UNDERSTANDING MARKET DISCIPLINE IN THE PRESENCE OF IMPLICIT GOVERNMENT GUARANTEES: AN ANALYSIS OF SUBORDINATED BOND AND STOCK RETURNS FOR GSES AND FOR BANK HOLDING COMPANIES

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ABSTRACT

When studying changes in the risks of large bank holding companies (BHCs) and government-sponsored enterprises (GSEs), researchers routinely argue that changes in the responsiveness of stock and subordinated bond returns to exogenous risk factors can be interpreted as reflecting changes in investors' views about the firm's expected losses. However, investors may perceive that these large firms have substantial implicit government guarantees. We show that these guarantees can confound the interpretation of stock and bond return responsiveness, making changes in the responsiveness of bond returns difficult to interpret. We also show that changes in the responsiveness of stock returns are almost impossible to interpret. These results suggest that implicit guarantees can hide investors' perceptions of changes in expected loss due to important risk factors, thereby confounding market and regulatory efforts to correctly price and manage risks. We provide conditions under which bond returns can be usefully interpreted as reflecting expected losses and thus the relative riskiness of firms.

We consider the risk-sensitivity of subordinated bond returns of highly rated BHCs and of GSEs to macroeconomic shocks during two periods: April 1, 2001 to May 31, 2003 and June 1, 2003 to September 15, 2004. Although the GSEs (Fannie Mae and Freddie Mac) and the largest U.S. bank holding companies may benefit substantially from a perceived implicit government guarantee of their liabilities, in the later period the political support for government backing of the GSEs seemed less certain to investors, while there was no news or legislative developments that likely would have changed the perceived implicit government guarantees for BHCs.

We show that the responsiveness of subordinated bond returns to macroeconomic shocks during the two periods considered indicate that (1) BHCs' bond returns across the two periods became less sensitive to changes in macroeconomic factors that affect credit risks but more sensitive to changes in macroeconomic factors that influence interest rate risks, (2) changes in implicit guarantees made it difficult to interpret GSE bond returns across the two periods, and (3) bond investors generally believed that GSEs are at least as risky, and maybe more risky, (that is, their expected losses are more sensitive to macroeconomic risk factors) when compared with BHCs. While our technique does not identify the source of this potentially greater risk, we note that financial theory would suggest that GSEs might have greater risks because they are less diversified and not as well capitalized as BHCs.

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I. INTRODUCTION

Market discipline has the potential to work with regulatory efforts to promote safety and soundness in financial firms. Investors with their own money at risk have strong incentives to monitor financial firms and to pressure them to conduct their business in a safe, sound, and efficient manner. They also have a strong incentive to pressure financial firms to maintain a strong capital base as a cushion against future losses arising from risks undertaken. Given these incentives, policymakers have a clear interest in facilitating effective market discipline as a catalyst for strengthening the safety and soundness of the financial system.[1]

Market discipline does not come naturally to some large financial firms. The federal safety net limits market discipline on banking organizations, for example, because insured depositors have virtually no incentive to pressure such organizations to maintain a strong capital base. Similarly, investors in housing-related government-sponsored enterprise (GSE) debentures perceive that federal sponsorship implies that the federal government would bail them out in the event of a default. This perception of an "implicit government guarantee" implies that investors are more willing to accept a lower rate of interest on GSE debt than they would otherwise.[2]

When studying changes in the risks of GSEs and large bank holding companies (BHCs), researchers routinely argue that changes in the responsiveness of stock and subordinated bond returns to exogenous risk factors can be interpreted as reflecting changes in investors' views about the firm's expected losses. However, investors may perceive that these large firms have substantial implicit government guarantees. We show that these guarantees can confound the interpretation of stock and bond return responsiveness, making changes in the responsiveness of bond returns difficult to interpret. We also show that changes in the responsiveness of stock returns are almost impossible to interpret. These results suggest that implicit guarantees can hide investors' perceptions of changes in expected loss due to important risk factors, thereby confounding market and regulatory efforts to correctly price and manage risks. We provide

[1] The Gramm-Leach-Bliley Act of 1999, for example, directed the Board of Governors of the Federal Reserve System and the Secretary of the Treasury to study and to report to Congress whether it would be feasible and appropriate to require systemically important depository institutions and their holding companies to maintain some portion of their capital in the form of subordinated debt. See Board of Governors of the Federal Reserve System and U.S. Department of Treasury (2000).

[2] Greenspan (2004, 2005a) argues that investors view the GSEs as extensions of the government and thus GSE debt as an extension of government debt. Passmore (2005) argues that these implicit guarantees are worth billions of dollars and Passmore, Sherlund and Burgess (2005) show that the benefit of these implicit guarantees are captured mainly by GSE shareholders and thus the implicit guarantees have little effect on mortgage rates.

conditions under which bond returns can be usefully interpreted as reflecting expected losses and thus the relative riskiness of firms.

We consider the risk sensitivity of subordinated bond returns of highly rated BHCs (in this study we use data on Bank America, Citigroup, and Wells Fargo) and of GSEs (Fannie Mae and Freddie Mac) to macroeconomic shocks during two periods: April 1, 2001 to May 31, 2003 and June 1, 2003 to September 15, 2004. Although the GSEs and BHCs may benefit substantially from a perceived implicit government guarantee of their liabilities, in the later period the political support for government backing of the GSEs seemed less certain to investors, while there was no news or legislative developments that likely would have changed the perceived implicit government guarantees for BHCs.

We show that the responsiveness of subordinated bond returns to macroeconomic shocks during the two periods considered indicate that (1) BHC's bond returns across the two periods became less sensitive to changes in macroeconomic factors that affect credit risks but more sensitive to changes in macroeconomic factors that influence interest rate risks, (2) changes in implicit guarantees made it difficult to interpret GSE bond returns across the two periods, and (3) bond investors generally believed that GSEs are at least as risky, and maybe more risky, (that is, their expected losses are more sensitive to macroeconomic risk factors) when compared with BHCs. While our technique does not identify the source of this potentially greater risk, we note that financial theory would suggest that GSEs might have greater risks because they are less diversified and not as well capitalized as BHCs.

The organization of the paper is as follows: In the next section, the market discipline literatures for banking organizations and for the housing enterprises are reviewed. Section III considers recent stock market time-series data for the GSEs. Section IV provides the intuition behind our approach for understanding recent changes in the risk sensitivity of financial firm asset returns. In Section V, the empirical model is specified. Data sources and methods are provided in Section VI. Our findings and conclusions are provided in sections VII and VIII, respectively.

II. CURRENT MARKET DISCIPLINE EVIDENCE

Banking Organizations. In empirical studies, changes in market discipline have traditionally been gauged using changes in the risk-sensitivity of debt spreads, or changes in the risk sensitivity of equity market-based data, across different regimes that are identified using news events, changes in deposit insurance liquidation procedures, or legislative changes. Banking organization *i*'s subordinated debt spread over a comparable maturity Treasury security at time t, r_{it}, for example, is typically assumed to depend on bank-specific risk factors, RF_{it},[3] and on various controls such as systematic risk factors (e.g., stock market excess returns) and bond market liquidity indicators, $CONTROLS_{it}$. In the notation terms,

$$r_{it} = f(RF_{it}, CONTROLS_{it}) + \varepsilon_{it}. \quad (1)$$

The default risk portion of the debt spread, r^d, depends on the firm's expected loss, *E(L)*, which is the product of the probability of default, *PD*, the loss given default, *LGD*, and the probability that the firm will *not* be bailed out by the government, *g*, or:

$$r^d = E(L) \bullet g \equiv PD \bullet LGD \bullet g. \quad (2)$$

As *g* approaches zero, the default risk portion of the debt spread, r^d, also approaches zero and the debt spread becomes insensitive to firm-specific risks. Under these circumstances, changes in returns would not necessarily reflect changes in investors' perceptions about expected losses and therefore investors would be impeded from exerting market discipline on the firm. But as *g* approaches one, the default risk portion of the debt spread approaches the true expected loss ($PD \cdot LGD$) as perceived by subordinated bond investors. Because *g* is not directly observable, researchers typically infer a change in *g* by looking at changes in the risk sensitivity of market-based risk measures, whether derived from bond market spreads or equity prices, across different regulatory or legislative regimes. However, as we show below, such identification is not sufficient under all circumstances to determine the direction of movement in the change in expected losses from changes in stock and bond returns.

Exhibits 1 and 2 summarize the news events and legislative changes used to define

[3] Commonly used risk factors include the ratio of nonaccrual loans to total assets, the ratio of accruing loans past due 90 days or more to total assets, the ratio of other real estate owned to total assets, the ratio of book liabilities to the market value of common stock plus the book value of preferred stock, and the absolute value of the banking organization's maturity gap as a proportion of equity value. See, for example, Flannery and Sorescu (1996).

