Financial Market Signals and Banking Supervision: Are Current Practices Consistent with Research Findings?*

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The trend toward incorporating information derived from financial markets into the bank supervision process has gained momentum over the past several years. This in part reflects an evolution in the thinking about how private market information can contribute to the process. In light of the evolving view of the potential contributions of market information, this paper reviews the empirical evidence relevant to the usefulness of financial market information in the bank supervision process. This paper reviews the research on what information can be gleaned from the pricing of equity and debt securities issued by banking organizations. The weight of the research leaves little room for doubt that financial market signals reflect underlying bank risk and that market evaluations of the risk of individual banking organizations are strongly correlated with supervisory findings. The evidence on the extent to which market signals can augment the information set of bank supervisors is more subtle, but overall it demonstrates that financial market signals should play a role in the bank supervision process.

1. Introduction

Over the past several years, financial market information has been incorporated more frequently into the bank supervision process. Burton and Seale (2005), for example, discuss the use of market information in bank supervision by the Federal Deposit Insurance Corporation (FDIC). Feldman and Schmidt (2003) document the incidence of references to financial market information in Federal Reserve supervisory reports and identify the types of market information considered. A follow-up review of supervisory practices by Federal Reserve staff found that, while resources directed at the use of market information in the supervisory process remain modest, they are increasing.

As Burton and Seale (2005) point out, part of the appeal of incorporating financial market information such as that imbedded in the prices of equity and debt securities in the bank supervision process is that the information can provide an objective assessment of the financial condition of banking organizations. At the same time, there are reasons for skepticism about the market's ability to uncover with any regularity problems among traditional banking organizations ahead of bank supervisors, who have access to confidential information and, in the case of the very largest banking organizations, are on-site full-time.

Nevertheless, the trend in the use of market information in bank supervision indicates that the banking agencies see net benefits. Part of the reason is that the assessment of the contribution of market information has moved beyond the very narrow consideration of how likely it is that the market would catch problems before they are uncovered by the supervision process. The evolution in thinking points to three roles for market information in the bank supervision process. First, the information helps to reinforce other sources of supervisory information. Second, market sentiment can

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affect a banking organization's operations, especially its access to funding; thus, using market information along with other sources of information may be especially helpful in gauging the effects of adverse events on conditions in the banking industry or within a given banking organization. Third, financial market information can be useful when the informational advantage of bank supervisors might be more limited. In particular, under the supervisory responsibilities laid out in the Gramm-Leach-Bliley Act, bank supervisors may have less of a comparative advantage over the market when it comes to assessing activities related to securities and insurance services in nonbank subsidiaries of financial holding companies.[1]

In addition, the assessment of when to use market information has moved from the narrow consideration of the direct impact on supervisory findings to the broader concept of using the information in the various stages of the supervision process. Not surprisingly, market information is most commonly used in monitoring—by both surveillance staff and exam team members. However, market information also comes into play in other stages of bank and bank holding company (BHC) supervision, such as strategic planning, scoping for exams, and even in interactions with bank management.[2]

In light of the broadening channels of contribution for market information, this paper reviews the empirical evidence relevant to the usefulness of financial market information from banking-related securities in the bank supervision process.[3] This paper focuses on research on the information that can be gleaned from the pricing of equity and debt securities issued by banking organizations. The bulk of the research on these market signals in banking deals with interest rate spreads on bank debt, the issuance of banking-related debt, stock returns, and expected default frequencies (EDFs), which refers to the probability of default (see Box 1).[4] A more expansive set of sources of market information is presented in Table 1 in Box 1.

The studies reviewed in this paper examine the reliability of market signals for banking organizations relative to those for other types of firms, the relation of market signals to other measures of bank risk, and the informational advantage of bank supervisors over market participants, as well as evidence relating to direct market discipline from banking organizations' responses to market signals.

The remainder of this paper, then, reviews the evidence regarding the potential usefulness of market signals for bank supervision. Section 2 examines whether the incentives of market participants need to coincide with those of bank supervisors in order for market signals to be useful in the supervision process. Section 3 discusses the findings related to the degree of transparency of banking organizations. Section 4 then turns to the rich array of studies on the information content of market signals. That is followed in Section 5 with a discussion of the findings related to the informational advantages of bank supervisors and the evidence regarding the effects of market signals on the operations of banking organizations. Section 6 briefly reviews recent proposals for improving the reliability of market signals based on subordinated debt issued by banking organizations. Section 7 presents our conclusions about the consistency of bank supervision practices with the evidence on market information in banking.

