990-91 recession and after the Russian debt default in 1998, the GSE advantage was larger than during the middle of the 1990s. Hence, studies of the GSE debt advantage using mainly data from the middle of the 1990s find smaller advantages than studies using data from before or after this period.

Finally, the GSEs differ in many ways from all potential competitors. For one thing, they are treated better than AAA-rated firms by the markets, as indicated by the willingness of private investors to accept yields that are lower than those paid by other AAA firms. In addition, the GSEs issue debt more frequently and in larger amounts than any other company, so their debt issues tend to be more liquid. Furthermore, they make extensive use of derivatives to change their debt maturities, including issuing substantial amounts of callable debt, for which there are almost no private sector comparisons. Many financial corporations would like to be able to replicate these actions of the GSEs if only they could do so at a reasonable cost.

The GSEs believe that these funding strategies provide them with the lowest-cost funding, given that they must manage the prepayment risks associated with holding mortgages. Because of this prepayment risk, one cannot assume that all GSE funding will take place at the maturity where there is the greatest subsidy advantage. The GSEs appear to have a substantial funding advantage at very long maturities because the implicit GSE guarantee seems to assure investors that the GSEs will not suffer a rating downgrade or default in the far future—an assurance that no other private corporations can provide. But the GSEs cannot fund all assets with very long-maturity debt because

homeowners might prepay their mortgages earlier than expected. To hedge against unexpectedly large prepayments, the GSEs need to fund with a mix of swaps, options, short-term debt, and long-term debt, complicating the comparison of GSE debt yields to those for other corporations.

GSE debt is also far more liquid than most corporate debt. Fannie Mae and Freddie Mac argue that this liquidity comes from scale economies and efficiencies of operations (see Gross, 2003; Nothaft, Pearce and Stavanoic, 2002). However, in addition, the greater liquidity of GSE debt is enhanced by its GSE status. The larger volume of GSE debt issuance reflects their large size, which reflects their GSE funding advantage. And the depth of the market for GSE debt—retail customers, foreign central banks, mutual funds that advertise themselves as investing only in government-related securities, and many trusts that invest only in the safest of assets—reflects the GSEs’ U.S. agency status. The GSEs are able to successfully issue large volume “benchmark” issues, whereas corporations like Ford have failed in similar efforts. (Nothaft, Pearce and Stavanoic (2002)) estimate that additional liquidity lowers GSE yields relative to comparable corporate yields about three to six basis points.

### **A Method for Estimating the GSE Funding Advantage**

As outlined in the top panel of exhibit 1, I measure the GSEs’ long-term debt advantage as the spread between observed yields on AAA/AA financial corporate debt and GSE debt with maturities from one to ten years.<sup>9</sup> It is not clear which corporations are best for this comparison. On one hand, Fannie Mae and Freddie Mac are currently rated AAA, partly because of their GSE status, and thus one might consider comparing their funding costs to those of other AAA corporations. On the other hand, without GSE status, the GSEs would be rated below AAA unless they raised substantial capital or took

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9. I stopped at ten years because there are few comparable corporate debt issues with longer maturities.

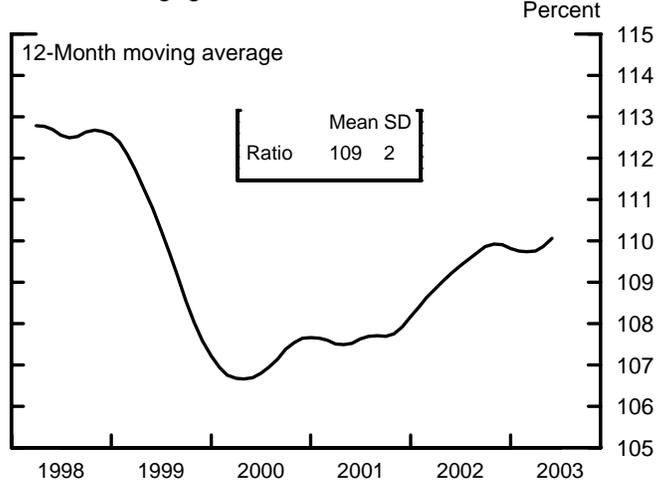
Exhibit 1

# GSE Debt Advantages

## Calculating GSE Debt Advantage

- Long-term advantage is the spread between yields on outstanding AAA/AA financial corporate and GSE debt with maturities of one year or greater.
- Short-term advantage is the spread between the yields on GSE discount notes and repos using MBS as collateral.
- GSE total debt advantage is the weighted average of these two spreads.

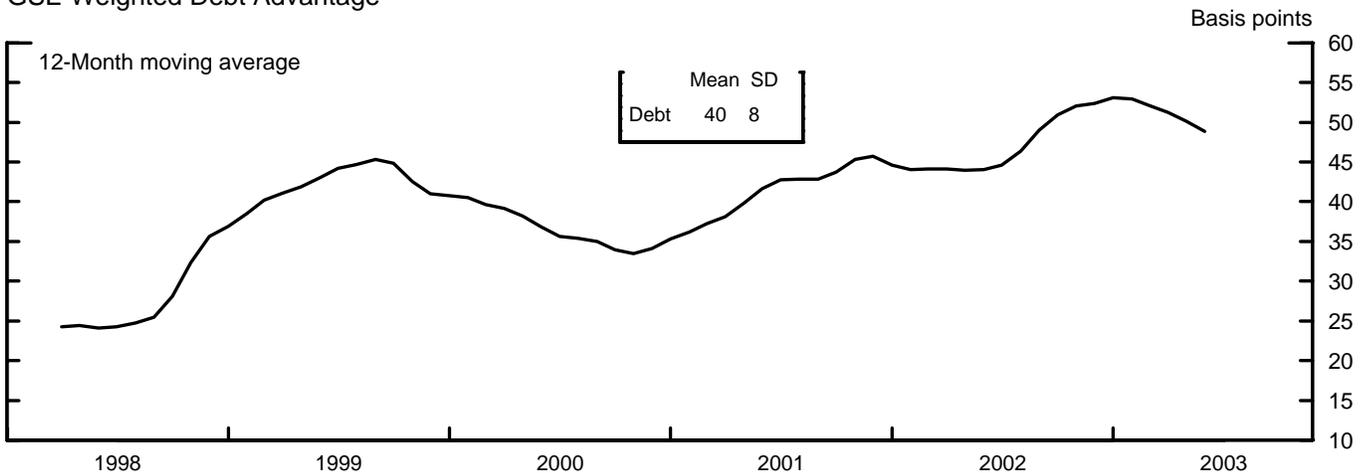
## Debt to Mortgage Portfolio Ratio



## GSE Debt Advantage by Parts



## GSE Weighted Debt Advantage



other actions to offset the loss of this status.<sup>10</sup> Almost all financial corporations, however, find that a AA or A rating is sufficient; few pursue a AAA rating. In an effort not to overstate the subsidy, I use AAA/AA financial corporations for my comparison.<sup>11</sup>

For both GSE and corporate long-term debt, I take the average yield on outstanding debt grouped by maturity “buckets” (using debt with remaining maturity from 1 to 3 years, 3 to 5 years, 5 to 7 years, and 7 to 10 years) for each business day and then take the weighted average of the yields on these four buckets, weighted by the proportion of GSE debt in each “bucket.” By this method, the maturities on corporate debt outstanding are adjusted to match GSE maturities.<sup>12</sup>

I create four different indexes of corporate debt spreads, where each index measures liquidity in a slightly different manner. My first index uses all 68 firms in the sample, regardless of issue size or frequency. The second index focuses on large debt issues, and includes only those issues above \$1 billion. There are 15 companies (4 foreign, 11 domestic) in this index. Here, the assumption is that the size of the debt issue is an important aspect of liquidity. My third index is also based on issue size and

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10. In addition to the AAA ratings that are based partly on their GSE status, Fannie Mae and Freddie Mac are given “bank financial strength” ratings by Moody’s Investors Service that assume that GSE status is withdrawn but that there are no other changes that affect the firms (such as changes in agency yields). These ratings are not meant to be compared to Moody’s other credit risk ratings. Fannie Mae’s and Freddie Mac’s financial strength rating of A- is the second-to-the-best rating in Moody’s system. Nothaft et al. (2002) state, “We believe the Standard and Poor’s and Moody’s ratings of Freddie Mac and Fannie Mae imply that the relevant comparators for estimating the long-term GSE funding advantage are securities rated AA-.”

Note that my subsidy estimates do not incorporate the dilution of shareholders’ equity that would occur if the GSEs had to raise capital to maintain a AA rating, assuming their government-sponsored status ended. If I accounted for this dilution, my estimate of the GSE subsidy captured by current shareholders would be larger.

11. This method of comparison is described in greater detail in Passmore, Sherlund, and Burgess (2003). The U.S. Department of the Treasury (1996) used a similar approach but settled on A-rated financial firms for the comparison group, arguing that this rating was common for high-quality financial firms with large portfolios of mortgages. I use Merrill Lynch’s financial corporation data and rely on their classification of corporations. Roughly one-third of the companies are AAA and the remainder are AA.

12. This “bucketing” technique is similar to that used in Sanders (2002).

includes any issue that exceeds the median size of the GSE issues in a given year. In 1997, this issuance threshold was \$165 million. By 2003, it had grown to \$696 million. There are 44 companies (11 foreign, 33 domestic) in this index. U.S. investors should be familiar with these issuers and thus one might assume that these issues are liquid. The fourth index is based on the debt issuance of GE Capital. GE Capital frequently issued throughout my sample in substantial quantities. I use each of these indexes in my estimation of the GSE funding advantage.

For debt with maturity of less than one year, I calculate the short-term advantage as the difference between the yield on GSE discount notes and the yield on repurchase agreements using GSE mortgage-backed securities (MBS) as collateral. I use MBS repos because Fannie and Freddie hold large amounts of this collateral in their portfolios and thus could use this market-based funding alternative.

As outlined in the upper left panel of exhibit 1, I assume that the GSEs' mortgage portfolio is effectively funded at the weighted-average yield on longer-term debt (regardless of whether longer-term debt is issued and swapped to shorter maturities, shorter-term debt is issued and swapped to longer maturities, or debt is issued without engaging in a swap) and that the remainder of GSE assets are funded using short-term debt (supposedly the GSEs issued this debt either to provide liquidity or to take advantage of short-term arbitrages using their GSE advantages.)<sup>13</sup> Thus, the GSEs' total debt advantage is the average of these two spreads, weighted by the percent of debt used

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13. This approach assumes that the GSEs' target debt maturity is the weighted-average maturity of their stock of debt. But rather than issue all debt at one maturity, they sometimes find it cheaper and less risky (because the tiering of maturities partly offsets the uncertainty about mortgage prepayments) to issue at other maturities, as well as to engage in swaps. It also assumes that the GSEs' funding advantage is only the yield difference on debt and is not in the swap transaction (although GSE status does give the GSEs some advantages with regard to posting collateral for swaps).

to fund mortgages.<sup>14</sup> As can be seen in the upper right panel, the GSEs issued more debt than they needed to fund their mortgage holdings, with the amount of their outstanding debt averaging about 109 percent of their mortgage portfolio.