Exhibit 1: Testing for Bond Market Discipline in Banking

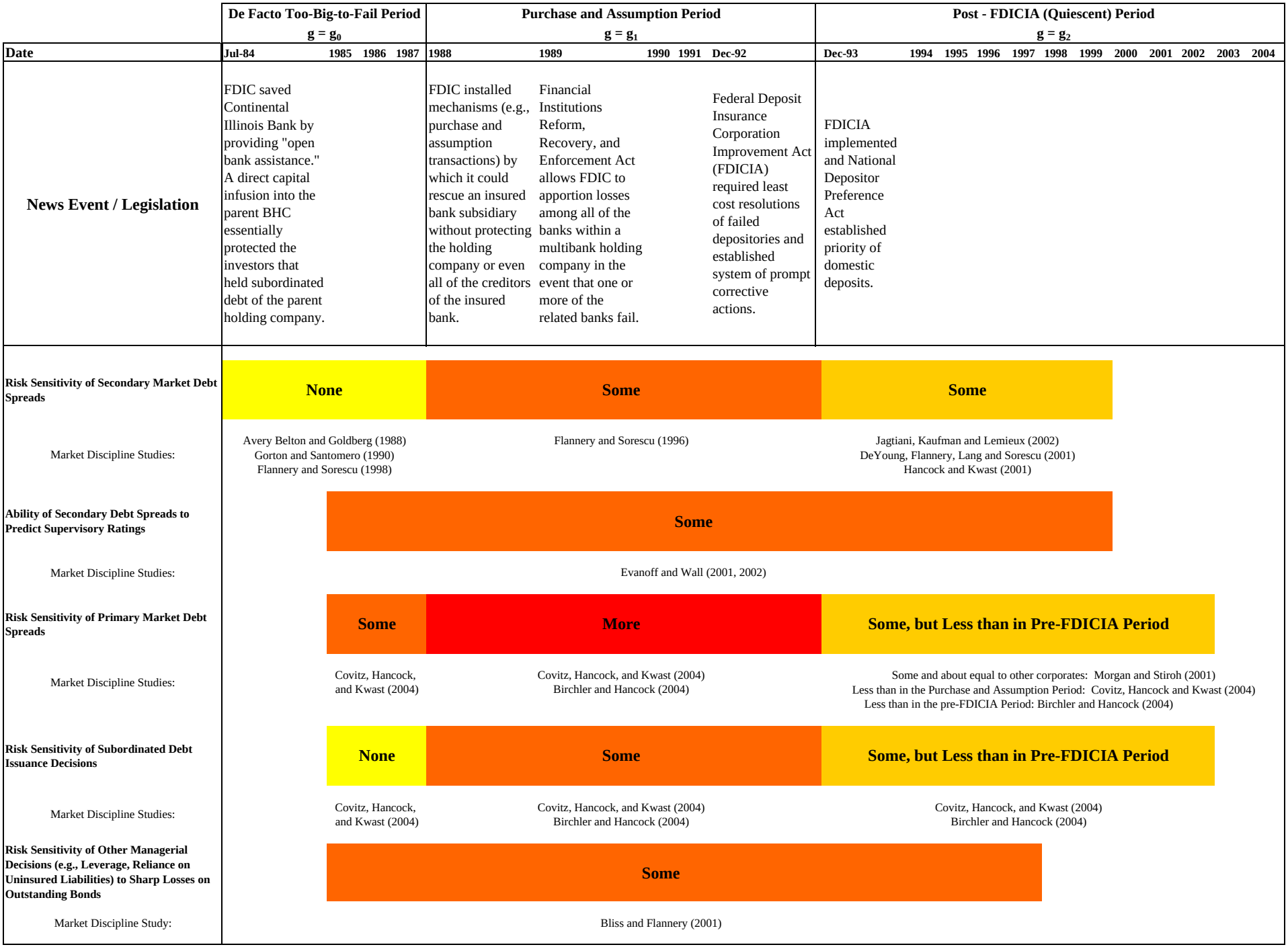


Exhibit 2: Testing for Equity Market Discipline in Banking

	De Facto Too-Big-to-Fail Period $g = g_0$				Purchase and Assumption Period $g = g_1$					Post - FDICIA (Quiescent) Period $g = g_2$								
Date	**Jul-84**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**Dec-92**	**Dec-93**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001 - 2004**
News Event / Legislation	FDIC saved Continental Illinois Bank by providing "open bank assistance." A direct capital infusion into the parent BHC essentially protected the investors that held subordinated debt of the parent holding company.				FDIC installed mechanisms (e.g., purchase and assumption transactions) by which it could rescue an insured bank subsidiary without protecting the holding company or even all of the creditors of the insured bank.	Financial Institutions Reform, Recovery, and Enforcement Act allows FDIC to apportion losses among all of the banks within a multibank holding company in the event that one or more of the related banks fail.			Federal Deposit Insurance Corporation Improvement Act (FDICIA) required least cost resolutions of failed depositories and established system of prompt corrective actions.	FDICIA implemented and National Depositor Preference Act established priority of domestic deposits.							
Risk Sensitivity of Shareholder Returns	**None**																	
Market Discipline Study:	Simons and Cross (1991): Returns do not anticipate supervisory downgrades																	
Risk Sensitivity of Abnormal Stock Returns					**Some**			**Some or Not Much**	**Not Much**									
Market Discipline Studies:					Aharony and Swary (1996): Investors make rational inferences about value of surviving banks.				Berger, Davies, Flannery (2000): Equity holders focus on non-default outcomes.									
Risk Sensitivity of Market-to-Book Equity Ratio					**Some**													
Market Discipline Study:					Davies (1993): Market leverage ratios can help predict bank solvency.													
Risk Sensitivity of Expected Default Frequency Derived from Equity Data														**Some**				
Market Discipline Study:														Gunther, Levonian, and Moore (2001):KMV EDFs help predict supervisory ratings.				

different regimes (top panels) and the major findings of market discipline studies (bottom panels) that have used information from the bond market and from the equity market, respectively. In the period just after the Federal Deposit Insurance Corporation (FDIC) saved Continental Illinois by providing open bank assistance – the *de facto* too-big-to-fail period – subordinated debt and equity investors of other large U.S. BHCs appear to have been almost certain that they would also be bailed out by the government (i.e., g_0^{BHC} was close to zero). Neither secondary market subordinated debt spreads over comparable maturity Treasury securities (Exhibit 1), nor shareholder returns (Exhibit 2), were sensitive to banking organization-specific risks in this period. Moreover, the risk sensitivity of subordinated debt issuance spreads was not sufficient to influence the issuance decisions of these firms (Exhibit 1).

After the FDIC installed mechanisms (e.g., purchase and assumption transactions) by which it could rescue an insured bank subsidiary without protecting the holding company or even all of the creditors of the insured bank – the purchase and assumption period – the risk sensitivity of subordinated debt spreads, observed in both the secondary and the primary debt markets, increased (Exhibit 1); the risk-sensitivity of subordinated debt issuance decisions increased (Exhibit 1); and risk-sensitivity of stock returns and the market-to-book equity ratio became statistically detectable (Exhibit 2). All these findings have been argued to be consistent with a reduction in implicit government guarantees (i.e., an increase in the probability that banking organizations would not be bailed out ($g_1^{BHC} > g_0^{BHC}$)).

In the early 1990s, the Federal Deposit Insurance Corporation Improvement Act (FDICIA) required least cost resolutions of failed depositories and established a system of prompt corrective actions for bank supervisors. In addition, National Depositor Preference established a priority for domestic deposits.[4] These reforms, which marked the beginning of the post-FDICIA period, may have influenced investor perceptions with respect to both *LGD* and the potential for government guarantees. On balance, the evidence suggests that the risk-sensitivity of subordinated debt spreads may have declined in the post-FDICIA period relative to the "purchase and assumption" period, but this decline was not sufficient to make issuance decisions become insensitive to banking organization-specific risks (Exhibit 1). Moreover, equity prices continued to be sensitive to banking organization-specific risks in the post-FDICIA period (Exhibit 2).

[4] See Title III of Omnibus Budget Reconciliation Act of 1993.

Housing Enterprises. The Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac) are GSEs chartered by the United States Congress. These housing-related 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, the size of their portfolios, the fact that the government mandates housing goals for these firms, and 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, exemptions from securities registration requirements similar to those provided to U.S. agencies, exemptions from bank regulations on security holdings, and tax exemptions. The result is an ambiguous relationship between the GSEs and the federal government in which investors infer government support while government officials deny it.

Both Fannie Mae and Freddie Mac have been embroiled in significant accounting scandals during the past three years—scandals that not only called into question their financial statements but also the quality of their managements. In both cases, many senior managers, including CEOs from both companies, resigned from the company. Both companies are engaged in substantial and costly audits in an effort to produce valid financial statements for recent years.

Because of the accounting scandals and management shake-ups, Congress has been debating strengthening the regulation of the GSEs. The GSEs' current regulator, the Office of Federal Housing Enterprise Oversight (OFHEO), generally does not have the same authority to set capital standards or impose regulatory sanctions as do regulators of banks and other depository institutions. While most participants in the Congressional debate agree on the need for strengthening the GSE regulator's authority, there are sharp differences about how to address the GSEs' ambiguous relationship with the federal government and thereby the implicit guarantee. In particular, some see this relationship as key to the success of the GSEs, allowing them to funnel low-cost funds into the mortgage markets. In contrast, others are influenced by

empirical evidence that indicates that the subsidy associated with the implicit guarantee is mainly captured by GSE shareholders and thus provides little benefit to mortgage or housing markets.[5]

More recently, the Bush Administration and the Federal Reserve Board have argued that the GSEs should not be allowed to hold very large portfolios of assets – particularly their own mortgage-backed securities – because they perceive little public benefit from such large holdings, while the size of these portfolios may create substantial systemic risk to the financial system (Greenspan, 2005b). These large portfolios raise many questions about the market discipline associated with the GSEs because of the large amount of debt issued to purchase the portfolio assets. (In contrast, the GSEs' securitization of mortgage assets does not generate many on-balance sheet assets nor result in debt issuance, and thus issues related to market discipline and systemic risk do not arise with respect to these activities.)

Because the implicit government guarantee for GSEs inferred by investors was very strong up until recent years, empirical studies that consider market discipline on these financial firms have focused on relatively recent bond and stock market information. In Exhibit 3, we summarize news events and legislative developments that define different periods (top panel) and major findings of the GSE market discipline studies (bottom panel). During the February 2000 to May 2003 period, U.S. Treasury Under Secretary Gensler expressed support for repealing the Treasury's discretionary authority to purchase $2.25 billion of an enterprise's debt, Fannie Mae and Freddie Mac announced plans to implement voluntary initiatives aimed at improving transparency and market discipline, Freddie Mac replaced its auditor and announced plans to restate its earnings for 2000-2001, the enterprises announced that they would register their stock with the SEC, and Fannie Mae registered its stock with the Securities and Exchange Commission (SEC). We refer to this period as the "GSE Reappraisal Period."

The replacement of Freddie Mac management on June 9, 2003 took the markets and many policymakers by surprise. During this most recent period, June 2003 to September 15, 2004, there was increased debate by policymakers (including hearings and proposed legislation) with regard to the role of a GSE regulator, an on-going management shake-up at Freddie Mac, an investigation of Freddie Mac by the SEC and the Department of Justice (DOJ), and restated

[5] See Passmore (2005), Passmore, Sherlund, and Burgess (2005), and Lehnert, Passmore, and Sherlund (2005).