2. Are Debt Signals Preferable to Equity Signals?

Before discussing the research findings regarding market signals in banking, it is useful to review what to expect from debt and equity market signals. Understandably, from a bank supervision perspective, debt signals might be preferable to equity signals since the interests of debt holders are more aligned with those of bank supervisors. In particular, compared to equity holders, debt holders and bank supervisors are concerned more about the downside risks affecting a bank's performance than the upside potential. Indeed, market discipline is often equated with oversight by debt holders because their motives and actions are expected to limit risk-taking. The ex ante (before debt issuance) actions that debt holders can take, such as demanding higher interest rates on riskier debt and with-

1. Flannery and Nikolova (2004) suggest other roles for market information. In particular, they note the work of Evanoff and Wall (2001) in connection with the use of market signals as trip wires to force regulatory action and, thus, forestall supervisory forbearance. Also see Evanoff and Wall (2002, 2003).

2. Another reason to focus on the use of market information in the supervision process is the provisions of Pillar 3 of the Basel II Accord that refer to the contribution of market discipline. See Lopez (2003).

3. Flannery and Nikolova (2004) review the research findings regarding market discipline in banking. Gropp (2004) reviews the related findings for banking organizations in Europe.

4. Other statistics reflecting equity market signals include dividend yields, book equity to market equity ratios, and price-to-earnings ratios. Empirical research on these statistics deals mainly with the power of the ratios to predict stock returns generally and, therefore, provide only indirect evidence for banking. Within the Federal Reserve System, a number of reports include data on these financial ratios, though there appears to be limited use of these ratios in the various stages of the supervisory process, and more research would be helpful to provide a coherent framework for using such market signals in monitoring banking organizations. In the Federal Reserve System, recent efforts also have focused on the use of information from credit default swaps.

Box 1
Financial Market Information Used in Bank Supervision

The term "financial market information" covers a wide range of items for bank supervision staff. Broadly defined, it is information derived from the private sector that relates to the financial condition of firms and sectors or broad financial markets. For example, in the interviews with Federal Reserve supervisory staff, they mentioned using information on broad financial markets such as the slope of the Treasury yield curve, measures of interest rate and stock market volatility, trading volumes in stock and debt markets, the performance of asset-backed securities markets, and even private sector sources of information on operational risk.

Supervision staff also consider market information relating directly to the financial condition of individual organizations, including quantitative market signals and sources of qualitative information. The quantitative signals are listed in the top part of Table 1. Most of the signals are derived from the prices of securities issued by individual firms. Market signals used most widely are stock returns, interest rate spreads on bonds, and EDFs. Another set of prominent quantitative indicators is the debt ratings issued by private rating agencies such as Moody's Investor Services, Standard & Poor's, and Fitch.

Qualitative private sector financial information also is incorporated into the supervisory process. As indicated in the bottom part of the table, the sources of qualitative information are analysis and reports from the rating agencies as well as stock and bond analysts' reports and firms' reports for investors and analysts.

The market signals and other financial information most commonly used are those for individual banking organizations or the banking sector generally. However, the scope is broader and includes information on nonbank financial sectors such as investment banking, insurance, and mutual funds—both for individual firms and for the respective sectors. Nonbank financial firms are used in peer-group analysis for nontraditional banking organizations. Financial information on the performance of these nonbank financial firms also is used in assessing risk associated with the related activities conducted by banking organizations more generally. Finally, financial market information on individual nonfinancial firms or sectors is used in assessing the credit risk of banking organizations with exposure to the firms or relevant sectors.

Table 1
Sources of Market Signals Used by Supervisors

Quantitative Signals
Debt
Subordinated debt (bond) interest rate spreads
Debt ratings by private agencies
Volumes of debt issuance
Uninsured CD interest rate spreads
Derivatives
Credit default swap premiums
Stock options (implied volatility of return)
Equity
Stock returns (stock price changes)
EDFs[a]
Market value of equity
Asset return volatility
Market betas (measure of systemic risk)[b]
Sharpe ratios[c]
Stock price-to-earnings ratios
Market-to-book equity ratios
Bid–ask spreads for stock prices
Trading volumes
Qualitative Signals
Private rating agency reports
Stock and bond analysis
Corporate briefings/reports
Financial statements required by the Securities and Exchange Commission
Media/Internet

a. Expected default frequencies (EDFs) are probabilities of default (usually over a one-year horizon). This market signal is produced by Moody's KMV. Key inputs are the market value of equity and the estimated volatility of the return on assets derived by applying an options model to stock prices of individual firms.