To calculate the long-term advantage, I use a weighted average of my four GSE debt advantage indexes.<sup>15</sup> As shown in the middle panel, I calculate that Fannie and Freddie have a funding advantage on long-term debt of 43 basis points, with a standard deviation of 8 basis points. In contrast, the estimated GSE advantage from issuing short-term debt averages 13 basis points, with a standard deviation of 2 basis points. As shown in the bottom panel, I estimate that the overall GSE advantage averaged about 40 basis points during the past five-and-one-half years, with a standard deviation of 8 basis points.

### **The Subsidy Value of Issuing MBS**

When Fannie Mae and Freddie Mac issue mortgage-backed securities, they promise purchasers that payments will be made on these securities even if some of the underlying mortgages default. In return for providing this insurance against credit risk, Fannie Mae and Freddie Mac charge a guarantee fee. The average GSE guarantee fee is about 20 basis points. A substantial portion of this fee covers costs associated with processing MBS payments. Of the remainder, the credit loss portion of this fee is very

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14. This approach is similar to CBO (2001), which assumed that the GSEs' optimal mix was 80 percent long-term (greater than one year) and 20 percent short-term (less than one year). This approach effectively treats callable debt and some short-term debt (the portion swapped to have longer maturities) the same as longer-term "plain-vanilla" debt, with the same subsidy advantages.

15. The weights are each index's contribution to the minimum distance estimator of the GSE pass-through as described later in this paper. That is, let  $b_i$  denote the  $i^{\text{th}}$  index's estimate of the GSE pass-through and let  $b^*$  denote the minimum distance estimate of the GSE pass-through. Then the predicted mortgage rate using the four indexes is  $\hat{y} = \sum w_i b_i x_i$ , where  $w_i$  is the  $i^{\text{th}}$  index's weight and  $x_i$  is the  $i^{\text{th}}$  index's GSE debt advantage. Equivalently, the predicted mortgage rate using the minimum distance estimator is  $y^* = x^* b^*$ , where  $x^*$  is not observed. We therefore substitute  $\hat{y}$  in for  $y^*$  and solve for  $x^*$ —a weighted average of the  $x_i$ 's—so that  $x^* = \sum w_i b_i x_i / b^*$ . For a more complete discussion, see Passmore, Sherlund, and Burgess, 2003.

small—perhaps only a few basis points—given the very low-risk nature of conforming mortgages.

To value the subsidy embedded in GSE MBS, one might compare the yields on purely private MBS to the yields on GSE MBS, if all other things were equal. But all other things are not equal because investors demand that purely private MBS have significant credit enhancements, which are difficult to observe and value, while investors do not demand such enhancements from GSE MBS.<sup>16</sup> In addition, purely private MBS are usually originated and structured by commercial banks, which are subject to stricter capital requirements concerning mortgage-backed securities than are the GSEs and therefore might be securitizing because regulatory capital standards are too high. Simulations of the value of the GSEs' advantage in mortgage securitization illustrate that it is very valuable (Passmore, Sparks and Ingpen, 2002), but estimating this value is even more difficult than estimating the GSE advantage when issuing debt.

Since I have little information about the cost of the credit enhancements that the GSEs' mortgage-backed securities would need if the GSEs were not government-sponsored, I make a conservative guess. Using Fannie Mae's 2002 financial data reported by line of business, it appears that income on its credit guarantee business, calculated as a share of the stock of outstanding MBS, was about 7.9 basis points. Fannie Mae's credit losses on mortgages were minimal—about 0.5 basis points. Thus, net income seems to range between 0 and 7.4 basis points, with part of this income representing a return on GSE capital and the remainder being an implicit subsidy. Assuming a rate of return on equity ranging from 10 percent to 15 percent and a

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16. CBO (1996, 2001) attempted to compare purely private yields to GSE MBS yields and argued that the yield difference is around 30 basis points. However, CBO made this estimate based on limited data. Moreover, the logic of this technique is suspect because, unlike the savings on debt issuance, the yield difference between private and GSE MBS issuance is unrelated to GSE earnings. For example, if the GSEs did not lower mortgage rates at all, then the GSEs' 30 basis points of savings on MBS yields would exceed their total charge for guaranteeing MBS (about 20 basis points). As described in the text, one should examine the difference in credit insurance fees, not in security yields.

regulatory capital requirement of 45 basis points, the return to equity could range from 4.5 basis points to about 7 basis points. Lacking better information, I will assume in the simulations below that the subsidy-related component of the guarantee fee ranges from zero to four basis points, with an average of two basis points across all of the simulations.

### **The Effect of the GSE Subsidy on Mortgage Rates**

A commonly asserted benefit of the GSEs is that they lower mortgage rates for homeowners. However, attempting to use government-sponsored enterprises to lower mortgage rates is indirect and, perhaps, less effective than a direct subsidy would be. As outlined above, the GSEs' implicit subsidy mainly takes the form of lower funding costs. To pass these lower costs on to homeowners requires that GSE shareholders not capture this subsidy in the form of increased profits. Even if a mechanism exists that forces the GSEs to transmit this subsidy on to mortgage originators, these originators may also capture some or all of the subsidy and not pass it on to homeowners.

Given that the intermediaries between the source of the subsidy (investors who view the GSEs as backed by the government) and the target of the subsidy (homeowners) must be restrained from appropriating the subsidy, the GSEs' presence may or may not change mortgage rates very much. As argued by Goodman and Passmore (1992) and Hermalin and Jaffee (1996), much of the subsidy may not be transmitted because of the structure of the conforming mortgage market. In addition, Fannie and Freddie—like all insurers of credit risk—face an adverse selection problem. Originators may tend to keep the highest-quality mortgages in their own portfolios unless the GSEs offer a higher price for these mortgages. Theoretically, the subsidy could be completely absorbed by the GSEs' efforts to avoid adverse selection (Passmore and Sparks, 1996), an outcome that has become more likely with the advent of automated underwriting because mortgage originators can determine, with little cost, whether a mortgage will be purchased by the GSEs (Passmore and Sparks, 2000). Finally, because the mortgage originators who are depository institutions always decide first which mortgages to keep and which to sell (a

“first mover advantage”), the GSEs—even if they desire to pass on a subsidy to homeowners—may find it difficult to use the mortgage banking system to actually transmit the subsidy because of the banks’ relative advantage in bargaining over pricing and underwriting standards (Heuson, Passmore, and Sparks, 2001).

I directly estimate the proportion of the subsidy transmitted by the GSEs to homeowners using a regression method that has some similarities to a method used in many other studies.<sup>17</sup> This technique focuses on the differences in mortgage rates observed on mortgages that exceed the size limit imposed on GSE mortgage purchases (so-called jumbo mortgages) and mortgages below this size limit. These smaller mortgages are often referred to as conforming mortgages, even though there are other restrictions on GSE purchases, and thus some of these mortgages cannot be purchased by the GSEs. The size limit on GSE purchases is called the conforming loan limit and is adjusted annually to reflect house price increases (but it is not adjusted downward when house prices decrease). In 2003, the conforming loan limit for most mortgages was \$322,700.

Mortgage-rate studies based on data from the late 1980s and early 1990s generally concluded that mortgage rates for conforming mortgages were about 20 to 40 basis points less than mortgage rates for other mortgages (Hendershott and Shilling, 1989; Cotterman and Pearce, 1996). Passmore, Sparks, and Ingpen (2002) showed that better screening of the data combined with more recent data lowers this estimate to about 20 basis points. McKenzie (2002) provides an extensive survey of this literature and estimates that the difference is 22 basis points over a long horizon (1986-2000) and 19 basis points in a more recent period (1996-2000). Torregrosa (2001) found similar

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17. The technique used here taken from Passmore, Sherlund, and Burgess (2003).

results for this latter period (1995-2000), with estimates ranging from 18 to 25 basis points depending on the estimation technique and screening of the data.<sup>18</sup>

Finally, in contrast to these studies of the effect of GSEs on mortgage rates, Ambrose, LaCour-Little, and Sanders (2002) do not rely on the Federal Housing Finance Board's Mortgage Interest Rate Survey (MIRS). Using data from an unidentified large national lender, they have much better measures of borrower credit quality and of a mortgage's conforming loan status than do studies based on the MIRS data. After taking into account some borrower characteristics and adjusting for sample selection problems, they find that jumbo mortgage rates are about 28 basis points higher than conforming mortgages and that about 9 to 25 basis points of this gap likely is due to the GSEs, depending on one's interpretation of the effects of GSEs on mortgage rates.

Like Ambrose et al., I believe that other factors besides GSEs influence the differences between jumbo and conforming mortgage rates and that the jumbo-conforming difference is a poor measure of the GSEs' influence on rates paid by the average mortgage borrower. In particular, most previous studies have ignored the fragmentation of the jumbo securitization markets, as well as the effects of banks' funding capacity, banks' investment alternatives, and fluctuating mortgage demand on mortgage rates. If banks have excess deposits and ample capacity to underwrite mortgages, or if mortgage demand is weak, then mortgage rates tend to be relatively low, all else being equal. In addition, the bargaining power of GSEs and jumbo mortgage securitizers relative to depository institutions, who have the capacity to fund their mortgage originations directly, may differ.

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18. The GSEs also have produced studies arguing that they reduce mortgage rate volatility as well as lower mortgage rates (Naranjo and Tovey, 2002). However, these studies fail to separate the simultaneous movements of mortgage rates, mortgage spreads, volatility and GSE purchase activity. As a result, the estimates likely reflect simultaneity bias. Unfortunately, there has been little independent research in this area. In addition, these studies rarely address how a GSE behaves differently than other non-GSE private purchasers in secondary markets and thus why government sponsorship is needed.

All these factors suggest that the jumbo-conforming spread varies over time and is influenced by a variety of factors, especially since the jumbo mortgage securitization market is artificially fragmented by the conforming loan limit and cannot realize economies of scale or scope because of the conforming loan limit.<sup>19</sup> I modify the traditional regression approach to control for these factors in estimating the difference between the conforming and jumbo mortgage rates.

My modeling technique is outlined at the top of exhibit 2. Using the individual mortgage loan data in MIRS, I run regressions describing the mortgage rates for individual loans in each month. (There are almost one million loans in this database.) I run separate regressions describing mortgage rates in four states—California, New Jersey, Maryland, and Virginia—as well as for the remaining states grouped together. These four states are considered separately because they have the most developed jumbo loan markets, a relatively high number of jumbo loans each month, the most jumbo loans over the period of estimation, and no months that report zero jumbo loans.<sup>20</sup> Controlling for state variation in mortgage rates is particularly important because states have unique laws regarding mortgage origination and foreclosure, which affect the cost of mortgage credit. In addition, the development of the jumbo mortgage market within states varies substantially because some states have very high home prices and therefore many home buyers needing jumbo mortgages, whereas other states have relatively low home prices and quite limited jumbo markets.