Exhibit 3: Testing for Bond and Equity Market Discipline on Housing-Related GSEs

	Quiescent Period $g = g_A$					GSE Reappraisal Period $g = g_B$										Legislative Risk Period $g = g_C$						
Date	**1984-'88**	**Aug-89**	**1990-'91**	**Oct-92**	**1993-'99**	**Mar-00**	**Oct-00**	**2001**	**Mar-02**	**Jul-02**	**Sep-02**	**Oct-02**	**Jan-03**	**Mar-03**	**Mar-03**	**Jun-03**	**Jun-03**	**Oct-03**	**Feb-04**	**Jul-04**	**Sep-04**	**Dec-04**
News Event / Legislation		FIRREA established Freddie Mac as a private entity.		OFHEO created as an independent entity within HUD to ensure the capital adequacy and financial soundness of the Enterprises.		U.S. Treasury Under Secretary Gensler testified before Rep. Baker's subcommittee. He expressed support for repealing the Treasury's discretionary authority to purchase $2.25 billion of an Enterprise's debt.	Fannie Mae and Freddie Mac announced plans to implement six voluntary initiatives.		Freddie Mac replaced its auditor, Arthur Anderson, with Price Waterhouse Coopers.	The Enterprises announced plans to register their stock with the SEC -- a voluntary initiative.	Fannie Mae released portfolio duration gap of -14 months.	Fannie Mae released portfolio duration gap of -10 months.	Freddie Mac announced plan to restate earnings for 2000-2001.	Federal Reserve Bank of Saint Louis President William Poole speech highlights GSE risks.	Fannie Mae registered stock with the SEC.	Freddie Mac's senior management shake-up.	SEC and DOJ investigations of Freddie Mac announced.	Fannie Mae restated earnings that varied from correct amounts by more than $1 billion in some cases.	Chairman Greenspan's initial testimony on GSEs.	Fannie cuts expected profit outlook.	Fannie makes OFHEO investigation public.	On Dec. 16, SEC orders Fannie to restate earnings. On Dec. 21, Fannie's Board of Directors announces retirement of Chairman and Chief Executive Raines and resignation of Vice Chairman and Chief Financial Officer Howard.
Sensitivity of Secondary Market Senior Debt Spreads to Financial and Political Risks																						
Market Discipline Study:						**Some**																
						Seiler (2003)																
Sensitivity of Share Prices to Financial and Political Risks																						
Market Discipline Study:						**Some**																
						Seiler (2003)																
Stock Return and Interest Rate Risk at Fannie Mae and Freddie Mac																						
Market Discipline Study:						**Some**																
						Schmid (2004)																
Convexity of the "Barrier Put Option" on the Equity Claim in Terms of the Market Excess Return																						
Market Discipline Study:						**Changing?**																
						Schmid (2004)																

earnings by Fannie Mae. We refer to this more turbulent time period as the "GSE Legislative Risk Period."

Consistent with the view that GSE investors are attuned to the implicit guarantee and worry that the government may not necessarily bail out a failing GSE, an econometric study using data from the February 2000 to June 2003 period found both equity returns and GSE secondary market *senior* debt spreads over comparable maturity Treasury securities seemed to be sensitive to both financial and legislative risks (Exhibit 3, bottom panel). However, the results with regard to senior debt were statistically weak and economically insignificant. Another nonparametric study examined GSE stock return data from May 1991 to December 2003 and reported that GSE equity investors behave as if they do not need to worry about substantial losses. However, it is difficult to infer from this nonparametric study whether the investors' perceived likelihood of a government bailout has declined or increased.

No study has considered changes in the risk-sensitivity of subordinated debt spreads or of stock market returns over different regimes for GSEs. This lack of research reflects the facts that (1) subordinated debt instruments were not issued by both GSEs until the first quarter of 2001, (2) the traditional approach tends to rely on quarterly accounting data for risk factors,[6] and (3) significant changes in the perceived probability that the government will not bail out GSE investors have occurred only recently.

III. RECENT TURMOIL AT THE GSES AND GSE EQUITY PRICE MOVEMENTS

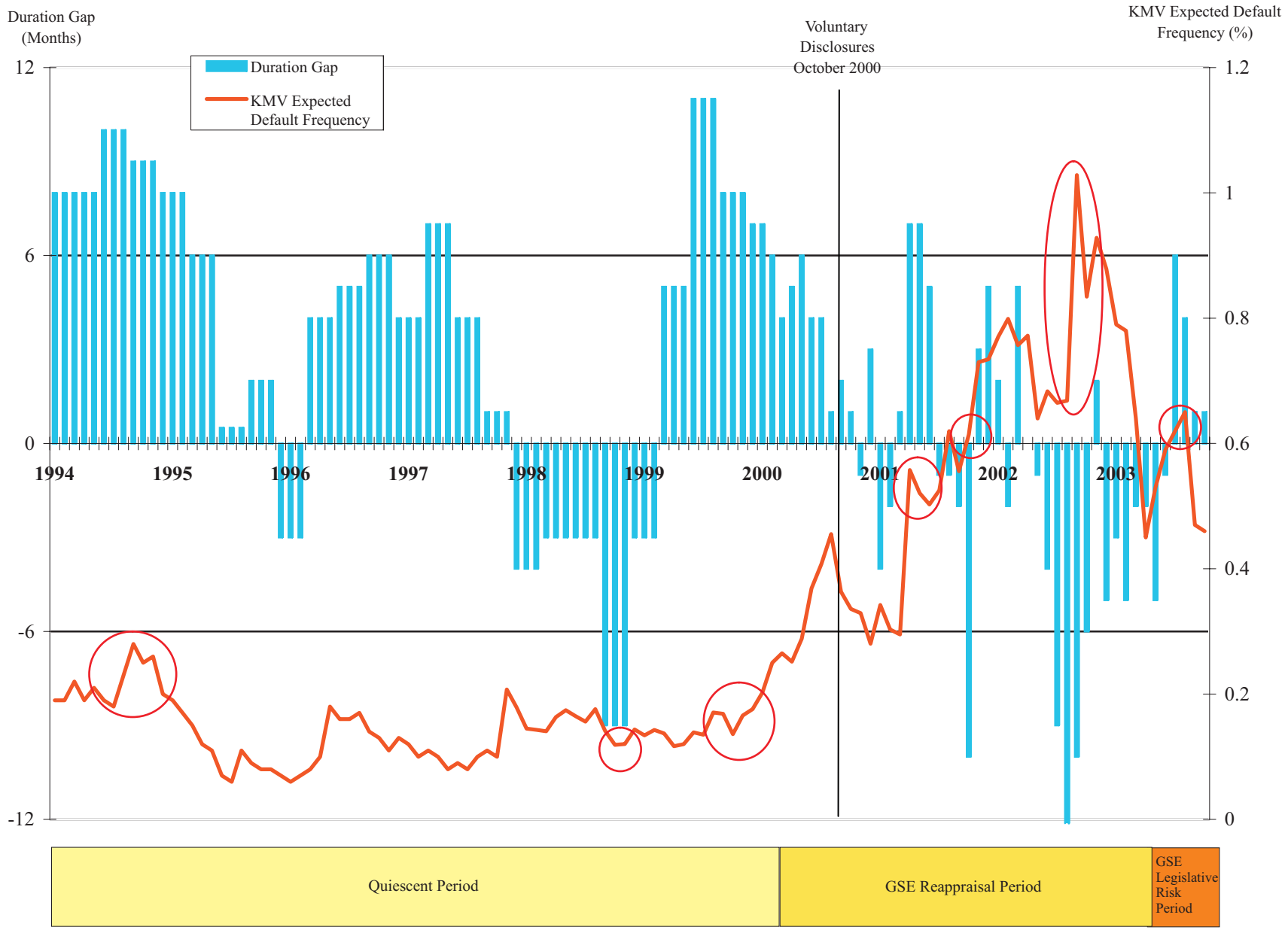
Recent turmoil at the GSEs concerning their government status may have been reflected in the time-series data for their equity prices. To determine whether GSE shareholders are more responsive to financial news during more recent time periods, we consider the degree to which equity market-based expected default frequencies (EDFs)[7] reflect GSE financial risk disclosures. Exhibit 4 presents Fannie Mae's EDFs with its duration gaps over 1994-2003.[8] Prior to October

[6] Correct accounting data have not been available for Fannie Mae and Freddie Mac during 2002-2003. See Exhibit 3.

[7] Using the insight that the payoff to the equity holders is comparable to that of a call option on the assets of a firm, KMV has derived EDF credit risk measures from publicly available equity prices and from data on the capital structures of firms. See Kealhofer (2003).

[8] Duration gap measures of interest rate risk were disclosed in Fannie Mae's 10Ks and 10Qs that are available on the SEC's EDGAR database. These interest rate risk measures were reported on a quarterly basis for 1994-1999, inclusive, and on a monthly basis since January 2000. A vertical marker placed at October 2000

Exhibit 4: Fannie Mae Estimated Default Frequencies (EDFs) and Reported Duration Gaps
(Monthly Data, January 1994 - December 2003)



Source: Moody's KMV for EDFs; SEC EDGAR for 10-Ks and 10-Qs that contain duration gap information.

2000, Fannie Mae EDFs did not significantly increase in periods when duration gaps were outside the bounds set by management (-6 months to +6 months, which are indicated with horizontal lines in Exhibit 4). But after October 2000, Fannie Mae's EDF rises precipitously each time there is an announcement that its duration gap is outside, or at, one of these bounds – and this increase is statistically significant at the 5 percent level. The differences in the time-series properties of Fannie Mae's EDFs before and after the voluntary risk disclosures announcement suggest that responses by equity market participants to changes in the term structure or to changes in short-term interest rates would be quite different in the "GSE Quiescent Period" (1984-1999) than they would be after October 2000.

Perhaps the most direct evidence of a lessening of the implicit government guarantee is the nature of the news announcements in the past several years. Prior to Under Secretary Gensler's testimony in March 2000, the government had made only minimal public comments about the ambiguous position of the government concerning whether GSEs were government-backed entities. However, rapid growth of GSE portfolios had raised concerns in the latter part of the 1990s and Gensler's testimony made these concerns public, much to the surprise of investors in the GSEs' bonds and equity. Key officials in the Bush administration (including Secretary of the Treasury Snow), along with the Federal Reserve Chairman Greenspan and other officials of the Federal Reserve System, have made clear through speeches and Congressional testimony their desire to diminish any investor perception of implicit government backing for the debt issued by the GSEs.

The increasingly public nature of government concerns about the GSEs' implicit guarantees and shareholders' reactions to these concerns can be seen in simple time-series models for daily GSE percentage changes in closing stock prices. Using such models, we identified those dates where the residual (i.e., the difference between the actual percentage change and the predicted percentage change) was more than two standard deviations from the "mean residual." [9] In our first specification, the daily percentage changes in closing stock prices were regressed on both the daily percentage change in the Dow Jones Bank Index[10] and the daily

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indicates that these duration gap measures were voluntarily disclosed on a contemporaneous monthly basis only after that date. We assume Fannie Mae's reports are correct although the more recent numbers may be affected by Fannie's ongoing financial restatement.

[9] The mean residual does not equal zero because it is calculated using the absolute value of each residual.