b. Market beta is a measure of the degree of exposure to systematic risk of a stock (or portfolio). If the systematic risk exposure of a stock is equal to that of the overall market, the stock's beta will equal 1. For stocks with betas greater (less) than one, their returns will be more (less) volatile than the return for the overall market. In a simple capital asset pricing model the expected return on an investment is related to the risk-free rate and the expected market return: $E(r_i) = R + \beta(E(r_m) - R)$, where i is a stock, $E(r_i)$ is expected rate of return of i, R is the rate of return of a riskless security, $E(r_m)$ is the expected return on the market portfolio, and β is the measure of the degree of systematic risk

c. Developed by William Sharpe, the Sharpe ratio is a measure of reward-to-risk. The idea is that investors require a higher return for holding assets with higher risk. Therefore, a higher Sharpe ratio for a portfolio would indicate a better risk–return tradeoff. The Sharpe ratio is calculated as $SR(i) = (r_i - R)/s(i)$, where i is an investment, r_i is the annual rate of return of i, R is the rate of return of a riskless security, and $s(i)$ is the standard deviation of r_i.

holding funding, would be expected to provide checks on risk-taking.[5] In addition, the ex post value of debt holders' claims declines as default risk increases. Therefore, if a firm's risk increases, the secondary market yield on its outstanding debt would be expected to rise relative to that benchmark security with little or no credit risks, typically a Treasury security of comparable maturity. Such a rise in the interest rate spread would provide a signal to other potential debt holders.[6]

For publicly held firms, equity holders also are a source of market oversight. Greater shareholder monitoring, for example, can result in better risk management procedures and controls at a banking organization. While it is the case that equity holders want a firm to attain an appropriate risk–return tradeoff, not to limit risk per se, equity signals still can be expected to reflect the risk posed by a banking organization. To put it another way, even though equity holders do not necessarily want to limit risk-taking as much as bank supervisors, they do have an interest in identifying and measuring risk accurately.[7]

There are circumstances that might affect the reliability of equity signals as indicators of risk. For banking organizations, in particular, the presence of a government safety net, owing to underpriced deposit insurance or the market's perception that some large banks may be "too big to fail," can affect the signals from changes in stock prices.[8] The explanation starts with noting that, with a safety net, the cost of funding for a banking organization will not be fully responsive to its risk-taking (though it could still be partially responsive). This means that a banking organization would benefit from the upside of taking risk without paying for the full cost of the downside.[9] In that case, the stock price (and the market value) of a banking organization could rise with an increase in its risk-taking, sending a "perverse" signal to bank supervisors.[10]

These considerations do not preclude the use of equity signals or mean that debt-based market signals are necessarily superior. First, as discussed in the research findings below, observed changes in stock prices tend to send appropriate signals about overall risk. Second, equity-based measures such as EDFs provide information on movements in market value and portfolio risk.[11] Third, on the choice of debt versus equity signals, interpreting debt spreads can also be problematic. If the market's perception is that uninsured debt holders might be protected, the signal from banking-related debt spreads also would be damped. Also, as discussed below, interest rate spreads on debt are affected by factors other than just default risk. Fourth, in terms of the depth and breadth of the market, the equity market is a much richer source of information on banking organizations than the long-term debt market. The dominant position of equity issuance for banking organizations is discussed in Board of Governors (2000), which examines public disclosures in banking. The study points out that the market value of common equity for banking organizations with data available on the Compustat database totaled $907 billion (as of the end of 1998). Moreover, the potential for equity market monitoring extends to medium-sized organizations, though large banking organizations account for the lion's share of the value of market equity. By comparison, the volume of subordinated debt (on a consolidated basis) at all BHCs was around $103 billion, or around 2 percent of assets.

In considering the potential contribution of market information, then, the differences in incentives between debt holders and equity holders in theory should not be a significant factor in differentiating between the use of debt and equity instruments issued by banking organizations.

5. As discussed in Furlong and Keeley (1987), in the presence of a federal subsidy to banks owing to, say, mispriced deposit insurance, debt holders' demanding higher interest rates on riskier bank debt is not sufficient to limit even ex ante risk-taking. The problem is that, with a subsidy associated with insured deposits, a bank may be willing to pay a higher rate to uninsured debt holders and still take the higher risk. In that case, bank supervision is still needed to limit risk-taking. On the other hand, the return to the bank from risk-taking would be reduced by the higher cost of uninsured funds, so it may be easier for bank supervisors to detect and control risk.