With the regressions, I compare the rates on mortgages that might be purchased by the GSEs with the rates on jumbo mortgages, controlling for credit risk using the loan-to-value information available in MIRS and dummy variables for other factors. For

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19. The effect of this fragmentation is investigated in Passmore, Sparks, and Ingpen (2002). Other factors can also create differences between conforming and jumbo mortgage rates—differences that are unrelated to the GSEs. For example, the differences in the volatilities of prices for higher-cost and lower-cost homes can account for some of the jumbo-conforming spread (Ambrose, Buttner, and Thibodeau, 2001).

20. Since the MIRS is a voluntary survey, there may be some states that have a substantial jumbo loan market, but few MIRS data reporters.

Exhibit 2

## Homeowners' Mortgage Savings

### Description of Mortgage Rate Regressions

- I use the MIRS data from April 1997 through May 2003, which contain almost 1 million loans.
- The dependent variable is the loan-level mortgage rate for each loan.
- For each month, I run five regressions using data from four states - California, New Jersey, Maryland and Virginia - and for the remaining states grouped together.
- These four states were selected because they have:
  - The highest average number of jumbo loans per month.
  - The most total jumbo loans over the period.
  - No months with zero jumbo loans.
- Independent variables are dummies for LTV group, new home purchase, principal greater than \$100,000, fees, origination by a mortgage company and whether a loan is jumbo.

### Calculation of the Jumbo-Conforming Spread

Step 1. Monthly Regression Equation for Each State or State Group (indexed by s):

$$RM = \alpha_0 + \alpha_{1,t,s}J + \sum_{i=1}^3 \alpha_{2,t,s}^i LTV_i + \alpha_{3,t,s}NEW + \alpha_{4,t,s}SMALL + \alpha_{5,t,s}FEES + \alpha_{6,t,s}MTGCO + \varepsilon$$

- |                                |  |
|--------------------------------|--|
| 1. J: Jumbo dummy              | 4. SMALL: Dummy for principal < \$100,000            |
| 2. LTV: LTV dummy <sup>1</sup> | 5. FEES: Fees dummy                                  |
| 3. NEW: New home dummy         | 6. MTGCO: Dummy for originated by a mortgage company |

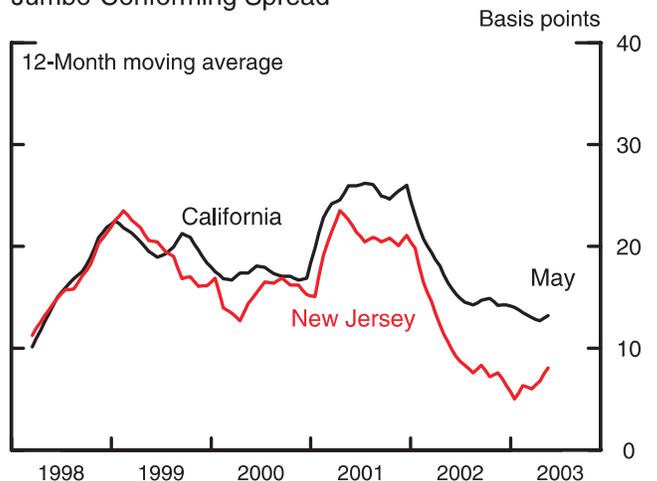
1. MIRS Data are divided into four groups by LTV ratio: below 0.75, between 0.75 and 0.81, between 0.81 and 0.91 and above 0.91. The dummy for being in the first group is excluded from the regression.

### Estimated Jumbo-Conforming Spread From Monthly Regressions <sup>1</sup>

State	Mean (Basis Points)	Standard Deviation
California	17	9
New Jersey	15	10
Maryland	18	12
Virginia	16	11
Other States	15	9

1. Mean and standard deviation of coefficients for the 370 regression estimates.

### Jumbo-Conforming Spread



Source: MIRS.

example, smaller loans are generally more expensive to originate than larger loans and, for marketing reasons, loans for new home purchases are often priced differently than loans for existing homes. In addition, mortgage bankers have a different cost structure than do depository institutions, so I control for the type of institution that originates the mortgage. Finally, part of the mortgage interest rate can effectively be paid in up-front fees, so I control for this mortgage feature as well.<sup>21</sup>

The equation I estimate is outlined in the middle panel of exhibit 2. The coefficient on the jumbo loan dummy variable represents the effect of jumbo status on the mortgage rate. However, assuming that this spread represents how much a mortgage rate on a conforming loan would rise if the GSEs were privatized is a bit misleading because it assumes that all other characteristics of the jumbo and conforming mortgage markets are the same. In particular, the secondary markets for jumbo and conforming mortgages, which are quite different, might converge if the GSEs were privatized, suggesting that the conforming rate might rise and that *jumbo rates might fall*. Thus, I view this estimate of the mortgage savings to homeowners as an upper bound on the estimate of how much rates might rise if the GSEs were privatized.

A summary of the results from this regression is shown in the lower left panel of exhibit 2. The average estimated difference between the jumbo and conforming mortgage rates across states (the estimated coefficient  $\alpha_1$  in each regression) ranges from 15 basis points to 18 basis points. The standard deviations of these estimates are large, suggesting that the observed difference varies substantially over time. The time pattern of the jumbo-conforming difference for California and New Jersey markets is presented in the lower right panel.

As described earlier, my estimated jumbo-conforming spreads reflect factors besides the GSE advantage. As outlined in exhibit 3, I adjust for some of these factors by

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21. I control for this feature in two ways: first, by using effective mortgage rates (as provided in the MIRS), which amortize the mortgage points and combine them with the mortgage rates, and, second, to control for variation that is not accounted for by the amortization process, I use a dummy variable to indicate whether fees were paid.

performing a second-step regression on the 370 estimates (one estimate for each state for each month of data) of the jumbo-conforming spread.<sup>22</sup> The mortgage rate has four major components—the cost of funding the mortgage and the spreads needed to compensate for the credit risk, for the prepayment risk, and for the maturity-mismatch risk associated with the mortgage.<sup>23</sup> (Interest rate risk is sometimes identified as maturity-mismatch risk and sometimes identified as the combination of this risk and prepayment risk. I use the more precise language here.) Each of these factors might be priced differently for jumbo mortgages versus conforming mortgages, especially given the truncated and idiosyncratic nature of the secondary market for jumbo mortgages. In addition, as described above, the core deposit capacity of the banking system relative to households' mortgage demand might play a major role in determining the jumbo-conforming spread.

I proxy the credit risk spreads associated with a conforming mortgage using the spread between a rate offered on a home equity line of credit (where the combined loan-to-value of the first and second mortgages cannot exceed 80 percent) and a conforming, one-year adjustable rate mortgage.<sup>24</sup> Because the home equity loan is backed by a second lien on the property and the mortgage is backed by a first lien, movements in this spread should partly reflect the small changes in credit risk associated with homeowner delinquency or default for very safe mortgages.

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22. As described in Passmore, Sherlund and Burgess (2003), my approach to estimating the effect of the GSEs involves two sequential regressions. The first-step regression captures, in a very general fashion, the variation in mortgage rates over time and across states. The second-step captures the effects of funding costs and risk premium on the jumbo-conforming spread. I conduct the analysis in two steps because I could not otherwise identify the effects of variables that are constant for a given state-month combination, which would then preclude the use of monthly interest rate data.

23. Maturity-mismatch risk is the risk that an institution's liability structure could become out of line with the duration of its assets and that it might be costly to appropriately adjust the liabilities to match the asset duration.

24. The rate on the home equity line of credit is from Bank Rate Monitor and the adjustable-rate mortgage rate is from Freddie Mac.

Exhibit 3

# Homeowners' Mortgage Savings

## Description of Mortgage Rate Regressions

- I perform a "second-step" regression on the 370 estimates of the jumbo-conforming spread from the first regressions to adjust for certain factors that influence the spread.
- I include measures for the GSE funding advantage, mortgage risk characteristics, aggregate mortgage demand, mortgage market capacity, a time trend to capture development of the market, and dummies for states and quarters to capture seasonal and region-specific effects.
- I use the following as proxies for mortgage risk characteristics:
  - Credit risk: Spread between short-term home equity line of credit and one-year conforming ARM loan.
  - Prepayment risk: Spread between current coupon Fannie MBS and duration-matched yield on AAA/AA corporate debt.
  - Maturity-mismatch risk: Difference in the duration-matched corporate yield and the average yield on corporate debt.
  - Cost of funds: One-year Treasury rate.

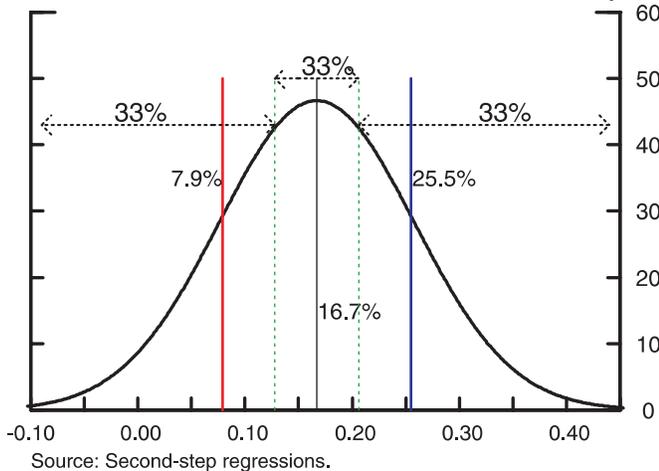
## Calculation of the GSE Effect on the Jumbo-Conforming Mortgage Rate Spread

Step 2 Regression Equation:

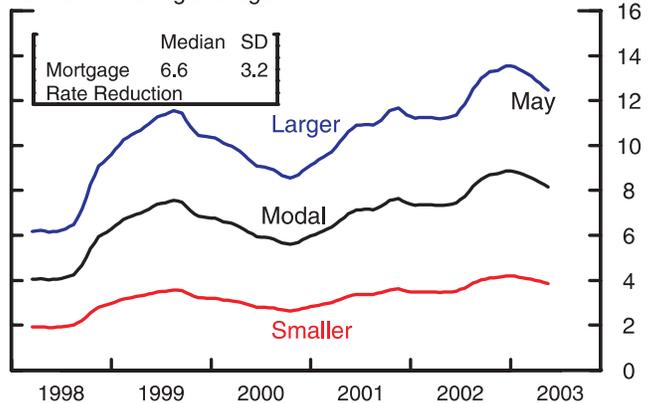
$$\alpha_1 = \beta_0 + \beta_1 GA + \beta_2 RT + \beta_3 CR + \beta_4 PR + \beta_5 MR + \beta_6 DEM + \beta_7 LTRT + \beta_8 CAP + \beta_9 DEV + \sum_{s=1}^s \beta_{10}^s STATE_s + \sum_{j=1}^j \beta_{11}^j QTR_j + \mu$$

1. GA: GSE Funding Advantage	7. LTRT: Ten-Year Treasury Rate
2. RT: One-Year Treasury Rate	8. CAP: Market Capacity
3. CR: Credit Risk	9. DEV: Market Development
4. PR: Prepayment Risk	10. STATE: Dummy for State
5. MR: Maturity-mismatch Risk	11. QTR: Dummy for Quarter
6. DEM: Mortgage Demand	

Probability Density Function of the GSE passthrough



Estimated GSE Mortgage Rate Reductions<sup>1</sup>



Source: Merrill Lynch and step 2 regressions.