[10] This index does not include the housing government-sponsored enterprises.

percentage change in the 1-year Treasury rate (measured either contemporaneously or lagged by one business day). In the second specification, daily percentage changes in GSE stock prices were regressed on daily percentage changes in the Dow Jones Bank Index, the daily percentage change in the federal funds target rate, and the percentage change in the spread between the 10-year Treasury yield, and the 1-year Treasury yield (measured either contemporaneously or lagged by one business day).

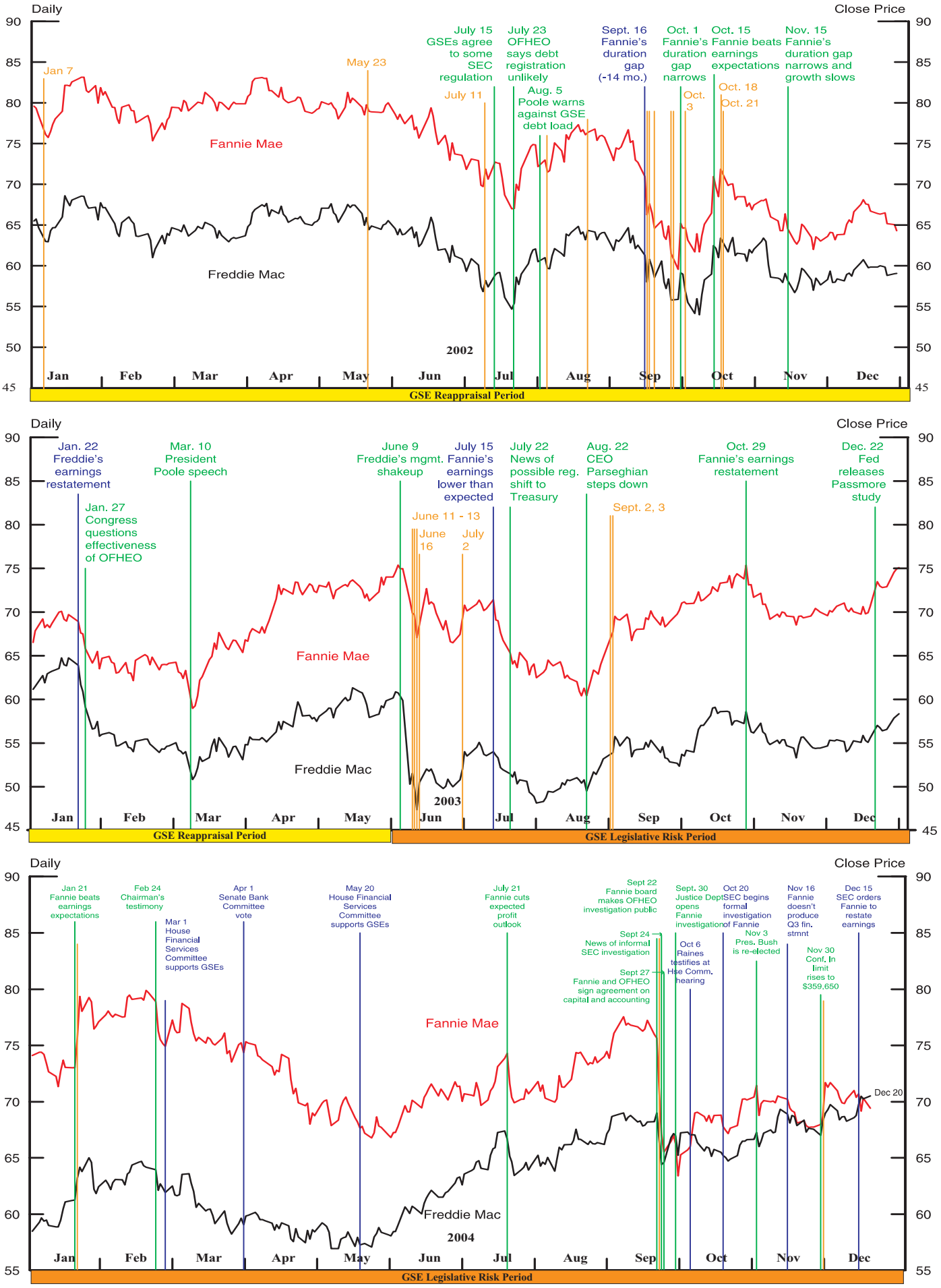
In Exhibit 5, green vertical bars have been placed on dates where the residual was greater than two standard deviations from the mean residual and where a news event could be identified, orange vertical bars have been placed on dates where the residual was greater than two standard deviations from the mean residual but where no news event could be identified, and blue vertical bars have been placed on dates where there were news events, but where the percentage change in stock prices was not large (i.e., two or more standard deviations from the mean residual). Of the 22 dates with green vertical bars, 14 occur during our "GSE Legislative Risk Period." Most of the blue bars also fall within this period as well. The bulk of stock movements not associated with new events (the orange bars) fall around the date of the announcement that Fannie had taken on substantial interest rate risk (September and October of 2002) or Freddie Mac's management shakeup, and those bars probably reflect the continuing fall out from that news.

The foregoing discussion suggests that GSE equity returns are likely to reflect term-structure shifts after October 2000. In addition, the effect of news events on changes in equity prices suggests that the implicit government guarantee was smaller in the "GSE Legislative Risk Period," relative to the "GSE Reappraisal Period." However, in both periods, we would argue that investors' perception was that the implicit guarantee for GSEs was likely substantially greater than, and certainly no less than, that for BHCs. Investors view the strong belief by Congress that the GSEs' have a important role in executing government housing policy, along with the greater number of large BHCs and the difficulties of invoking the systemic risk exception for government support of a failing BHC, as all supporting the view that the GSEs' implicit government backing is stronger.

IV. Our Approach for Measuring Market Discipline

Equity and bond investors can influence the decisions of management in two ways: First, they influence decisions through direct market discipline, where debt costs or equity returns

Exhibit 5: Time-Series for Fannie Mae and Freddie Mac Stock Prices
(Daily Data, January 2002-December 2004)



Source: Bloomberg.

change in response to the actions of management. Second, investors can exert influence through indirect market discipline, where changes in bond yields or stock prices cause others, such as rating agencies or government supervisors, to evaluate managements' actions. To be effective, both types of pressure on management *must be persistent*; that is, it cannot be reversed in subsequent days or in a few weeks.

Moreover, for indirect market discipline to be effective, changes in bond or stock returns must be unambiguously interpretable as changes in expected losses as perceived by investors. Firm management, outside investors, and government supervisors cannot take actions that offset investors' perceptions of higher expected losses if the movements in the bond and stock returns are confounded by other factors. In particular, implicit government guarantees can confound the relationship between changes in expected returns and changes in expected losses. If bondholders view their debt as implicitly government guaranteed, then changes in bond returns can reflect changes in investors' perceptions of implicit government guarantees rather than expected losses. Some previous studies on market discipline and banking have failed to control for changes in implicit government relationships within the time period studied.

Finally, bond returns are more likely than stock returns to provide unambiguous signals about expected losses. Since bondholders can only suffer high losses but not make greater gains in response to management's risk taking, expected losses are more closely tied to expected returns. In contrast, stockholders can potentially also get upside gains from greater risk taking. While this fact is perhaps an obvious point, it makes interpreting stock return movements very difficult and calls into question much of the previous research on market discipline in banking, where movements in stock returns have often been inferred to be directly related to changes in expected losses.

Market Discipline and Bond Holders

A typical way to measure the effect of an implicit guarantee is to compare two sets of bond yields, one from a firm without an implicit guarantee, firm *i*, and one from a firm with such a guarantee, firm *j*. Using equation (2) the difference in observed bond yields for firm *i* and firm *j* is:

$$r_i^d - r_j^d = E(L) \bullet (g_i - g_j) \tag{3}$$

where the *E(L)* is assumed to be about the same for both firms because the risk characteristics of

the firms (or, more accurately, the firms' debt) have been closely matched.

This technique has been used in several comparisons of BHCs and GSEs (CBO 2003, Passmore, Sherlund and Burgess (2005)). Since the goal of this spread-based approach is to compare the implicit guarantees of two sets of firms, it cannot comment directly on the relative riskiness of the comparison groups, which in effect were assumed away in the matching process.

A common technique used to assess the risk sensitivity of bond yields is to estimate equation (1) using panel data on subordinated debt spreads over comparable-maturity Treasury securities as the dependent variable. Explanatory variables generally include firm-specific risk factors, RF_{it}, based on quarterly accounting information that vary across firms and across time, as well as CONTROLS_t that vary across time (e.g., systematic risk factors) and possibly across instruments (e.g., bond characteristics, such as the amount outstanding). As indicated above, the panel data typically are split into different regimes that are identified using news events, changes in liquidation procedures, or legislative changes.

Since a bondholder's default risk depends on the firm's expected loss, *E(L)*, and its implicit government guarantee, *g*, differentiation of equation (2) shows that the default risk portion of the debt spread for firm *i* during period *t* will change as the risk factor evolves, or:

$$\frac{\partial r_{it}^{d}}{\partial RF_t} = \left(\frac{\partial E(L)_{it}}{\partial RF_t} \bullet g_{it} \right) + \left(\frac{\partial g_{it}}{\partial RF_t} \bullet E(L)_{it} \right) \tag{4}$$

It is traditionally assumed that the probability that the firm will not get bailed out does not depend on the risk factors (i.e., $\partial g_{it} / \partial RF_t \approx \partial g_{jt} / \partial RF_t \approx 0$).[11] In other words, government actions – from which investors infer the strength of a government guarantee – are not influenced by short-run risk factors that influence the default risk portion of bond returns. Thus, an increase in the risk sensitivity of the default risk portion of the bond return becomes:

$$\frac{\partial r_{it}^{d}}{\partial RF_t} = \left(\frac{\partial E(L)_{it}}{\partial RF_t} \bullet g_{it} \right) \tag{5}$$

Thus, over a short-horizon (in our case, between periods 1 and 2) changes in risk factors may influence bondholders' perception of expected loss. This assumption has played a central role in

[11] The macroeconomic risk factors considered below did not move in a consistent fashion when there were news announcements that are commonly believed to have a potential influence on investors' perceptions with respect to the probability that housing-related GSE firms would *not* get bailed out. That is, it appears that the condition $\partial g_{it} / \partial RF_t \approx \partial g_{jt} / \partial RF_t \approx 0$ does hold for all of the financial firms analyzed in this study.

previous market discipline studies both for BHCs and for GSEs.