6. Note that for a banking organization approaching insolvency, the interests of subordinated debt holders regarding risk-taking can become aligned with those of equity holders.

7. The information content of equity markets for bank supervision is discussed in Board of Governors (2000). Also see Saunders (2001).

8. The provisions of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) make it less likely that debt holders would be protected in the case of failure (insolvency) of a large banking organization. As discussed below, recent studies find that interest rate spreads on banking-related (bank and BHC) debt are sensitive to the risks of issuing organizations.

9. Deposit insurance, in effect, represents a put option on the value of a bank's assets at a strike price equal to the value of deposits. The effects of leverage and portfolio risk on the value of deposit insurance are described in Furlong and Keeley (1989). There are statistical techniques for controlling for the value of such federal guarantees for banking organizations (see Furlong 1988). However, equity market signals typically used in bank supervision do not include such an adjustment.

10. More generally, a firm can gain at the expense of existing debt holders by increasing risk. To guard against this, debt contracts often include covenants limiting a firm's ability to increase its risk ex post—that is, after it has issued the debt.

11. While the commercially available EDFs do not control for the value of the federal safety net for individual banking organizations, they should tend to rise with increases in both portfolio risk and leverage (see Gropp 2003).

Moreover, the greater depth and breadth of the market for BHC equity give a distinct advantage of equity-based signals compared to those from subordinated debt. A development that has cut somewhat into the advantage of equity-based signals is the growing prevalence of credit default swaps (CDSs). In CDS arrangements, one party agrees to provide protection to a second party upon a credit event of a reference entity, such as a BHC. Similar to the spread between the interest rate on subordinated debt and the yield on a comparable Treasury security, the premium (or spread) paid on a CDS should reflect the riskiness of the reference entity. However, the CDS market is more active than that for subordinated debt, so the signals about the risk from premiums on CDSs for which a BHC is the reference entity generally should be more reliable than those based directly on subordinated debt.[12]

3. Transparency in Banking

For market signals from either debt or equity instruments to be useful in bank supervision, it is necessary to have sufficient transparency in banking so that market signals have an acceptable degree of reliability. The observations that many assets, such as loans, held by banks tend to be opaque raises the concern that the makeup of bank portfolios presents a significant hurdle for the market's ability to evaluate the financial condition, performance, and risk of banking organizations.[13]

To investigate this exact issue, a study by Flannery, Kwan, and Nimalendran (2004) focuses on the adverse selection component of the bid-ask spreads on stocks; this component is the portion of the spread that compensates market makers for the risk of trading with informed parties. A wider spread can be interpreted as indicating more uncertainty or opacity. The study's results are consistent with the hypothesis that investors are able to value large banking firms about as well as they can value large nonbanking firms with matching characteristics. Moreover, the findings show that market investors have good information about smaller banking firms (listed on Nasdaq) compared with size-matched nonfinancial firms.

Another study, Morgan (2002), uses differences in ratings by Moody's and Standard & Poor's as proxies for the difficulty in assessing risk. Since the focus is on the rating agencies, the results do not provide direct evidence on the market's relative ability to assess banks. In any case, the study finds that the ratings of the two agencies tend to differ more for BHCs and insurance companies than for other firms of comparable size and risk. The study also finds that the likelihood of a split rating increases with a higher proportion of loans (as opposed to securities) in a bank's asset portfolio and decreases with higher capital ratios. These findings suggest that the riskiness of bank debt, particularly among less financially sound banks, may be more difficult for the rating agencies—and perhaps the market—to assess.

Overall, analysis using stock market data indicates that transparency among larger banking organizations is at least on a par with that for other types of firms. On the other hand, patterns of debt ratings suggest that the private rating agencies have more difficulty assessing banking organizations than they do assessing nonfinancial firms.

4. Market Signals and Bank Risk

Research findings on market signals and risk in banking relate to three basic questions. First, are market signals sensitive to differences in risk among banking organizations? Second, are the assessments of banking organizations reflected in market signals consistent with supervisory assessments? Third, if the market's assessment is consistent with the views of bank supervisors, does the information conveyed by market signals add to the "intelligence" amassed through other means in the supervision process?