1. The GSE liquidity effect is assumed to be passed through in part to the homeowners. In the high scenario, the GSE passes through 25.5% of debt savings; in the average scenario, 16.7%; and in the low scenario, 7.9%.

Prepayment risk is measured by comparing the daily yield on the current coupon Fannie Mae mortgage-backed security to a duration-matched yield on AAA/AA financial corporate debt. The maturity-mismatch risk spread is measured by the difference between the duration-matched corporate yield and the average yield on financial corporate funding, as weighted by the GSEs' distribution of debt maturities. (This is a measure of how far the GSE debt distribution is out of alignment with the current duration of mortgages.) I use the one-year Treasury rate as a proxy for the risk-free cost of funds and the ten-year Treasury rate as a measure of the opportunity costs of funding housing (both for portfolio lenders and households).

I also use proxies to measure the deposit capacity of the banking system and desired mortgage demand, as well as a time trend. The trend may capture such factors as the ongoing development of mortgage securitization, particularly private market mortgage securitization.

Finally, I include my estimate of the GSE funding advantage—the spread between the GSEs' funding costs and comparable funding costs for other financial corporations—in the regression.<sup>25</sup> As described earlier, I have four different indexes of the GSE yields advantage, each reflecting a slightly different measures of corporate debt liquidity.

My regression is outlined in the middle panel of exhibit 3. The fraction of the GSE debt advantage transmitted to homeowners (the GSE pass-through) is estimated by the coefficient  $\beta_1$  on "GA," the GSE funding advantage. Since I have four different proxies for corporate yields, the model is estimated four times, resulting in four estimates of the passthrough from the GSEs' gross debt advantage to homeowners' mortgage payment savings via mortgage rates. In order to reconcile my different estimates of the GSE passthrough, I use minimum distance estimation (for a more complete discussion,

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25. I take monthly averages for the variables on the right-hand side of the second-step regression. Duration-matched values are found by using Bloomberg's daily calculation of the MBS current coupon duration and then matching that duration using a daily corporate yield curve for AA/AAA financial corporations. The daily yield curves are calculated using the technique of Nelson and Siegel (1987), as implemented in Bolder and Stréliski (1999).

see Passmore, Sherlund, and Burgess, 2003). The minimum distance estimator works well in this context because it implicitly takes a weighted average of the parameter estimates to minimize its loss function.<sup>26</sup> This results in a point estimate of about 16.7 percent for the GSE passthrough. The 95-percent confidence interval runs from -1.1 percent to 34.5 percent.<sup>27</sup>

For my simulations, I use three pass-through scenarios: the modal scenario, the larger pass-through scenario, and the smaller pass-through scenario. As shown in the lower left panel of the exhibit, these scenarios each represent the median pass-through for a set of equally-likely ranges of estimated coefficients. For the smaller range of coefficient estimates, the median pass-through estimate is about 8 percent. For the larger range of coefficient estimates, the median pass-through rate is about 26 percent. Finally, for the modal range of coefficient estimates, the median is about 17 percent. As shown in the lower right panel, the median mortgage rate reduction consistent with these scenarios implies that the activities of the GSEs seem to typically account for about 6.6 basis points of the difference between jumbo and conforming mortgage rates, with an estimated standard deviation of 3.2 basis points.

### **Starting Values and Growth Assumptions for Simulating the GSE Subsidy**

I now want to simulate the present discounted value of the implicit GSE subsidy. The preceding sections described the techniques used to estimate the parameters of the subsidy model. Recall my method, as described by equation (5):

$$Net\ Subsidy = (1 - \tau_{GSE}) \sum_{t=1}^n \frac{(r_t^{private} - r_t^{GSE})(1 - \omega\delta)D_t + f_t^{GSE} MBS_t + Ex}{(1 - d_t^e)^t}$$

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26. In Passmore, Sherlund, and Burgess (2003), we minimize the square of the standardized difference between the minimum distance estimate and the four parameter estimates. The weighting is therefore a function of variance and covariance terms.

27. This confidence interval has been adjusted for heteroskedasticity, first-order autocorrelation, and clustering across states by month.

As described earlier, my estimates of  $(r^{private} - r^{GSE})$  are based on the debt spreads, my estimate of  $\omega$  is equal to  $\beta_1$  in the second-step regression, and my estimates of  $f^{GSE}$  are based on Fannie Mae's income statement.

My simulation treats Fannie Mae and Freddie Mac as one entity. For initial values of the size of this entity, I average the combined values of their portfolios over the past two years. The two-year average smooths out any recent, temporary fluctuations in these values. As outlined in the top left panel of exhibit 4, this combined entity has \$1.4 trillion of debt, has issued \$1.6 trillion of mortgage-backed securities that are not held in its own portfolio, holds \$1.3 trillion of mortgages and mortgage-backed securities in its portfolio, and has a market value of \$119 billion.

As described in the upper right panel, I also assume that the starting level of mortgage debt is \$5.3 trillion (the average over the past two years), which implies that the GSEs' initial market share is 54 percent. Projecting the growth of GSE mortgage-related assets is difficult because the GSEs almost always grow faster than the mortgage market (as shown in the middle panel of the exhibit). Such growth cannot continue over a long horizon, however, without the GSEs absorbing the whole market. Therefore, I assume that there exists a limit to the GSE share of the conventional, conforming mortgage market.

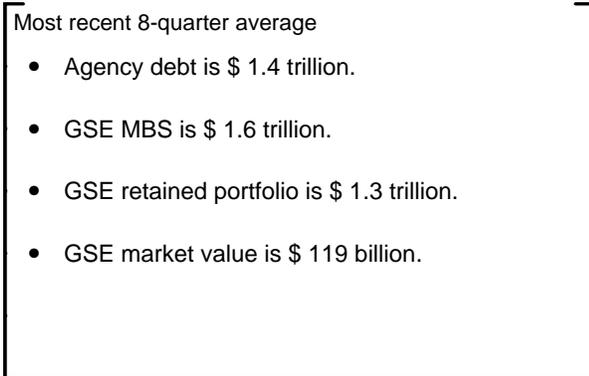
I pick a maximum market share and assume that in simulations where the GSE growth rate exceeds the market's growth rate, the GSEs grow faster than the market until they hit their maximum market share, at which time the GSEs' growth rate gradually declines to the market growth rate (thus temporarily exceeding the "maximum share").<sup>28</sup> I conservatively choose, in turn, 55 percent, 60 percent, and 65 percent as the maximum market share in the simulations.

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28. In the simulations, the growth rate is applied to the total of GSE mortgage obligations (both those held in portfolios and those off-balance sheet.) The total is then split into on- and off-balance-sheet obligations based on the two-year average ratio prior to the initial period (roughly 56 percent of the GSE mortgage obligations are on-balance-sheet—both whole mortgages and MBS—and the rest are securities traded publicly). The GSEs, however, might be likely to hold an increasing portion of their securities on their balance sheets as their growth rates decline in an effort to boost profits. Thus, holding this split constant may understate the subsidy.

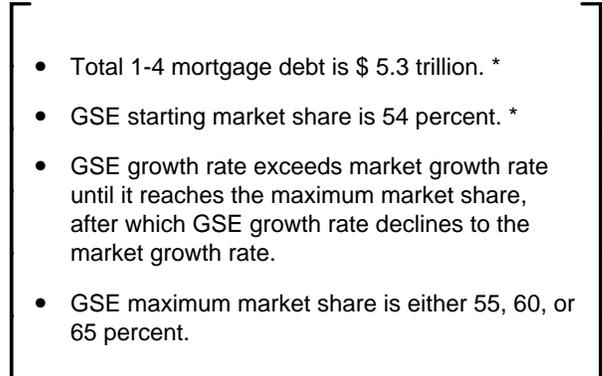
## Exhibit 4 Historical Values

### Starting Values for GSEs' Combined Portfolios\*



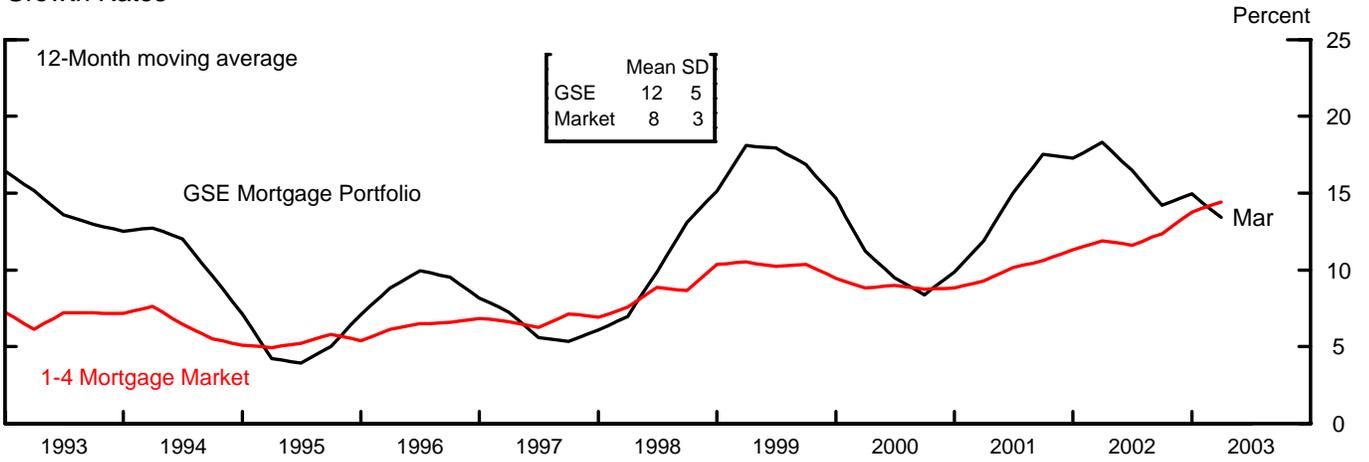
\* Average over 8 quarters, 2001:Q2 to 2003:Q1

### Market Growth Assumptions



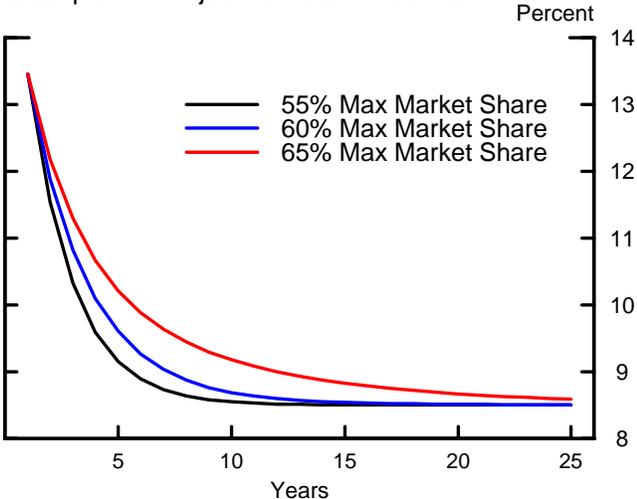
\* Average over same 8 quarters.