In this study, we specify when a change in bond returns can be interpreted as reflecting a change in expected losses and the circumstances when such changes can provide information about the relative riskiness of firms. Our approach relies on measuring the responsiveness of bond returns to macroeconomic risk factors.

Comparing the Responsiveness of Bond Returns Between Time Periods and Across Firms

Interpretation 1: *The responsiveness of BHC bond returns to macroeconomic shocks between the two periods is directly related to changes in loss mitigation.*

As we established above, after the passage of FDICIA and National Depositor Preference, there was little news that would have influenced investors' perceptions of implicit guarantees for large BHCs during either the GSE Reappraisal Period (period 1) or the GSE Legislative Risk Period (period 2). Thus, we posit that $g_1^{BHC} = g_2^{BHC}$ over these periods. Using (5):

$$\frac{\partial r_2^{BHC}}{\partial RF_2} - \frac{\partial r_1^{BHC}}{\partial RF_1} = g^{BHC}\left[\frac{\partial E(L)_2^{BHC}}{\partial RF_2} - \frac{\partial E(L)_1^{BHC}}{\partial RF_1}\right], \tag{6}$$

This relationship suggests that changes in the responsiveness in BHC bond returns are directly related to changes in loss mitigation. For example, if the bond return response to a macroeconomic shock is smaller in period 2 than in period 1, then BHC loss mitigation improved in period 2.

Interpretation 2: *If investors' perception of a GSE implicit guarantee declined during the two periods, then only if the responsiveness of GSE bond returns declined can the change be attributed to a change [in this case, an improvement]in loss mitigation.*

This interpretation follows from:

$$\frac{\partial r_2^{GSE}}{\partial RF_2} - \frac{\partial r_1^{GSE}}{\partial RF_1} = \frac{\partial E(L)_2^{GSE}}{\partial RF_2} g_2^{GSE} - \frac{\partial E(L)_1^{GSE}}{\partial RF_1} g_1^{GSE}, \tag{7}$$

which in turn suggests that:

$$When \;\; g_2^{GSE} > g_1^{GSE}, \;\; then \;\; \frac{\partial r_2^{GSE}}{\partial RF_2} - \frac{\partial r_1^{GSE}}{\partial RF_1} \leq 0 \Rightarrow \frac{\partial E(L)_1^{GSE}}{\partial RF_1} - \frac{\partial E(L)_2^{GSE}}{\partial RF_2} \geq 0. \qquad (8)$$

Interpretation 3: *When investors perceive a stronger, or equal, implicit government guarantee for GSE debt relative to BHC debt, a greater responsiveness of GSE bond returns to a shock in a macroeconomic risk factor relative to the responsiveness of BHC bond returns to that shock implies a greater change in investor perceptions of expected losses for GSEs than for BHCs.*

Because bond market investors perceive a stronger implicit government backing for GSE instruments than for the instruments issued by BHCs throughout the time period considered, this implies that $g_t^{BHC} \geq g_t^{GSE}$. Comparing the responsiveness of GSE bond returns to the responsiveness of BHC bond returns during each time period implies:

$$\frac{\partial r_t^{BHC}}{\partial RF_t} - \frac{\partial r_t^{GSE}}{\partial RF_t} = \frac{\partial E(L)_t^{BHC}}{\partial RF_t} g_t^{BHC} - \frac{\partial E(L)_t^{GSE}}{\partial RF_t} g_t^{GSE}. \qquad (9)$$

From this relationship, we derive:

$$When \;\; g_t^{BHC} \geq g_t^{GSE}, \; then \;\; \frac{\partial r_t^{BHC}}{\partial RF_t} - \frac{\partial r_t^{GSE}}{\partial RF_t} \leq 0 \Rightarrow \frac{\partial E(L)_t^{GSE}}{\partial RF_t} - \frac{\partial E(L)_t^{BHC}}{\partial RF_t} \geq 0. \qquad (10)$$

Market Discipline and Equity Holders

Unlike bondholders, stockholders are the residual claimants to the firm's cash flows and are thus concerned both about default risks and the firm's future revenues.

$$r_{it}^{stock} = (1 - PD_{it})E(\mathrm{Re}\, v_{it}) + PD_{it} \bullet (LGD_{it} \bullet g_{stock}). \qquad (11)$$

where $E(\mathrm{Re}v)$ is the firm's expected revenues net of its costs, contingent on no default. We assume that neither the BHC nor GSE stockholders expect to be bailed out in case of a default and thus g_{stock} equals one in this case.[12] We also assume that the shareholder losses given default

[12] This assumption is questionable in the case of the GSEs because the GSE bankruptcy process is so murky. Indeed, shareholders may expect that they will continue to have a claim to the GSE charter even if a GSE is effectively bankrupt and Congress needs to bail it out. See Carnell (2005) as well as Lucas and MacDonald (2005)

are equal to their entire investment (that is, their *LGD* equals one). Thus, a change in a risk factor results in a change in the stockholder's return in the following way:

$$\frac{\partial r_{it}^{stock}}{\partial RF_t} = \left((1 - PD_{it}) \bullet \frac{\partial E(\mathrm{Re}\, v)_{it}}{\partial RF_t} \right) \tag{12}$$

The revenues of the firm depend on the interest payments to bondholders, which themselves are dependent on the bondholders' expectations of the firm's default risk. In other words:

$$\frac{\partial r_{it}^{stock}}{\partial RF_t} = \left((1 - PD_{it}) \bullet \left[\frac{\partial E(\mathrm{P})_{it}}{\partial RF_t} - \frac{\partial r_{it}^{d}}{\partial RF_t} \right] \right) \tag{13}$$

where $E(\mathrm{P})$ is the firm's profit net of the default premium that is paid to bondholders.

Relating the responsiveness of stock returns to the firm's default risks is difficult because the risk factors also influence the firm's growth and revenue possibilities. However, we can use a difference-in-differences technique to identify the default risk portion of the responsiveness of stock returns. Specifically, BHCs can invest in all of the same assets as GSEs and, in particular, the retail-oriented BHCs used in our study are all heavily invested in mortgages. Thus, the difference between BHCs and GSEs in managing portfolios of mortgages (putting aside any difference in firm-specific default risks) is likely due to the inherent differences between BHC and GSE business strategies concerning mortgages. Many revenue and cost factors with regard to mortgages, such as hedging or servicing costs, are readily priced in the marketplace and unlikely to result in persistent profit differences. Thus, we would argue that the difference between BHCs and GSEs in the responsiveness of their revenue streams (sans default risks) over time is unchanging and that this difference reflects a fundamental distinction between BHCs and GSEs. Thus, it is reasonable to assume that:

$$(1 - PD_{BHC,t}) \left[\frac{\partial E(\mathrm{P})_{BHC,t}}{\partial RF_{BHC,t}} \right] - (1 - PD_{GSE,t}) \left[\frac{\partial E(\mathrm{P})_{GSE,t}}{\partial RF_{GSE,t}} \right] = F \tag{14}$$

where F is a constant for both periods.

If the difference in revenue generation is fixed between BHCs and GSEs, then the differences between BHCs and GSEs in the responsiveness of stock returns to risk factors over

for a discussion of GSE receivership.

time becomes:

$$\frac{\partial r^{stock}_{BHC,t}}{\partial RF_t} - \frac{\partial r^{stock}_{GSE,t}}{\partial RF_t} = F - \left((1 - PD_{BHC,t}) \bullet \left[\frac{\partial r^{d}_{BHC,t}}{\partial RF_t} \right] \right) + \left((1 - PD_{GSE,t}) \bullet \left[\frac{\partial r^{d}_{GSE,t}}{\partial RF_t} \right] \right) \tag{15}$$

Using the difference-in-differences technique, we remove the fixed effect (F) by comparing two time periods. Making this comparison we get:

$$\begin{aligned} &\left(\frac{\partial r^{stock}_{BHC,2}}{\partial RF_2} - \frac{\partial r^{stock}_{GSE,2}}{\partial RF_2} \right) - \left(\frac{\partial r^{stock}_{BHC,1}}{\partial RF_1} - \frac{\partial r^{stock}_{GSE,1}}{\partial RF_1} \right) = \\ &\left[(1 - PD_{GSE,2}) \frac{\partial r^{d}_{GSE,2}}{\partial RF_2} - (1 - PD_{GSE,1}) \frac{\partial r^{d}_{GSE,1}}{\partial RF_1} \right] - \left[(1 - PD_{BHC,2}) \frac{\partial r^{d}_{BHC,2}}{\partial RF_2} - (1 - PD_{BHC,1}) \frac{\partial r^{d}_{BHC,1}}{\partial RF_1} \right] \end{aligned} \tag{16}$$

In this case, the difference in changes in the responsiveness of stock returns to macroeconomic shocks is directly related to the changes in the responsiveness of the bondholders' perception of changes in expected returns. This difference is also related to the relative probability of default of the two groups of firms. Suppose we assume that the probability of default at the two firms did not change over time. Then:

$$\left(\frac{\partial r^{stock}_{BHC,2}}{\partial RF_2} - \frac{\partial r^{stock}_{GSE,2}}{\partial RF_2} \right) - \left(\frac{\partial r^{stock}_{BHC,1}}{\partial RF_1} - \frac{\partial r^{stock}_{GSE,1}}{\partial RF_1} \right) = (1 - PD_{GSE}) \left[\frac{\partial r^{d}_{GSE,2}}{\partial RF_2} - \frac{\partial r^{d}_{GSE,1}}{\partial RF_1} \right] - (1 - PD_{BHC}) \left[\frac{\partial r^{d}_{BHC,2}}{\partial RF_2} - \frac{\partial r^{d}_{BHC,1}}{\partial RF_1} \right] \tag{17}$$

which can be rewritten as :

$$\begin{aligned} &\left(\frac{\partial r^{stock}_{BHC,2}}{\partial RF_2} - \frac{\partial r^{stock}_{GSE,2}}{\partial RF_2} \right) - \left(\frac{\partial r^{stock}_{BHC,1}}{\partial RF_1} - \frac{\partial r^{stock}_{GSE,1}}{\partial RF_1} \right) = \\ &(1 - PD)^{GSE} \left[g_2^{GSE} \frac{\partial E(L)^{GSE}_2}{\partial RF_2} - g_1^{GSE} \frac{\partial E(L)^{GSE}_1}{\partial RF_1} \right] - (1 - PD)^{BHC} g^{BHC} \left[\frac{\partial E(L)^{BHC}_2}{\partial RF_2} - \frac{\partial E(L)^{BHC}_1}{\partial RF_1} \right]. \end{aligned} \tag{18}$$

Interpretation 4: *When implicit government guarantees are present, then even under very strong assumptions, changes in stock returns cannot be used to directly infer that investors have changed their view about the firm's expected losses.*

Consider equation (18). Even though we removed the changes in the firm's expected revenues by using a difference-in-differences technique and assumed that our two groups of firms had equivalent default risks, the relative change in the responsiveness in stock returns across the two periods cannot be related to investors' perceptions of expected losses because of the implicit government guarantee and the firms' relative default risks. If a researcher was willing to specify

the relative default risks and implicit government guarantees of the firms (and if the guarantee had been constant throughout the two periods), then the relative change in stock returns over time could be directly related to changes in the firms' relative expected losses under some circumstances. Given the strong assumptions needed to interpret stock return responses to risk factors, we focus our attention on bond returns.