4.1. Do Market Signals Reflect Bank Risk?

The short answer is yes, market signals reflect bank risk. Considerable research has been dedicated to determining the extent to which prices (interest rates) for the uninsured debt of banking organizations are related to various measures of risk. Most studies focus on longer-term subordinated debt. A core set of studies examines whether risk measures such as interest rate spreads on banking-related subordinated debt are sensitive to various accounting risk indicators, including problem loan ratios and charge-offs. Among these studies, most of the ones relying on data for periods prior to the 1990s tend to find little evidence that

12. In a CDS contract, one party pays a premium to a second party for protection against a credit event for a reference entity's security. A credit event could be a default on a bond (or loan) of the reference entity declaring bankruptcy or restructuring its debt obligations. The payment by the first party for the protection usually is expressed in terms of basis points of the value of the reference bond (loan). The premium in effect is the compensation to the second party for bearing risk, and, therefore, should reflect the credit risk of the reference entity. If a credit event occurs, the second party makes a payment to the first party, and the swap terminates. Also, note that some banking organizations use CDSs in managing their own risk (Minton, Stulz, and Williamson 2005 and Lopez 2005).

13. The transparency of banking organizations also can be limited by holdings of asset-backed securities and other derivatives and off-balance-sheet activities more generally.

yields on long-term debt consistently reflect traditional measures of risk in banking.[14]

More recent research, however, finds that yields on banking-related subordinated debt are sensitive to the risk of the issuing organizations. An especially pertinent study by Flannery and Sorescu (1996) concludes that interest rates on long-term bank debt tend to vary with the riskiness of the institution issuing the debt in the period 1989 to 1991, but not earlier in the 1980s. A subsequent study, Covitz, Hancock, and Kwast (2002), indicates that these results for the earlier 1980s may be related to measurement issues. The study finds that, after accounting for liquidity premiums in yields on subordinated debt, banking-related subordinated debt spreads were sensitive to organization-specific risks in the mid-1980s, and that the risk sensitivity of such spreads was about the same in the pre- and post-FDICIA periods.[15]

Even with the latter evidence, it is important to reiterate the point that only a limited number of banking organizations have tradable subordinated debt outstanding. Moreover, only the very largest BHCs have meaningful amounts of regularly traded subordinated debt. Again, this limits the scope for applying subordinated debt spreads in the supervision process. Hancock and Kwast (2001) also point out that the movements in debt spreads on subordinated debt at individual BHCs are sensitive to the data source for the bond prices, thus further complicating the interpretation of movements in yield spreads on long-term debt.[16]

Short-term banking-related debt instruments, such as large denomination certificates of deposit (CDs), commercial paper, and federal funds, are potential sources of market signals related to bank risk. As discussed in Board of Governors (2000), banks issue large volumes of short-term uninsured debt compared to subordinated debt. While yields on short-term instruments might not be sufficiently sensitive to an organization's risk, the volume of short-term debt issued by a banking organization might be an added source of information since potential holders of such instruments might withhold funding from an institution facing financial problems.

Most studies assessing the information content of market signals from short-term bank debt focus on large CDs. Studies of yields on large CDs have used quoted interest rates (marginal yields) and average interest rates paid based on bank Call Report data. Using quoted rates for a sample of large banks, Ellis and Flannery (1992) find that measured bank risk affects large CD rates in a plausible fashion. However, the Board of Governors (2000) indicates that quoted rates on large CDs have been less sensitive to bank-specific risk in recent years. This lower sensitivity may be in response to the substantial increase in bank capital during the 1990s. In addition, the depositor preference rule, instituted in 1993, may have had an effect. The intent of the rule was to provide more protection for the FDIC by placing it ahead of other general creditors. However, it also gives holders of large-denomination domestic CDs priority over other general creditors. The latter would be expected to be more responsive to changes in risk-taking by a bank.

The most comprehensive studies (in terms of the number of banks covered) have relied on average interest rates on large CDs based on bank Call Report information. This approach is appealing since it raises the possibility that market signals would be available at the individual bank level (rather than at the holding company level) and for small and medium-sized institutions. The drawback is that the studies use average, rather than marginal, interest rates; a recent example is Gilbert, Meyer, and Vaughan (2003), which compiles the results from a number of earlier studies along with new evidence on the risk premiums in large CD rates. The findings from these studies are somewhat mixed. While the studies tend to find links between large CD yields and traditional measures of bank risk, the relation appears to have weakened in recent years.