### Growth Rates

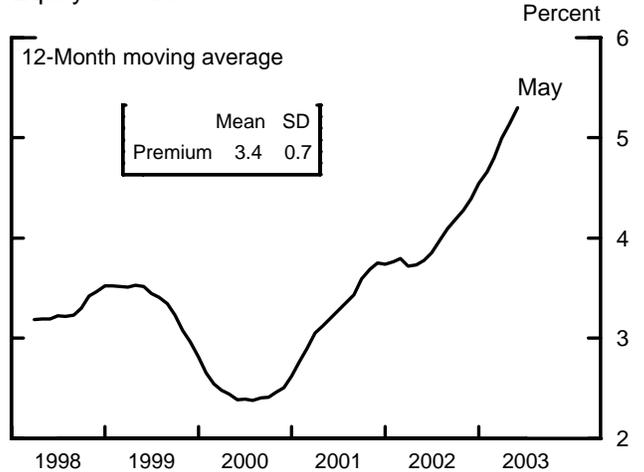


Source: Federal Reserve.

### Examples of Projected GSE Growth Rates



### Equity Premium



Note: The long-run expected return on the S&P 500 less the 10-year Treasury bond yield.

The median growth paths for each market share assumption are shown in the lower left panel. In these growth paths, the GSEs' growth rate starts higher than the market growth rate and then declines slowly to the market growth rate. However, in the simulations, there are some growth paths that start below the market growth rate and then rise, and some that have a "hump shape" where the GSE growth rate increases initially and then declines to the long-run market growth rate of about 8-1/2 percent (the average growth rate of the mortgage market over the past ten years).

Finally, to discount the cash flows generated by the GSEs, I assume that equity investors compare the return from investing in the GSEs to the return from investing in the overall market. I discount the cash flows using the Treasury yield curve plus an equity premium (for example, for the cash flow five years out, I discount using the five-year Treasury rate, and for the cash flow ten years out, I discount using the ten-year Treasury rate). The lower right panel shows the time-varying estimate of the equity premium (my estimation technique for the equity premium is similar to that described in Sharpe, 2002).

### **The GSE Subsidy Calculations**

Perhaps the easiest way to illustrate my simulation technique is to focus on the calculation of the subsidy embedded in GSE debt. As outlined at the top of exhibit 5, I start with the two-year average of GSE debt outstanding and then pick a historical combination of debt growth, the spread between the yield on GSE debt and the yield on the debt issued by AAA or AA financial corporations—the GSE debt advantage—as well as the associated Treasury yield curve and equity premium (which are added together to create the discount rates). The GSE debt advantage is multiplied by the size of the portfolio to generate the initial cash flow associated with the GSE subsidy at a given time. Over the projection horizon (25 years), the spread moves to its long-run historical average, with the movement based on a simple ARIMA model. Generally, this average is reached fairly quickly (in less than five years).

Exhibit 5  
**Subsidy Calculations**

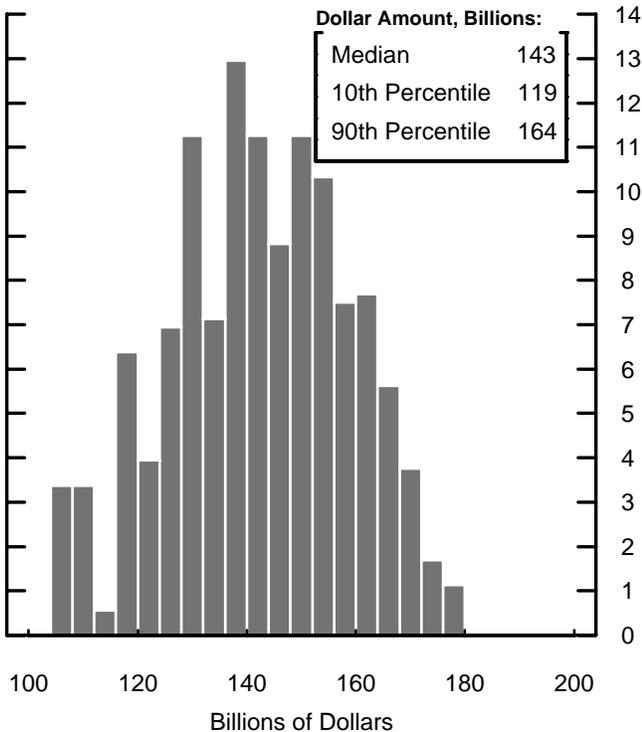
GSE Debt Subsidy Calculation

- |   |   |
|---|---|
| <p>1) Two-year average of GSE debt outstanding.</p> <p>2) Pick historical combinations of debt growth rate, GSE debt advantage, Treasury yield curve, and equity premium (at 12-month moving averages).</p> <p>3) GSE debt advantage multiplied by debt outstanding to yield cash flow at given time.</p> | <p>4) Debt advantage and debt growth move toward long-run average over projection period.</p> <p>5) Cash flows discounted and summed to estimate subsidy value.</p> <p>6) Similar technique is used for homeowners' mortgage savings.</p> |
|---|---|

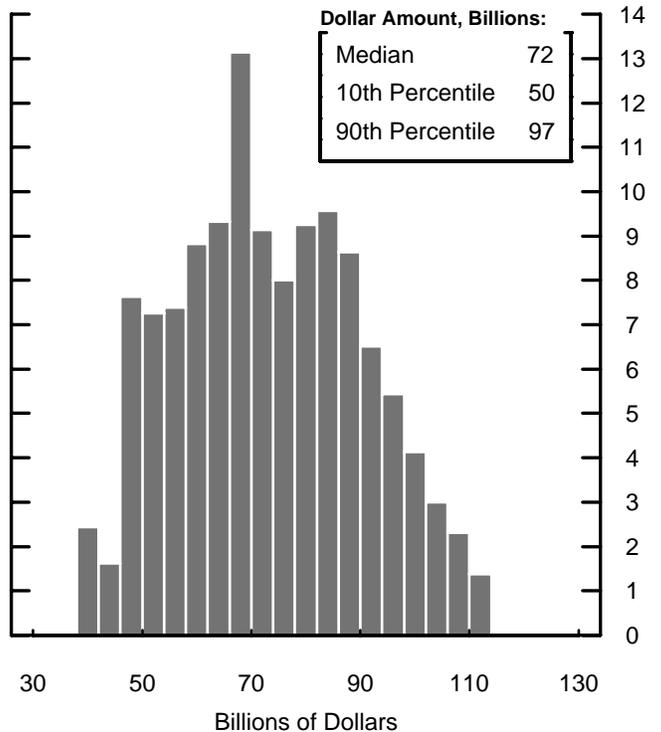
*Number of Simulations*

- 74 historical observations (April 1997 to May 2003, monthly)
- 3 estimates of mortgage rate savings (High, average and low)
- 3 Maximum market shares (55, 60, 65 percent)
- 3 MBS subsidies (0 - 4 basis points, by 2)
- **1,998 simulations.**

Fannie & Freddie Gross Subsidy, Level  
Percent of Cases



Fannie & Freddie After-tax Net Subsidy, Level  
Percent of Cases



The GSE portfolio growth rate, as discussed earlier, often exceeds the growth rate of the mortgage market. Once the maximum market share is reached, however, the GSE growth rate gradually falls towards the market growth rate, eventually reaching the market growth rate. In turn, the growth rate of GSE debt also moves to the mortgage market's long-run growth rate. My measure of the GSE debt subsidy for this simulation is the sum of these annual discounted cash flows over the 25 year period. I follow a similar nonparametric process to calculate the value of the mortgage savings of households. To generate the cash flows, I multiply the estimated  $\omega$  by the GSE debt advantage that prevailed at a given time, and then multiply this spread by the mortgages purchased and held or securitized by the GSEs.

I use 74 monthly observations (from April 1997 to May 2003) of the equity premium, the Treasury yield curve, the GSEs' debt advantage, the growth rates of the GSEs' mortgage and debt portfolios, and the estimated mortgage savings to homeowners observed during a given month. To eliminate outliers, I smooth the data using 12-month moving averages. For each simulation, I choose the values for these variables that were observed in a given month so that the historical joint relationships between the variables are maintained. With 74 historical observations over time and 3 different estimates of the mortgage savings for each month, this nonparametric process generates 222 simulations of the cash flow attributable to the GSE subsidy. In addition, I make reasonable assumptions about the range of the MBS subsidy and the maximum GSE market share and assume that values within this range are equally likely, letting the former vary from 0 to 4 basis points (in increments of 2) and the latter have a value of either 55 percent, 60 percent or 65 percent. All told, I run 1,998 simulations. The result of my simulations should not be interpreted as a current estimate of the subsidy value (that is, based only on current spreads, etc.), but instead as an estimate that averages over expected future market conditions based on recent historical experience.

As shown in the lower left panel, I estimate the median gross subsidy to Fannie Mae and Freddie Mac to be \$143 billion, with 80 percent of the estimates falling between

\$119 billion and \$164 billion. Similarly, as shown to the right, most estimates of the after-tax net subsidy fall between \$50 billion and \$97 billion, with a median estimate of \$72 billion. The wide range of estimates emphasizes the data limitations and fluctuations of key variables over the sample. Nonetheless, the estimates suggest that the gross GSE subsidy is positive and large.

### **The Robustness of GSE Subsidy Estimates and the Need for Better Data**

As described in the first line of the top panel of exhibit 6, my median estimate of the present value of the GSE spread advantage on debt is \$126 billion (line 1, column 2). Adding in the value of the MBS subsidy and the GSE exemptions (tax exemptions, registration exemptions and others<sup>29</sup>) increases the gross subsidy to \$143 billion (line 4). Homeowners saved \$44 billion on their mortgage payments (line 5), yielding a net GSE subsidy of \$72 billion after tax (line 6). I estimate that 60 percent of the GSEs' market value is attributable to the subsidy.