Our Econometric Technique

Like previous studies that have considered the market discipline imposed on financial firms, we consider different time regimes. However, our approach departs from the standard approach in several ways.

Asset Pricing Modeling Methodology. At each point in time, we recognize that observed secondary market asset prices for instruments issued by financial firms reflect investors' forecasts with respect to future stock dividends, inflation, short-term interest rates and excess long-term asset returns.[13] These forecasts reflect all information that is publicly available to investors, including income statements, earnings forecasts, balance sheets, trading positions, public disclosures, and analyst reports. In support of this view for the evolution of asset returns, numerous papers have shown that regressions of asset returns onto variables known in advance have a modest, but statistically reliable, degree of explanatory power.[14]

Macroeconomic Risk Factors. We use risk factors that are not constructed from firm-specific accounting data. Because macroeconomic conditions influence aggregate expected returns on stocks and bonds, they cannot be easily diversified away by investors, and therefore it is likely they will also influence financial firm stock and bond returns. The long-short yield spread, for example, has been shown to have long-horizon forecasting power for nominal interest rate movements, for inflation rates, and for longer-term bond returns.[15] Stochastically detrended short-term interest rates have been shown to be useful for forecasting stock returns. In addition,

[13] Campbell, Lo, and MacKinlay (1997) demonstrate that present value conditions imply log-linear relationships between asset prices, dividends, and returns. These present value conditions also imply that high stock prices must eventually be followed by high future dividends, low returns, or some combination of the two. And because investors' expectations must be consistent with this relationship, high stock prices must be associated with high expected future dividends, low expected returns, or some combination of the two.

[14] See, for example, Campbell (1997) and Fama and French (1988, 1989).

[15] See Campbell and Shiller (1987).

stronger economic activity has been shown to raise the demand for credit and increase financial firms' willingness to lend.[16] Since such macroeconomic risk factors are available at a high frequency (e.g., daily or weekly), we can exploit the fact that financial firm stocks and bonds are traded on a frequent basis.

Responses of Subordinated Bond Returns. To estimate responses of financial-firm bond returns, we use a panel vector autoregression (panel-VAR) approach.[17] Importantly, this approach enables us to approximate complicated interdependent dynamic adjustment paths between financial firm equity and bond returns, which are likely to be correlated with one another. Moreover, panel data permit us to estimate the responses of financial firm bond returns to macroeconomic shocks using a shorter time period than would be required with aggregate data. This feature of panel-VAR estimation allows us to estimate whether cumulative responses to those shocks were larger in the GSE Legislative Risk Period than in the GSE Reappraisal Period. In addition, using panel-VAR estimation techniques also allows us to consider whether such responses differ across regimes for different types of financial firms.

Bank Holding Companies versus GSEs. For our comparison, we use a group of U.S. bank holding companies with high public debt ratings and a retail banking orientation (Bank America, Citigroup, and Wells Fargo). These firms were chosen for the comparison because: (1) the Moody's, Standard and Poor's and Fitch subordinated debt ratings for the two housing GSEs (Fannie Mae and Freddie Mac) and for the parent BHCs of Wells Fargo Bank, Bank of America and Citibank are similar; (2) secondary bond market subordinated debt spreads and estimated default frequencies (EDFs) derived from equity prices for these highly rated bank holding companies are in comparable ranges to those recently observed for the two housing GSEs; (3) these banking organizations each have holdings of 1-4 family mortgage loans and mortgage-backed securities in excess of 150 billion dollars as of year-end 2003,[18] and (4) there have not been either news or legislative events that would likely increase, or reduce, investors'

[16] See Hancock, Laing and Wilcox (1995).

[17] Each of the variables in the system can be written as a linear function of its own lagged values and the lagged values of other variables in the system.

[18] Holdings of 1-4 family mortgages and mortgage backed securities for the three highly rated banking organizations – Bank of America, Citigroup, and Wells Fargo – at year-end 2003 were $227 billion, $153 billion, and $173 billion, respectively.

perceptions with respect to the probability that these bank organizations would get bailed out by the government over the two sample periods that are considered in this study (i.e., g^{BHC} is commonly viewed as being stable over the 2000-2004 period).

V. MODEL SPECIFICATION

We estimated a second-order VAR system that included firm-specific effects and five variables. One group of variables – the firm-specific stock return, the firm-specific subordinated bond return, and the 10-year minus 1-year Treasury yield spread – are meant to measure firm-specific stock and bond returns and their components.

The other group of variables – industrial production and the relative federal funds rate – consists of useful forecasting variables for financial-firm asset returns. Because stronger economic activity is expected to raise the demand for credit from mortgage (and other) borrowers, as well as the financial firms' willingness to lend, changes in industrial production would change investor expectations of future cash flows associated with financial firm stock and bond returns. And the relative federal funds rate (which is defined to be the current federal funds rate, less a backwards 1-year moving average of federal funds rates) is included because many authors have noted that the level of (stochastically detrended) short-term interest rates helps to forecast stock returns.[19] The inclusion of the relative federal funds rate also allows for the consideration of the effects of monetary policy shocks on financial firm stock and bond returns.

The VAR specification consisted of an equation based on equation (19) for each of the variables, A_i (i = 1, ..., 5):

$$A_{i,\,j,\,t} = \delta_{i,\,j} + \sum_{k=1}^{5}\sum_{m=1}^{2} \alpha_{i,\,k,\,m}\, A_{k,\,j,\,t\,-\,m} + \varepsilon_{i,\,j,\,t} \qquad (19)$$

where $A_{i,j,t}$ is the level of variable i for financial firm j at time t and the individual financial firm-specific effects, $\delta_{i,j}$, allow each firm to have its own mean for stock and bond returns.

The individual financial-firm-specific effects in equation (19) were neither measurable nor identified. Consistent estimates of a panel VAR are obtained when the financial-firm-

[19] The relative federal funds rate can also be written as a triangular moving average of changes in the short-term interest rate, so it is stationary in levels if the short-rate is stationary in differences. The relative federal funds rate helps to capture some of the longer-run dynamics of changes in interest rates without introducing long lags, and hence a large number of parameters, into the VAR system. Most present value modelers use a triangular moving average of the one-month Treasury bill series (e.g., Fama and Schwert (1977), Campbell (1987), and Campbell and Ammer (1993)). The correlation between the relative T-bill rate and the relative federal funds rate is 0.80.

specific effects are eliminated by first-differencing equation (19):

$$A_{i,j,t} - A_{i,j,t-1} = \sum_{k=1}^{5} \sum_{m=1}^{2} \alpha_0 + \alpha_{i,k,m}\left(A_{k,j,t-m} - A_{k,j,t-m-1}\right) + \left(\varepsilon_{i,j,t} - \varepsilon_{i,j,t-1}\right) \qquad (20)$$

We estimated equation (20) using the instrumental variable technique described by Holtz-Eakin, Newey and Rosen, 1988. This technique allowed for the negative correlation of the once-lagged first-differenced terms of the endogenous variables with the first-differenced disturbance terms. We used the following instrumental variables: (1) first-differenced model variables (industrial production, the financial firm-specific stock return, the financial firm-specific subordinated bond return, the 10-year minus 1-year Treasury yield spread, and the relative funds rate) each lagged two through six periods; (2) the first-differenced lag of two Fama-French systematic risk factors (i.e., the performance of small firms relative to large firms and the performance of value stocks relative to growth stocks);[20] (3) a first-differenced time trend term (i.e., a constant); and (4) a contemporaneous merger indicator variable for the BHCs together with six of its lags.[21]

Impulse-response functions are based on VARs with variables entered in the following order: (1) industrial production, (2) the financial-firm-specific stock return, (3) the financial-firm-specific subordinated bond return, (4) the 10-year minus 1-year Treasury yield spread, and (5) the relative federal funds rate. This ordering reflects both conventional wisdom regarding the timing of business cycle indicators and the typical ordering of variables used when estimating present value models with aggregate data on stock and bond returns.[22]

VI. DATA SOURCES AND METHODS

Weekly series for financial firm-specific stock and bond returns, were constructed for the three highly rated bank holding companies (Bank of America, Citigroup, and Wells Fargo) and for the two housing GSEs (Fannie Mae and Freddie Mac). For each of these financial firms,

[20] The Fama-French benchmark portfolios were rebalanced quarterly using independent sorts on size (market equity) and the ratio of book equity to market equity. The book-to-market ratio is high for value stocks and low for growth stocks.

[21] The appropriate number of lags for each instrument was determined using log likelihood tests for various lag lengths.

[22] See, for example, Campbell and Ammer (1993).

end-of-business week Center for Research in Security Prices (CRSP) stock data were used to construct weekly stock returns.

Because each banking organization typically had several subordinated bonds outstanding at each point in time and because the trading frequency varied across such bonds, we constructed a weekly subordinated bond return that used only returns on bonds that were actually traded in each week. First, daily returns on each non-callable bond were calculated using the Bloomberg "generic" bond pricing series, which is constructed using the consensus method that takes an average of observed trading prices on each day after dropping the highest and lowest price observations.[23] Second, these daily returns were weighted by their issue amount outstanding, which is a proxy for the liquidity of each bond.[24] Third, the total amount outstanding for *traded bonds* was calculated each day and this sum was used in the denominator of the subordinated bond return index calculation. This three-step procedure ensured that only traded bonds were included in the subordinated bond return for each banking organization and that the most liquid bonds would be given the greatest weight in the return calculation. A weekly subordinated bond return was calculated for each GSE using only returns on bonds that were actually traded each week using the identical procedure used to construct subordinated bond returns for banking organizations.

Data on yields for Treasury securities came from the Department of Treasury and are based on the most actively traded marketable securities. The weekly series for the 10-year minus 1-year Treasury yield spread was calculated using two weekly series for constant-maturity Treasury securities.