One study also tests for evidence that bank credit risk affects interest rates on federal funds. Furfine (2001) assembled a database of transactions on overnight federal funds for the period from January 2 to March 31, 1998. In the empirical analysis, the borrowing bank's leverage ratio was used to control for credit risk. The study finds that lower leverage did result in lower borrowing rates on federal

14. See, for example, Gorton and Santomero (1990) and Avery, Belton, and Goldberg (1988).

15. Also see Jagtiani and Lemieux (2001) and Morgan and Stiroh (2001). Jagtiani, Kaufman, and Lemieux (2002) find evidence of risk premiums for subordinated debt issued by BHCs and by banks. While these studies indicate that interest rate spreads on longer-term bank debt will respond to changes in risk, the spreads do not necessarily fully reflect the underlying risk of the issuer. For some very large organizations, for example, the debt holders might assume that under certain circumstances they would be protected, perhaps to stave off systemic risk. As pointed out earlier in the text, to the extent that this is the case, the interest rate spreads on a banking organization's debt would be smaller than they would be in the absence of the assumed protection of debt holders.

16. As indicated earlier, premiums on CDSs that are tied to debt issued by a BHC also provide market signals regarding the default risk of the banking organization. Studies examining broad samples of firms find consistent relationships between interest rate spreads on bonds and CDS premiums, suggesting they have similar information about a firm's risk (see, for example, Hull, Predescu, and White 2004). A recent study also finds a close relationship between estimates of default probabilities from EDFs and CDS premiums (Berndt et al. 2004). A few studies have examined the relation of CDS premiums and bank risk. Düllmann and Sosinka (2005), for example, examine a sample of German banking organizations and conclude that signals from CDSs are useful in gauging risk but should be used in conjunction with other market signals such as EDFs. Ito and Harada (2004) argue that CDS premiums (spreads) are good measures of the soundness of Japanese banking organizations.

funds. This study also reports that leverage has a statistically significant effect on the borrowing costs for smaller banks. The study, however, does not provide separate results for large banks.

4.2. Are Market Signals Consistent with Supervisory Assessments?

Empirical research does show that subordinated debt spreads and equity market signals are consistent with supervisory assessments of the financial condition of individual banking organizations. Key findings in this regard are that market participants' views about the financial condition of banking organizations, as reflected in individual financial market signals, tend to be consistent with the views of bank supervisors as reflected in their ratings of institutions. For example, the studies by Krainer and Lopez (2002, 2003, 2004) find that signals from banking-related debt and equity tend to anticipate changes in supervisory ratings. In particular, they find that interest rate spreads on banking-related subordinated debt show statistically significant increases (decreases) up to 12 months prior to downgrades (upgrades) in bank holding companies' BOPEC ratings.[17] Similarly, they find that abnormally low (high) BHC stock returns tend to precede downgrades (upgrades) in supervisory ratings.

In the univariate results of Curry, Fissel, and Hanweck (2003), the individual mean values of several variables derived from equity prices for BHCs grouped by supervisory ratings also suggest that market variables are consistent with the ratings. The equity market-based data for BHCs considered in Curry et al. (2003) are coefficients of variation of the stock prices, market abnormal returns (the difference between the actual cumulative quarterly return on a BHC's equity and the comparable return computed from an index of market performance), the standard deviation of the return for BHCs, the market-to-book equity ratio for BHCs, and the relative trading volume of a BHC's equity.

4.3. Is There an Informational Advantage? Market Signals versus Supervisory Information

The weight of the research leaves little room for doubt that financial market signals reflect underlying bank risk and that market evaluations of the risk of individual banking organizations are strongly correlated with supervisory findings. The evidence on the extent to which market signals can augment the information set of bank supervisors is somewhat more subtle. Several recent studies have assessed the contribution of market information by using empirical models that include various market signals with lagged supervisory ratings and information from financial statements of banking organizations.[18] Lagged supervisory ratings are assumed to capture the whole of supervisory information as of the most recent full-scope examinations and the data from financial statements are assumed to represent the information available between examinations.[19]

Using this approach in a multivariate regression analysis, Curry et al. (2003) find that various equity market based signals for BHCs were significant in explaining holding company ratings.[20] Those findings are consistent with the work by Krainer and Lopez, which is representative of the wider research findings. Their work shows that, for within-sample estimates, signals from debt and equity markets tend to be statistically significant in explaining supervisory ratings when controlling for past supervisory ratings and information from publicly available financial statements. Also of note, their research does not find that debt market signals perform better than equity market signals. Moreover, for equity market signals, Krainer and Lopez (2004) indicate that stock market return measures perform somewhat better than EDF measures.