As shown in columns 3 and 4 of the table, my estimates vary widely, mainly reflecting the uncertainty regarding the size and the variation over time in my estimates of the GSE debt spread advantage, my estimates of the difference between jumbo and conforming mortgage rates, and my estimates of the proportion of the jumbo-conforming spread difference that can be attributed to the GSEs. These spreads are often very small and thus difficult to estimate precisely with available data. The variation in estimates suggests that the net subsidy to the GSEs could be as little as 42 percent and as much as 81 percent of their market value.<sup>30</sup>

The imprecision in my implicit subsidy estimates reflects the fact that small differences in the estimated mortgage savings and the GSE debt advantage make a big difference in the subsidy estimate. As shown in the lower left panel, a 3 basis point increase in the estimated GSE effect on the median jumbo-conforming mortgage spread

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29. I use CBO's valuation of these exemptions (CBO, 2001).

30. Theoretically, the subsidy can exceed the market value if part of the subsidy is absorbed by higher than usual costs such as management salaries and benefits.

Exhibit 6  
**Robustness**

Estimates of Present Value of GSE Subsidy

Billions				
Elements of Subsidy	Mean	Median	10th Percentile	90th Percentile
	(1)	(2)	(3)	(4)
1. GSE Debt Subsidy	124	126	103	137
2. GSE MBS Subsidy	12	12	0	26
3. GSE Exemptions	6	6	5	7
<hr/>				
4. GSE Gross Subsidy	142	143	119	164
5. Homeowner Savings	43	44	20	70
<hr/>				
6. GSE Net Subsidy *	73	72	50	97
Memo:				
7. Percent Retained **	51	52	36	64
8. Net Subsidy as Percent of Market Value	62	60	42	81

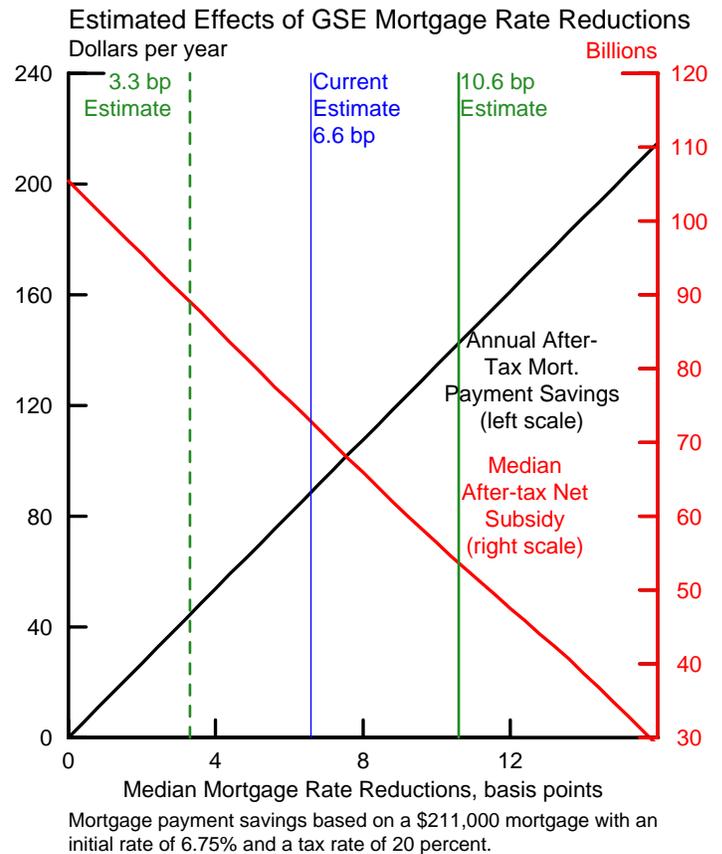
\* Difference between the GSE gross subsidy and the homeowner savings after a 26% tax rate. Values in columns 2, 3, and 4 do not necessarily sum because they reflect individual variable distributions.

\*\* Median and percentiles calculated for all 1998 simulations (not line 6 divided by line 4).

Robustness Test

	Increase in Factor (bps)	GSE Net Subsidy* Change (\$B)	GSE Net Subsidy* Change (%)
(1) Mortgage Savings	3	-11	-17
(2) Weighted Debt Spread	6	9	12
(3) Equity Premium	66	-5	-7
(4) MBS Subsidy	2	8	11
(5) Max Market Share	500	2	3

\* Compares the median over all simulations to the median of simulations where the given factor incremented by the given amount. For the MBS subsidy the base case is a subset of all simulations where the MBS subsidy equals 2 basis points and for the maximum market share the base case is a subset of all simulations where the maximum market share equals 60 percent.



drops the average net subsidy estimate \$11 billion, or 17 percent (line 1). A 6 basis point increase in the estimated GSE debt spread advantage raises the net subsidy estimate by \$9 billion or 12 percent (line 2). Both of these changes are within my bounds of error, illustrating that making precise implicit subsidy estimates is difficult. Regardless, the GSEs' implicit subsidy appears to be substantial. Other changes shown in the table, such as in the maximum market share assumption, have a much smaller impact.

The red line in the lower right panel further illustrates the importance of the estimated mortgage rate savings passthrough to homeowners in determining the size of the subsidy estimate. Small changes in this parameter can substantially change the size of the estimated subsidy. My simulations suggest that the GSEs retain a substantial portion of the subsidy—\$72 billion given my median estimated spread of 6.6 basis points (shown by the intersection of the red and blue lines on the chart). However, they would retain much less—\$53 billion—if rates were lowered by 10.6 basis points (the median reduction in the larger mortgage rate reduction scenario) and much more—\$88 billion—if rates were lowered only 3.3 basis points (the median in the smaller mortgage rate reduction scenario). (Note that these values are shown on the chart by the intersections of the red line with the solid green and the dashed green lines, respectively.)

Looking at this calculation from the perspective of the average homeowner, the annual mortgage payment saving (after accounting for the mortgage interest deduction) for a homeowner with a typical conforming mortgage in 2002 (the black line) was \$87 per year if GSE activity lowered their mortgage rate 6.6 basis points (the intersection of the black and the blue lines on the chart), \$145 if the mortgage rate were lowered 10.6 basis points (the intersection with the solid green line), and only \$46 (the intersection with the dashed green line) if the rate were lowered only 3.3 basis points. It is very hard to estimate such small quantities with precision using the data currently available. But given the large number of mortgages purchased by the GSEs, such estimates are important when judging the size of the GSE subsidy.

### **GSEs, Leverage, and the Implicit Government Subsidy**

As illustrated in exhibit 7, the implicit government subsidy has allowed Fannie Mae and Freddie Mac to operate with a higher return on equity, a lower return on assets, and a lower capital-to-asset ratio than other large financial institutions.<sup>31</sup> If the implicit subsidy could be removed and if the GSEs operated under the same conditions as other financial institutions, how would the GSEs change?

Without the implicit subsidy, the GSEs would likely hold fewer of their own securities directly and, instead, would allow a greater volume of their securities (as well as securities originated by others) to trade in public markets among purely private investors.<sup>32</sup> Note that such a decision has little effect on GSE mortgage purchases and thus little effect on mortgage rates and homeownership. Mortgages would still be purchased, but they would be securitized and distributed to the public, rather than securitized and held in GSE portfolios (and thus funded with implicitly-subsidized GSE debt). A rough estimate of how much capital the GSEs would need to raise and how much of their securities they would need to distribute to the public if the implicit subsidy was eliminated can be obtained by calculating the fraction of GSE income generated by the subsidy and then assuming that more typical financial ratios would result from their complete privatization.

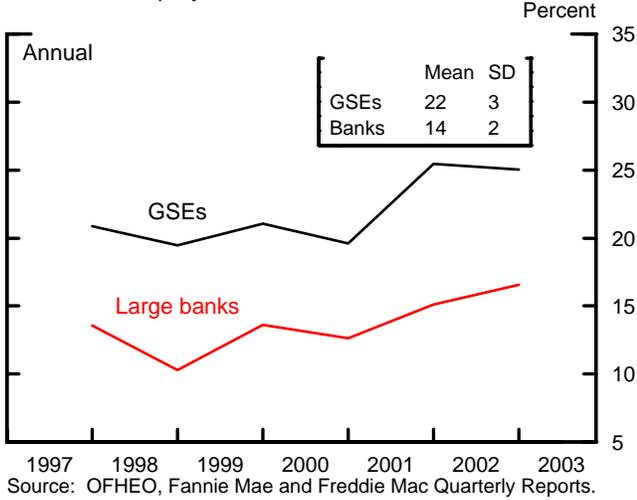
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31. I compare Fannie Mae and Freddie Mac to banks holding greater than \$50 billion in assets who belong to bank holding companies (BHCs) with risk characteristics similar to those of Fannie Mae and Freddie Mac. (There are 11 such companies.) To compare risk characteristics, I use Bloomberg's calculation of "beta." Beta is a measure of non-diversifiable risk to equity investors. Fannie Mae and Freddie Mac have a beta of around 0.8. In my comparison group, all of the BHCs have betas between 0.6 and 1.0. I use the commercial banks' return on equity and return on assets rather than the BHCs' returns to control for the possibility that large commercial banks are indirectly subsidized through the safety net or deposit insurance (the so-called "dueling subsidies" argument). For a description of this argument, see Van Order (2000a, 2000b).

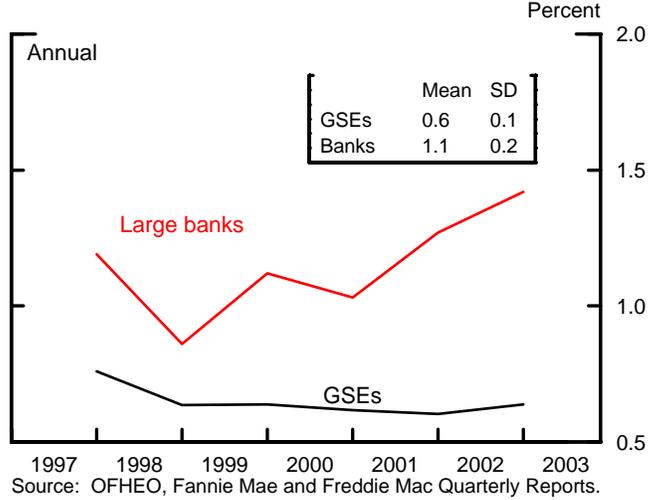
32. Most of the GSEs' mortgage-related assets in portfolio are mortgage-backed securities.