The relative federal funds rate was calculated using the weekly series for effective federal funds rates. These data are published by the Federal Reserve in the *Federal Reserve Bulletin*.[25]

Weekly data for Fama-French factors – the performance of small firms relative to large

[23] For the consensus method, a minimum of three observations is required, after dropping the highest and lowest observations, for a price to be reported; otherwise a missing value is entered for the trading price.

[24] Liquidity premiums contained in secondary prices for banking organization subordinated instruments can be quite large. It has been found that subordinated debt spreads are most consistent across data sources for bonds of relatively large issuance size, relatively young age, issued by relatively large firms traded in a relatively robust overall bond market. See Hancock and Kwast (2001).

[25] The federal funds rate is the cost of borrowing immediately available funds primarily for one day. The effective rate is a weighted average of the reported rates at which different amounts of the days' trading through New York brokers occurs.

firms and the performance of value stocks relative to growth stocks – were constructed from CRSP stock market data using procedures described in Fama and French (1993). These factors were used as instrumental variables in our panel-VAR because they have been shown to systematically influence aggregate returns on both stocks and bonds, and because some bank holding companies may be more sensitive to systematic factors than other bank holding companies.[26]

VII. FINDINGS

The second-order VAR system was estimated for two periods – the GSE Reappraisal Period (April 1, 2001 to May 31, 2003) and the GSE Legislative Risk Period (June 1, 2003 to September 15, 2004) – using weekly panel data for the housing enterprises (Fannie Mae and Freddie Mac) and for highly rated U.S. bank holding companies (Bank of America, Citigroup, and Wells Fargo).

We considered three macroeconomic risk factors that would potentially influence the default risk portion of financial firm bond returns: (1) industrial production, (2) the term-structure effect (measured by the 10-year minus 1-year Treasury yield spread), and (3) the monetary policy effect (measured by the relative federal funds rate). One-standard-deviation (positive) shocks were standardized for each macroeconomic risk factor across the two sample periods for both types of financial firms using a two-step procedure. First, for each macroeconomic risk factor, the one-standard-deviation shocks for BHCs in both periods and for GSEs in the GSE Reappraisal Period were measured relative to the one-standard-deviation shock in the GSE Legislative Risk Period. Second, these relative shocks from the first step were used to adjust multiplicatively the respective impulse-response functions. This two-step procedure to standardize macroeconomic shocks allows for the comparison of responses of BHCs and of GSEs to macroeconomic shocks within and across the two time periods considered.

Impulse-Response Functions for Stock Returns and for Subordinated Bond Returns. Our empirical model delivered impulse response functions that returned to the baseline (a zero response) within 15 to 20 weeks. In the GSE Reappraisal Period, for example, initial weekly

[26] For example, Hancock and Kwast (2001) report that some large U.S. banking organizations subordinated bond spreads are more sensitive to excess stock market returns than other large U.S. banking organization subordinated bond spreads.

stock return responses of highly rated BHCs to a standardized one-standard-deviation industrial production shock were estimated to be as high as 6 basis points, but such responses dampened out within 15 weeks to the zero response level. During this period, the highly rated BHC subordinated bond return responses to a standardized one-standard-deviation industrial production shock were on average of smaller magnitude, but also dampened out to a zero response within 15 weeks. Similarly, for the GSE Reappraisal Period, GSE stock return responses to a standardized one-standard-deviation industrial production shock were estimated to be as high as 3 basis points, but such responses dampened out to a zero response within about 15 weeks. These responses were on average of larger magnitude than were GSE subordinated bond return responses to the same macroeconomic shock. Nevertheless, the GSE subordinated bond return responses dampened out to a zero response within 15 weeks. For both periods considered, these patterns for the estimated stock and subordinated bond return responses also are evident for the other two macroeconomic shocks considered – term structure shocks and monetary policy shocks – although in some cases the initial response of stock or bond returns for highly rated BHCs to a macroeconomic shock was smaller than the corresponding initial response of stock or bond returns for GSEs.

Cumulative Subordinated Bond Return Responses. As indicated above, our approach for measuring the potential for market discipline depends on persistent bond return responses that are not reversed in a few days or weeks. As a gauge of these persistent responses to macroeconomic risk factors, we used our estimated impulse-response functions to derive estimates of the cumulative subordinated bond response to each standardized one-standard-deviation macroeconomic shock for each period and for each entity type.

In table 1, we present estimated cumulative responses of subordinated bond returns to three standardized one-standard-deviation macroeconomic shocks (industrial production shocks, term-structure shocks, and monetary policy shocks) for two periods (the GSE Reappraisal Period (April 1, 2001 to May 31, 2003) and the GSE Legislative Period (June 1, 2003 to September 15, 2004)) and for two types of entities (highly rated BHCs and GSEs). In addition, we present (1) differences in cumulative responses between period 2 (the GSE Legislative Risk Period) and period 1 (the GSE Reappraisal Period) by entity type, and (2) differences in cumulative responses across entity types (highly rated BHCs and GSEs) in each period. We bootstrapped the panel-VAR model, using 1000 replications, to test whether calculated differences in

Table 1: Estimated Cumulative Responses of Financial Firm Bond Returns to Selected Macroeconomic Shocks

Highly rated Bank Holding Companies (BHCs), Government Sponsored Enterprises (GSEs)
Period 1 (GSE Reappraisal Period), Period 2 (GSE Lesgislative Risk Period)

Type of Macoeconomic Shock	BHC Cumulative Responses to Macroeconomic Shocks		GSE Cumulative Responses to Macroeconomic Shocks		Differences in Cumulative Responses Between Period 2 and Period 1 by Entity Type*		Differences in Cumulative Responses Across Entity Types in Each Period*	
	Period 1	Period 2	Period 1	Period 2	BHCs	GSEs	Period 1	Period 2
	(B1)	(B2)	(G1)	(G2)	(B2-B1)	(G2-G1)	(B1-G1)	(B2-G2)
Industrial Production	0.86	-0.28	-0.01	0.07	**-1.15** (X2=652.9)	**0.08** (X2=547.6)	**0.87** (X2=862.2)	**-0.36** (X2=226.6)
Term Structure	-0.31	0.27	0.22	0.57	**0.58** (X2=547.6)	**0.35** (X2=448.9)	**-0.53** (X2=360.0)	**-0.30** (X2=462.4)
Monetary Policy	-0.26	0.31	0.04	0.29	**0.57** (X2=774.4)	**0.25** (X2=270.4)	**-0.30** (X2=532.9)	0.02 (X2=5.8)

* The reported differences in cumulative responses across columns do not reflect rounding that appears in other columns.
In parentheses are chi-square statistics for an odds test that the parameter is the sign of the actual difference between two cumulative responses.
The critical value for a 5 percent significance level is 5.99. Bold face numbers are significantly likely to be of the sign of the estimated difference.

cumulative subordinated bond return responses over time and across entity types were likely to be negative (positive) as calculated. For each calculated difference in table 1, we used matched pairs from the bootstrap procedure and calculated the odds that the difference was either negative or positive. We tested the significance of the sign of the difference using a Chi-square test statistic, which is presented beneath each difference in table 1. The critical value of this statistic is 5.99 for a 5 percent level of significance. Therefore, as shown in table 1, only one difference in cumulative responses was not likely to be of the sign of the calculated difference.

Interpreting the Cumulative Subordinated Bond Return Responses. Recall from interpretation 1 that changes in the responsiveness of BHC subordinated bond returns are related directly to changes in loss mitigation techniques because the implicit government guarantee for BHCs did not change between periods 1 and 2. Consequently, if the cumulative response of subordinated bond returns to a standardized macroeconomic shock in the second period is *less* than the cumulative response of subordinated bond returns to that standardized macroeconomic shock in the first period (B2-B1<0), it would suggest that subordinated bond investors perceive that the BHCs adopted *better* loss mitigation techniques. In table 1, the difference in cumulative responses between period 2 and period 1 is negative for BHCs for the standardized industrial production shocks (column B2-B1). This finding is consistent with bond investors perceiving that BHCs adopted more sophisticated credit risk management methods in period 2. In contrast, the differences in cumulative responses between period 2 and period 1 are positive for BHCs for the standardized term structure and monetary policy shocks. These cumulative bond return responses are consistent with BHCs being less able in the eyes of investors to mitigate losses that arose from interest rate movements.

In contrast, for the GSEs, changes in the responsiveness of bond returns can only be interpreted across the two periods after accounting for the change in the implicit government guarantee. Suppose that investors' perception of the GSE implicit government guarantee declined between period 1 and period 2. In this case, only a decline in the responsiveness of GSE bond returns can be attributed to an improvement in loss mitigation (interpretation 2). Since each of the differences in cumulative subordinated bond return responses between period 1 and period 2 for GSEs is positive for each of the three macroeconomic shocks considered (column G2-G1), it is not possible to infer whether investors perceived that these entities improved their loss mitigation methods.

Turning to the differences in cumulative responses across entity types in each period (columns B1-G1 and B2-G2), negative such differences suggest that subordinated bond investors perceive that the change in expected losses are greater for the GSEs than for the BHCs in response to the standardized macroeconomic shock. For example, in period 1, the differences in cumulative responses for subordinated bond returns across BHCs and GSEs are negative for both the standardized term structure and monetary policy shocks (see column B1-G1). These findings are consistent with bond market investors believing that GSE expected losses are higher with respect to interest rate movements than are BHC expected losses. However, the positive difference in the cumulative responses across entity types for the industrial production shock in the first period cannot be interpreted because it could have resulted from either a lower implicit government guarantee for the GSEs than for the BHCs or a larger change in expected losses for the BHCs than for the GSEs from that type of macroeconomic shock.

In period 2, however, all of the differences in cumulative responses across entity types are negative. Together these findings suggest that subordinated bond investors believe that GSE expected losses are *more* sensitive to the macroeconomic shocks considered than are BHC expected losses. Therefore, our results suggest that bond market investors perceive that the GSEs are at least as risky, and maybe relatively more risky (i.e., have higher default risk), compared to highly rated BHCs. While our technique does not identify the source of this greater risk, we note that financial theory would suggest that GSEs would have greater risks because they are less diversified and not as well capitalized as BHCs.

IX. THE GSE VOLUNTARY SUBORDINATED DEBT INITIATIVE

Our discussion with regard to measuring market discipline and our empirical findings suggest that under some circumstances changes in bond returns can be useful indicators of changes in expected losses. In contrast, stock market returns are unlikely to be as useful in this regard. This suggests that subordinated debt can play a useful role for investors and regulators interested in monitoring the financial condition of large financial firms.