The results from the in-sample tests showing the sensitivity of various market signals when controlling for certain supervisory information suggests that market data have the potential to provide useful information to supervisors in assessing banking organizations. A more stringent test of the information content of market signals is the per-

17. The term BOPEC stands for the five key areas of supervisory concern: the condition of the BHC's **B**ank subsidiaries, **O**ther nonbank subsidiaries, **P**arent company, **E**arnings, and **C**apital adequacy. BOPEC ratings range from one (best) to five (worst). A rating of one or two indicates that the BHC is not considered to be of supervisory concern. BOPEC ratings are highly confidential and are not publicly available.

18. A noteworthy study that does not take this approach but finds a contribution from market information is Evanoff and Wall (2001). They find that using subordinated debt spreads results in more accurate predictions of supervisory ratings than using regulatory capital ratios.

19. Note, however, that these sources do not actually capture the full content of supervisory information between exams. As indicated earlier, bank supervisors have access to confidential information, and on-site examinations staff gain information between formal exams. In particular, the empirical research focuses on full-scope exams and cannot assess the "value" of information from targeted exams. This means that supervisors' full information set is not observable by researchers. If we assume that the bank examiners are correct in their assessments, the share of the supervisory ratings not explained by the off-site monitoring models that use the most current data is an indication of the contribution of the "insider" informational advantage of bank supervisors. In Krainer and Lopez (2004), the proportion of the variation in ratings (adjusted R^2) accounted for by the models that include lagged BHC supervisory ratings, financial statement data, and market signals is about 0.5 (out of a maximum of 1).

20. Also see Gunther, Levonian, and Moore (2001).

formance in out-of-sample predictions of supervisory ratings.[21] When this higher hurdle is used, the performance of market signals is less impressive, though financial market signals still appear to have scope for contribution in the bank supervision process.

Curry et al. (2003), for example, consider the contribution of equity market variables in out-of-sample forecasts of supervisory ratings for BHCs. In the study, the out-of-sample contribution of equity market variables is assessed in terms of the percent of actual ratings categories—that is, downgrades, no changes, and upgrades—that were predicted correctly. Based on this metric, the findings regarding the contribution of adding equity market information to a model with lagged supervisory ratings and financial statement variables are mixed. The inclusion of equity market information increases the percent of correctly predicted supervisory actions for some categories for certain time periods and reduces it for others.

An alternative metric for assessing the accuracy of model forecasts of supervisory ratings is the percent of, say, downgrades predicted by the models that were actually downgrades. This second criterion is critical since the share of false positives is important to supervisors. Consider downgrades, for example. From Curry et al. (2003) in the 1993 to 1995 period, about 6 percent of full-scope exams resulted in downgrades in their sample. For that period, a model that predicted that, say, all BHCs would be downgraded would have 100 percent accuracy for downgrades based on the first criterion. On the second criterion, however, the accuracy rate would be only 6 percent.[22] The practical problem posed by a false positive (prediction of a downgrade for a financially sound organization) is that following up on the false signal absorbs scarce supervisory resources.

The second criterion for assessing the accuracy of supervisory rating forecasts is reported on in the work by Krainer and Lopez. They estimate models for predicting BOPEC ratings for bank holding companies. The explanatory variables in the most complete models include the lagged BOPEC ratings and information from financial statements along with selected market signals.[23] The basic finding is that, when the models' forecast accuracy is calibrated in terms of the percent of predictions that were correct, the models' out-of-sample forecasting power is not appreciably increased by including market signals compared with forecasts of supervisory ratings based on information available to bank supervisors.

However, as pointed out by Krainer and Lopez (2004), the contribution of monitoring models that incorporate market signals can be increased if separate monitoring models are used for holding companies with publicly traded equity and for other holding companies.[24] They find that, while the overall out-of-sample accuracy of models with and without market information is about the same, the individual BHCs identified as potential problems are not exactly the same. In particular, models that included market data correctly flagged publicly traded banking organizations as potential downgrades that were not flagged by models with only lagged supervisory ratings and data from financial statements. As noted by Krainer and Lopez, the usefulness of models with and models without market signals depends on the acceptable trade-off between the costs of missed signals (that is, failures to predict rating downgrades for BHCs) and false positives (that is, incorrect predictions of downgrades for BHCs).