## Exhibit 7 Comparing GSEs to Large Banks <sup>1</sup>

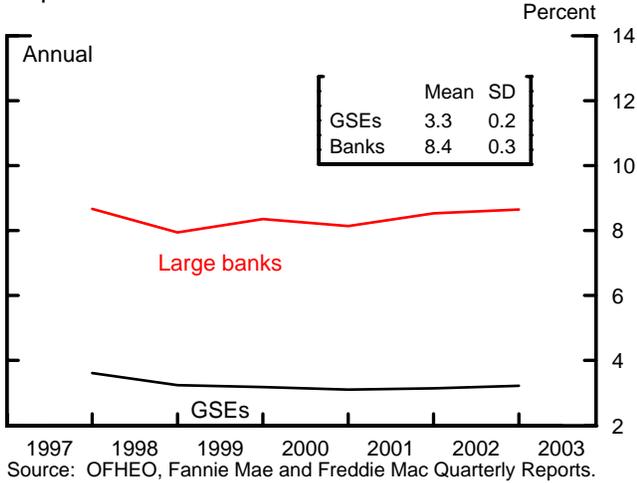
Return on Equity



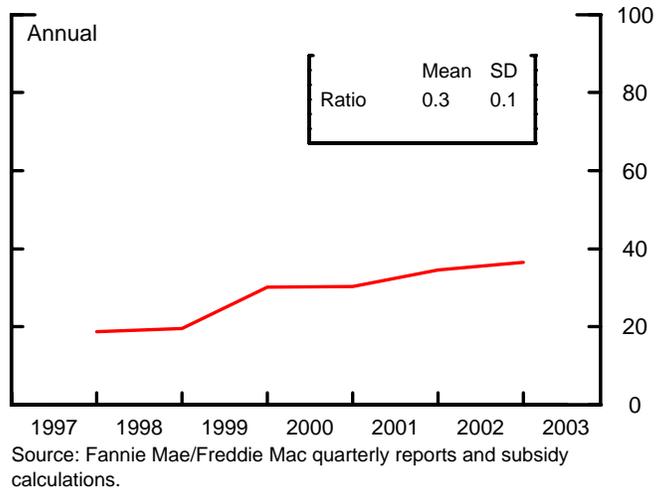
Return on Assets



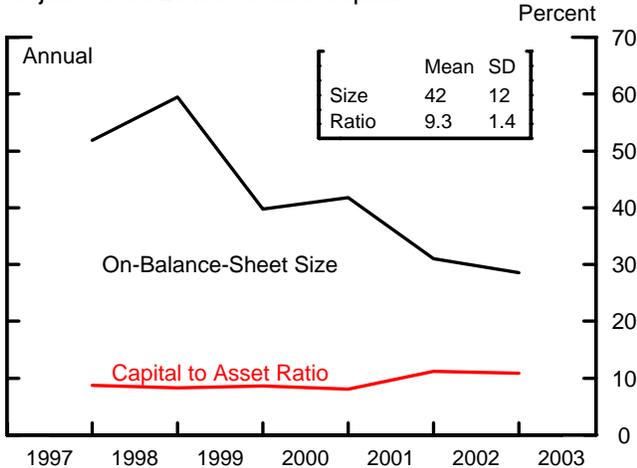
Capital to Assets



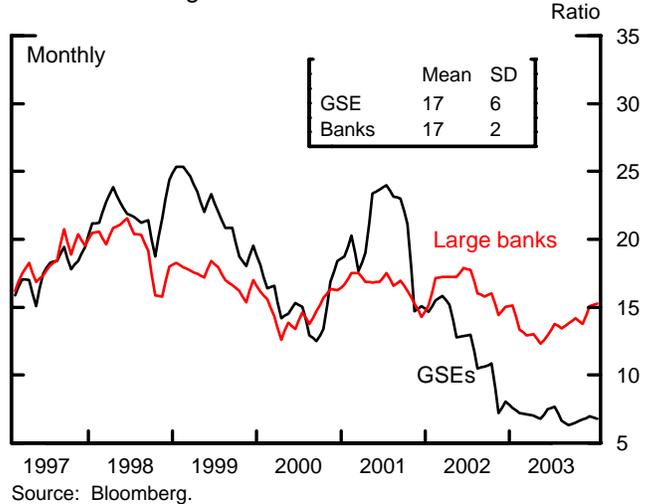
Estimated Net Subsidy to Net Income Ratio, GSEs



Adjusted GSE Assets and Capital



Price to Earnings Ratios



1. Large banks are all banks over \$50 billion with beta values within 0.2 of the GSEs.

The GSEs' income can be written as:

$$I_{GSE} = sI_{GSE} + (1 - s)I_{GSE} \quad (7)$$

where  $s$  is the share of income resulting from the implicit subsidy.

To calculate  $s$ , I use the same approach as used earlier to calculate the present values of the subsidy cash flows. In this case, however, I calculate the subsidy for a given year, rather than over a 25-year period. The result is divided by the actual income of the GSEs.<sup>33</sup> As shown in the middle right panel of exhibit 7, this share ranges between 20 percent and 40 percent, and mainly reflects my calculation of the GSE debt advantage for a given year.

As described above, if the implicit subsidy was zero, the GSEs would need to adjust their balance sheets so that their returns were more in line with the typical returns generated by large financial institutions. In particular, returns on assets would have to rise and returns on equity would have to fall until the risk-adjusted returns on assets and equity are equal across institutions with similar risk characteristics. One manifestation of the implicit subsidy is that GSE assets are generally safer than most other financial assets, but GSE returns on equity are higher—contrary to the common view that financial markets generally reward taking increased risk with higher financial returns. To make my calculation, I conservatively assume that GSE returns fall in line with the returns generated by large commercial banks whose parent companies are similar to the GSEs, even though the low risk of GSE assets might suggest they should fall even lower.<sup>34</sup> In other words,

$$roe_{bank} = \frac{(1 - s)I_{GSE}}{K^*} \quad ; \quad roa_{bank} = \frac{(1 - s)I_{GSE}}{A^*} \quad (8)$$

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33. The actual income for Freddie Mac in 2001, 2002, and 2003, however, is uncertain until their restatements are completed. I use the most recent values available as of November 2003.

34. As discussed earlier, it is difficult to find purely private financial institutions that are comparable to GSEs. No large financial institutions specialize in holding conforming mortgages.

where  $K^*$  and  $A^*$  would represent the capital and asset holdings of the GSEs without the implicit subsidy.

Since

$$roe_{GSE} = \frac{I_{GSE}}{K_{GSE}} \quad ; \quad roa_{GSE} = \frac{I_{GSE}}{A_{GSE}}, \quad (9)$$

I can rewrite these equations as:

$$\frac{K^*}{K_{GSE}} = \frac{(1-s)roe_{GSE}}{roe_{bank}} \quad ; \quad \frac{A^*}{A_{GSE}} = \frac{(1-s)roa_{GSE}}{roa_{bank}} \quad (10)$$

In the lower left panel of exhibit 7, I calculate the capital-to-asset ratio of this hypothetical no-implicit-subsidy GSE ( $K^*/A^*$ ) and the size of its on-balance sheet assets relative to the current GSE size ( $A^*/A$ ). Given the rough nature of these calculations, they can only be taken as suggestive. However, it appears that the GSEs would need to raise their capital-to-asset ratio substantially—to between 8 percent and 10 percent—and sell many of the mortgage-backed securities they currently hold in portfolio to the public, so that their mortgage-asset portfolio would be roughly thirty to sixty percent of its current size (although, recall, the dollar amount of mortgages purchased by the GSEs would not necessarily change because the mortgages would be purchased, securitized, and distributed to the public rather than purchased, securitized, and held in the GSEs' portfolios).<sup>35</sup>

While such actions would clearly lower GSE profitability, they might raise the GSEs' price-to-earning ratios. As shown in the lower right panel, the price-to-earnings ratios of these large commercial banks have recently exceeded that of the GSEs, suggesting that investors value more highly a dollar of earnings produced by banks than a

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35. If the GSEs only securitized mortgages, the percent of capital needed would be substantially less because of the low credit risk associated with conforming mortgages. It is the mortgage portfolio, with its interest rate and prepayment risks, that requires much higher levels of capitalization.

dollar of earnings produced by GSEs. One possible explanation for this different valuation is investors' realization that the political dependency of the GSEs makes their future earnings more uncertain and thus more difficult to value.

### **Directions for Further Research**

#### *Better Mortgage Rate Data*

Given the importance of the GSEs in mortgage markets and the size of the implicit subsidy suggested by my study, more attention should be paid to the measurement of the GSEs' performance in terms of passing their subsidy on to homeowners by lowering mortgage rates. Currently, the available data suggest that the size of the mortgage rate reduction brought about by the GSEs is small, but these data are not up to the task of measuring the GSEs' effect on mortgage rates precisely. More precise estimates could be made if more extensive mortgage data were collected that included mortgage rates, more extensive borrower credit characteristics, and whether the mortgage was purchased by a GSE. Given the large size of the GSEs' gross subsidy, ongoing evaluation of the size of the mortgage rate reduction brought about by the GSEs would seem warranted.

#### *Effects on Homeownership*

According to most research, small changes in interest rates have little effect on homeownership. A comprehensive survey by Feldman (2001) finds that mortgage rates would have to change by at least 200 basis points before there would be more than a trivial effect on homeownership, which suggests that the GSEs' influence on homeownership through mortgage rates is very small.

Lessening downpayment constraints on households and resolving problems with credit histories, in contrast to lowering mortgage rates, does seem to have a significant effect on home purchases (Barakova, Bostic, Calem, and Wachter, 2003; Rosenthal, 2002). Some of this effect reflects timing, as some households purchase homes sooner

than they would have otherwise. The Federal Housing Administration (FHA) is the government's primary tool for providing mortgages with minimal downpayments to low- and moderate-income households.

The GSEs, along with many banks, thrifts, credit unions, and state and local governments, do provide some mortgages with lower downpayment requirements. One study, sponsored by Freddie Mac, argues that downpayment requirements constrain some households from homeownership and that GSEs increase homeownership by offering programs that lower downpayments for some mortgages (Quercia, McCarthy, and Wachter, 2003). However, the authors' analysis provides no explicit link between GSE activities and homeownership, nor does it address the role of other government and private-sector initiatives, such as the Community Reinvestment Act (CRA). Indeed, in terms of underwriting the risk or providing the funding for mortgages to low- and moderate-income households, the GSEs have often been shown to lag behind the FHA and other types of lenders, although the GSEs' performance may have improved in recent years (Bunce, 2002; Bunce and Scheessele, 1996; Canner, Passmore and Surette, 1996; Williams, McConnell, and Nesiba, 2001; McClure, 2001). In fact, the GSEs may be poorly suited to finance low-downpayment mortgages because their charter requires that mortgages they purchase be similar in credit risk to mortgages with loan-to-value ratios of 80 percent or less.

#### *The GSEs, Home Prices, and Homebuilding*

Mortgage rates are a key part of the "user costs" of owning a home. However, a one-time downward shift in mortgage rates (possibly due to the GSEs) might or might not lower these costs. Any decline in user costs might be absorbed by higher home prices. Similarly, a one-time increase in mortgage rates might eventually be partly or completely offset by lower home prices. Who benefits from lower mortgage rates—home sellers or home buyers—depends on the relative bargaining power of sellers and buyers and, ultimately, on the relative ease of building new homes. If building new

homes is relatively easy, the bargaining power of home sellers is limited and home buyers are more likely to capture the benefits of lower mortgage costs.

This bargaining process between home buyers and sellers makes determining the effects of mortgage rates on homebuilding difficult. Unfortunately, current academic research does not seem to directly address the question of the magnitude of the effect on home prices or homebuilding of a one-time shift in mortgage rates. Some older research suggests there may be a significant effect, although the effect is difficult to interpret (Topel and Rosen, 1988).