Prior to October 2000, neither Freddie Mac nor Fannie Mae issued subordinated debt. In response to pressure from the Department of the Treasury, both announced that they would voluntarily implement several new measures to improve financial transparency and market discipline in that month. The most meaningful part of this agreement was related to the issuance

of subordinated debt. As part of that pledge, both enterprises indicated that they expected to issue rated and publicly traded subordinated debt securities at least *twice* per year in amounts such that the sum of core capital, loan loss reserves, and outstanding subordinated securities would equal or exceed 4 percent of on-balance-sheet assets, after adjusting for the capital that is required to support the off-balance-sheet mortgage securities business.

The GSEs' voluntary debt policy increased market discipline in the sense that the GSEs issued more market sensitive debt when they issued more subordinated debt. The voluntary nature of the issuance decision, however, undermined the direct market discipline that might have been provided by subordinated debt holders. Research suggests that relatively risky financial firms are less likely to issue subordinated debt.[27] Table 2 provides information on subordinated debt securities that were issued by Fannie Mae and Freddie Mac since October 2000. At the end of 2004, Fannie Mae and Freddie Mac had outstanding subordinated debt equal to $12.5 billion and $5.5 billion, respectively. Fannie Mae issued subordinated debt seven times during 2001-2004, inclusive, but Freddie Mac only issued subordinated debt four times during this period. Moreover, as Freddie Mac's accounting problems intensified during 2003, it did not issue *any* subordinated debt instruments even though Fannie Mae issued such debt on three occasions and faced similar spreads in the marketplace (Exhibit 6).[28] It is notable, however, that Fannie Mae also did not issue any subordinated debt instruments in 2004 as its profit outlook deteriorated and its accounting problems were publicly disclosed. By not issuing subordinated debt [during these periods], these firms could avoid the higher direct costs associated with such debt and, more importantly, the signal that the yields on that new issuance might have provided.

VIII. CONCLUSION

Observing the underlying risks of GSEs and of large bank holding companies can be

[27] See, for example, Covitz, Hancock and Kwast (2004). Fannie Mae and Freddie Mac recently (September 2, 2005) entered an agreement with their regulator, OFHEO, to resume issuing subordinated debt in 2006 and to continue to do so regardless of their financial conditions.

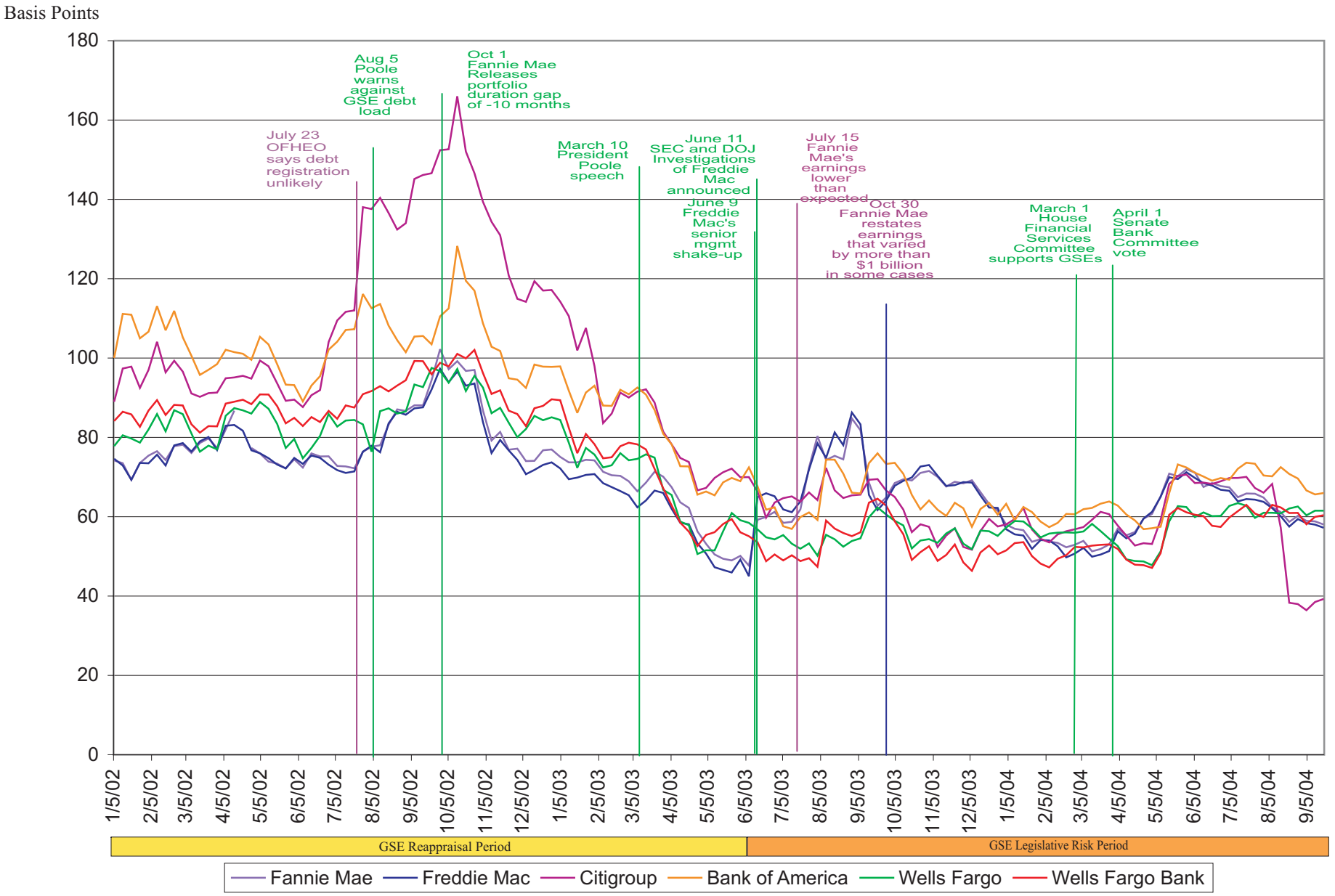
[28] As of June 1, 2004, Freddie Mac indicated on its website that the enterprise "did not issue any Freddie SUBS in 2003. As a result of not having timely consolidated financial statements, Freddie Mac's ability to issue subordinated debt may be limited." A daily percentage change in subordinated debt spread time-series model was estimated that used as explanatory variables the percentage change in a Merrill Lynch 1-to-5 year corporate bond yield (rated AA or BBB), the daily percentage change in the 1-year Treasury yield (measured either contemporaneously or lagged one business day), and the level of the Chicago Board of Options Exchange volatility index, VIX. Green vertical bars on Exhibit 6 have been placed on dates where the residual was greater than two

Table 2: Subordinated Debt Instruments Issued by Housing Enterprises (2001 - 2004)

Issuer	Issue Date	Maturity Date	Coupon (in percent)	Amount Outstanding ($ Billion)
Fannie Mae	February 1, 2001	February 1, 2011	6.250	2.5
	May 8, 2001	May 2, 2006	5.500	1.5
	December 7, 2001	January 2, 2007	4.750	2.0
	July 26, 2002	August 1, 2012	5.250	2.5
	April 21, 2003	May 1, 2013	4.625	1.5
	August 15, 2003	September 2, 2008	4.000	1.0
	November 6, 2003	January 2, 2014	5.125	1.5
Freddie Mac	March 21, 2001	March 21, 2011	5.875	2.0
	August 1, 2001	August 1, 2011	6.375	1.0
	March 3, 2002	March 5, 2012	6.250	1.5
	November 5, 2002	November 5, 2012	5.250	1.0

Source: Company websites

Exhibit 6: Subordinated Debt Spreads over Comparable Maturity Treasury Securities (January 1, 2002 to September 13, 2004)



*Daily data were used to construct weekly moving averages for each entity.

difficult because stock and bond investors account for the levels and changes in implicit government guarantees when evaluating news that affects the risks to these firms. We show how these implicit guarantees can confound the common interpretation that changes in the responsiveness of stock and bond returns necessarily reflect changes in investor perceptions of expected losses. We argue that changes in assets returns must be persistent to influence management decisions through market discipline. Moreover, such returns must provide a direct link to underlying changes in firms' expected losses for investors and others, such as rating agencies or government supervisors, to evaluate managements' actions. Finally, we provide conditions under which bond returns can be usefully interpreted as reflecting expected losses and thus the relative riskiness of firms.

We show that the responsiveness of subordinated bond returns to macroeconomic shocks during the two periods considered indicate that (1) BHCs' returns across the two periods became less sensitive to changes in macroeconomic factors that affect credit risks but more sensitive to changes in macroeconomic factors that influence interest rate risks, (2) changes in implicit guarantees made it difficult to interpret GSE bond returns across the two periods, and that (3) bond investors generally believed that GSEs are at least as risky, and maybe more risky, (that is, their expected losses are more sensitive to macroeconomic risk factors) when compared with BHCs. This result may not seem surprising, given that the assets in Fannie Mae's and Freddie Mac's portfolios can be duplicated by the BHCs and that the GSEs have less capital and are large monoline financial firms with few diversification opportunities, whereas the comparison group of highly rated BHCs is better capitalized and better diversified.

Our results also suggest that mandatory subordinated debt policies would increase market discipline even when investors perceive substantial implicit guarantees because changes in the responsiveness of subordinated debt returns to risk factors provide a clearer indication of investors' perceptions of underlying risks than do changes in responsiveness of stock returns. Indeed, in response to concerns about their lack of capital, Fannie Mae and Freddie Mac agreed to increase their issuance of subordinated debt and stated that such debt provides "a canary in the mine, that if some of the credit capacity of these institutions erodes at the edges, it will show up in the prices of liabilities which are not insured and that have no collateral behind them."[29]

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standard deviations from the "mean residual" and where a news event could be identified.

[29] See Fannie Mae website, "Views on Subordinated Debt as a Useful Tool of Market Discipline."

However, because of the voluntary nature of the subordinated debt initiative, the GSEs stopped issuing subordinated debt as soon as it became very costly to do so. The discretion to stop issuance clearly undermined the ability of such debt to act a catalyst for more direct and indirect market discipline. Our results suggest that recent actions by the GSEs' regulator, OFHEO, to prompt Fannie and Freddie to resume issuing subordinated debt might increase market discipline on the GSEs, since under most conditions there is a more direct link between changes in the responsiveness of subordinated debt returns to risk factors and investors' perceptions of changes in expected losses.

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