The Federal Reserve Board staff's model of the U.S. economy (FRB US) suggests that raising interest rates 100 basis points lowers the annual rate of housing starts in the short-run about 4 to 5 percent (Reifschneider, Tetlow, and Williams, 1999). The effect is roughly linear, so a 10 basis point increase in mortgage rates would reduce housing starts about 0.5 percent or about 9,000 units—a small effect. The long-run effects are even smaller.

#### *Better Designs for Subsidizing Homeowners*

As pointed out by Feldman (1996), there are two major implications of using GSEs to deliver subsidies to homeowners. First, the size of the implicit subsidy is only weakly controlled by policymakers because the GSEs control their own debt issuance and hence the size of the implicit subsidy. Second, the shareholders of Fannie and Freddie have incentives to maximize the value of their stock, which may impede the efficient delivery of GSE benefits to homeowners.

To this list, one might add two more considerations. First, the implicit subsidy ultimately depends on purchasers of GSE debt and their view of the GSEs' relationship to the federal government. As noted by Poole (2003), this ambiguous relationship means that the subsidy might end abruptly should investors come to substantially doubt that the GSEs are government-backed. Second, as discussed earlier, the implicit subsidy has to pass through many channels before reaching home purchasers.

These four concerns suggest that more research is needed about the relative efficiency of different institutions for delivery of subsidies to homeowners. In particular, the effects of GSEs should be compared to more direct and targeted government mechanisms, such as the FHA, to determine which is more effective in reaching first-time and lower-income homebuyers.

**References**

- Ambrose, B., R. Buttimer, and T. Thibodeau (2001). "A New Spin on the Jumbo/Conforming Loan Rate Differential," *The Journal of Real Estate Finance and Economics*, 23, 309-336.
- Ambrose, B., M. LaCour-Little, and A. Sanders (2003). "The Effect of Conforming Loan Status on Mortgage Yield Spreads: A Loan Level Analysis," mimeo from authors, November 3, 2003.
- Ambrose, B., and A. Warga (1996). "Implications of Privatization: The Costs to Fannie Mae and Freddie Mac," in U.S. Department of Housing and Urban Development (Ed.), *Studies on Privatizing Fannie Mae and Freddie Mac*, U.S. Department of Housing and Urban Development, Washington D.C.: U.S. Department of Housing and Urban Development, 169-204.
- Ambrose, B., and A. Warga (2002). "Measuring Potential GSE Funding Advantages," *The Journal of Real Estate Finance and Economics*, 25, 129-150.
- Barakova, I., R. Bostic, P. Calem, and S. Wachter (2003). "Does Credit Quality Matter for Homeownership?" *Journal of Housing Economics*, 12:4, 318-336.
- Bolder, D., and D. Strélski (1999). "Yield Curve Modeling at the Bank of Canada," *Technical Report No. 84*, Bank of Canada.
- Bunce, H. (2002). "The GSEs Funding of Affordable Loans: A 2000 Update," *Housing Finance Working Paper No. HF-013*, Office of Policy Development and Research, Department of Housing and Urban Development, April.
- Bunce, H., and R. Scheessele (1996). "The GSEs' Funding of Affordable Loans," *Housing Finance Working Paper No. HF-001*, Office of Policy Development and Research, Department of Housing and Urban Development, December 31.
- Canner, G., W. Passmore, and B. Surette (1996). "Distribution of Credit Risk Among Providers of Mortgages to Lower-income and Minority Homebuyers," *Federal Reserve Bulletin* 82, 1077-1102.

Congressional Budget Office (1996). *Assessing the Public Costs and Benefits of Fannie Mae and Freddie Mac*, Washington D.C.: Government Printing Office.

Congressional Budget Office (2001). *Federal Subsidies and the Housing GSEs*, Washington D.C.: Government Printing Office.

Cotterman, R., and J. Pearce (1996). "The Effects of the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation on Conventional Fixed-Rate Mortgage Yields" in U.S. Department of Housing and Urban Development (Ed.), *Studies on Privatizing Fannie Mae and Freddie Mac*, U.S. Department of Housing and Urban Development, Washington D.C.: U.S. Department of Housing and Urban Development, 97-168.

Fannie Mae (2001), *Setting the Record Straight: An Analysis of CBO's 2001 Report on Fannie Mae and Freddie Mac*, May 23.

Feldman, R. (1996). "Uncertainty in Federal Intervention," *The Region*, Federal Reserve Bank of Minneapolis, September.

Feldman, R. (1999). "Estimating and Managing the Federal Subsidy of Fannie Mae and Freddie Mac: Is Either Task Possible?" *Journal of Public Budgeting, Accounting and Financial Management*, 11, Spring, 81-116.

Feldman, R. (2001). "Mortgage Rates, Homeownership Rates, and Government-Sponsored Enterprises," *Federal Reserve Bank of Minneapolis Annual Report*, pp. 3-23.

Gatti, J., and R. Spahr (1997). "The Value of Federal Sponsorship: The Case of Freddie Mac," *Real Estate Economics*, 23, 453-486.

Goodman, J., and W. Passmore (1992). "Market Power and the Pricing of Mortgage Securitization," *Federal Reserve Board Finance and Economics Discussion Series*, Paper no. 187.

Gross, D. (2003). "The Government's Role in Promoting Financial Sector Stability," *Fannie Mae Papers*, 2:3.

Hendershott, P., and J. Shilling (1989). "The Impact of Agencies on Conventional Fixed-Rate Mortgage Yields," *The Journal of Real Estate Finance and Economics*, 2, 101-115.

Hermalin, B., and D. Jaffee (1996). "The Privatization of Fannie Mae and Freddie Mac: Implications for Mortgage Industry Structure," in U.S. Department of Housing and Urban Development (Ed.), *Studies on Privatizing Fannie Mae and Freddie Mac, U.S. Department of Housing and Urban Development*, Washington D.C.: U.S. Department of Housing and Urban Development, 225-302.

Heuson, A., W. Passmore, and R. Sparks (2001). "Credit Scoring and Mortgage Securitization: Implications for Mortgage Rates and Credit Availability," *Journal of Real Estate Finance and Economics*, 23, 337-364.

Kane, E. (1999). "Housing Finance GSEs: Who Gets the Subsidy?" *Journal of Financial Services Research*, 15, 197-209.

McClure, K., (2001). "The Twin Mandates Given the GSEs: Which Works Best Helping Low-Income Homebuyers or Helping Underserved Areas?" *Cityscape*, 5:3, 107-143.

McKenzie, J., (2002). "A Reconsideration of the Jumbo/Non-Jumbo Mortgage Rate Differential," *Journal of Real Estate Finance and Economics*, 25, 197-213.

Naranjo, A., and A. Toevs (2002). "The Effects of Purchases of Mortgages and Securitization by Government Sponsored Enterprises on Mortgage Yield Spreads and Volatility," *The Journal of Real Estate Finance and Economics*, 25, 173-196.

Nelson, C., and A. Siegel (1987). "Parsimonious Modeling of Yield Curves," *Journal of Business* 60, 473-489.

Nott L., and M. Jickling (2003). "Improving the Effectiveness of GSE Oversight: Legislative Proposals," *CRS Report for Congress RL32069*, Congressional Research Service, The Library of Congress.

Nothaft, F., J. Pearce, and S. Stevanovic (2002). "Debt Spreads Between GSEs and Other Corporations," *Journal of Real Estate Finance and Economics*, 25, 151-172.

Passmore, W., S. Sherlund, and G. Burgess (2003). "The Effect of Government Sponsored Enterprises on Mortgage Rates," preliminary draft available from the authors.

Passmore, W., and R. Sparks (1996). "Putting the Squeeze on a Market for Lemons: Government-Sponsored Mortgage Securitization," *Journal of Real Estate Finance and Economics*, 13, 27-43.

Passmore, W. and R. Sparks (2000). "Automated Underwriting and the Profitability of Mortgage Securitization," *Journal of Real Estate Economics*, 25, 285-305.

Passmore, W., R. Sparks and J. Ingpen (2002). "GSEs, Mortgage Rates and Mortgage Securitization," *Journal of Real Estate Finance and Economics*, 25, 215-242.

Pearce, J., and J. Miller (2001). "Freddie Mac and Fannie Mae: Their Funding Advantage and Benefits to Consumers," Freddie Mac mimeo.

Poole, W. (2003). "Housing in the Macroeconomy," Speech delivered at Office of Federal Housing Enterprise Oversight Symposium, March 10.

Quercia, R., G. McCarthy, and S. Wachter (2003). "The Impacts of Affordable Lending Efforts on Homeownership Rates," *Journal of Housing Economics*, 12, 29-59.

Reifschneider, D., R. Tetlow, and J. Williams (1999), "Aggregate Disturbances, Monetary Policy, and the Macroeconomy: The FRB/US Perspective," *Federal Reserve Bulletin*, 85, 1-19.

Rosenthal, S. (2002), "Eliminating Credit Barriers: How Far Can We Go?" in Relsinas, N. and Belsky, E., *Low Income Homeownership*, Brookings Institute, Washington D.C., 111-145.

Sanders, A. (2002). "Government Sponsored Agencies: Do the Benefits Outweigh the Costs?" *Journal of Real Estate Economics*, 25, 121-127.

Sharpe, S. (2002). "Reexamining Stock Valuation and Inflation: The Implications of Analysts' Earnings Forecasts," *The Review of Economics and Statistics*, 84, 632-48.

Snow, J. (2003). "Testimony Before the Committee on Financial Services," House of Representatives, September 10.

Snow, J. (2003). "Testimony Before the Committee on Banking, Housing, and Urban Affairs," United States Senate, October 16.

Toevs, A. (2001) "A Critique of the CBO's Sponsorship Benefit Analysis," *Proceedings of the 37<sup>th</sup> Annual Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 150-164.

Topel, R., and Sherwin Rosen (1988). "Housing Investment in the United States," *Journal of Political Economy*, 96, 718-740.

Torregrosa, D. (2001). "Interest Rate Differentials Between Jumbo and Conforming Mortgages, 1995-2000," Congressional Budget Office.

U.S. Department of Treasury (1996). *Government Sponsorship of the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation*, Washington D.C.: Government Printing Office.

U.S. General Accounting Office (1996). *Housing Enterprises: Potential Impacts of Severing Government Sponsorship*, Washington D.C.: Government Printing Office.

Van Order, R. (2000a). "A Microeconomic Analysis of Fannie Mae and Freddie Mac," *Regulation*, 23:2, 27-33.

Van Order, R. (2000b). "The U.S. Mortgage Market: A Model of Dueling Charters," *Journal of Housing Research*, 11:2, 233-255.

Williams, R., E. McConnell, and R. Nesiba (2001). "The Effects of the GSEs, CRA, and Institutional Characteristics on Home Mortgage Lending to Underserved Markets," *Cityscape*, 5:3, 9-106.