Another important study examines the contribution of risk premiums on the large CDs of small commercial banks in predicting supervisory ratings. Gilbert et al. (2003) find that, when combined with other accounting information relating to the condition of banks, the risk premiums on large CDs do not add to the predictive power of an off-site monitoring model.

The other side of the question is whether the bank supervisory process uncovers information ahead of financial markets; a number of studies take on this issue of informational advantage. Flannery and Houston (1999), for example, show that financial markets evaluate information from a bank's financial statements differently when an exam of the banks has occurred recently. For a sample of banks examined in the fourth quarter of 1988, they find that accounting statements of recently examined banks are more informative than those of "non-examined" banks; they also find that examined banks' market values are slightly higher. These effects are stronger for smaller banks, banks with higher stock return variance, banks with harder-to-value assets, and banks not rated by bond rating agencies.

21. Out-of-sample here means that the changes in supervisory ratings being predicted were not used in estimating the models relating supervisory ratings to the other explanatory variables.

22. This is pertinent to the findings reported in Curry et al. (2003) that models in the out-of-sample forecasts with only equity market information tend to be much more accurate at predicting downgrades because they overpredict by large margins, and tend to be less accurate for the other two categories because they underpredict no changes and upgrades. That is, these models had a large share of false positives for downgrades.

23. The model is roughly based on the System for Estimating Examiner Ratings (SEER) off-site monitoring model for banks (Krainer and Lopez 2002).

24. Curry et al. (2003) also argue for using a multiple models approach.

The authors argue that these findings provide evidence that bank examiners play a valuable role in the certification of banks' accounting data and that bank shareholders benefit from this activity.

Berger, Davies, and Flannery (2000) employ Granger causality tests to compare the relative timeliness of government supervisors' and market participants' assessments of banks to see if one or more of the groups use some relevant information before the others. They find that both bond rating agencies and supervisors regularly discover relevant information that is only subsequently incorporated into the other group's assessments. The evidence pointing to the discovery of information by stock market participants ahead of bank supervisors is not as strong. However, in terms of predicting future performance, the authors find that supervisory assessments contribute substantially to forecasting future bank performance and often exceed the contribution of the market's assessment for short periods following supervisory exams, but not for longer horizons.

Curry et al. (2003) also look at whether supervisors acquire information in exams that was not previously revealed to the market. The study finds that, even controlling for the information of financial statement variables, lagged information on supervisory ratings had predictive power for several of the equity-based, market variables. This suggests that some information acquired in on-site supervisory exams is not initially known by the market but apparently is disseminated to the equity market over time. These results are consistent with bank supervisors acquiring some information ahead of the equity market.

DeYoung, Flannery, Lang, and Sorescu (2001) examine whether private information uncovered in bank exams is incorporated into the pricing of banking-related subordinated debt. They find that examiner assessments contain relevant information about bank conditions that is not fully incorporated into the pricing of subordinated debt at the time of the exam but that is incorporated in subsequent quarters. They also find that when examiners uncover "bad" information in an exam, the information generally does not become public until subsequent quarters, but "good" information generally finds its way to the market quickly. This finding suggests that bank managers tend to disclose good news more readily than bad news.

The findings in Berger and Davies (1998) are also indicative of an informational advantage for bank supervisors. The authors examine the relationship between stock returns and the examination process. Analyzing abnormal stock returns of BHCs in the period after the lead bank had been examined, they find that exams discovering unfavorable information about bank conditions result in abnormal negative returns. The finding suggests that bank managers may reveal favorable information in advance, while the supervision process, in effect, forces the dissemination of unfavorable information.

Jordan, Peek, and Rosengren (2000) examine the effects of disclosing formal enforcement actions. The U.S. Congress adopted legislation in 1989 and 1990 requiring bank regulatory agencies to make public all formal enforcement actions imposed on banks. By making the formal actions public, bank supervisors were, in effect, disclosing that certain institutions were believed to have a high probability of failure in the absence of substantial remedial action.

The authors show that announcements of formal supervisory actions provide useful information to the market. They find that investors and depositors reacted to the news in a manner that was consistent with enhanced market discipline, and the reaction was far from catastrophic. On average, an announcement of a formal action caused the announcing bank's stock price to decline only 5 percent. The declines tended to be smaller for banks for which the market had already anticipated the problems and larger for those banks for which little news of impending problems had been revealed. Thus, the market's ability to uncover problems is at least in part a function of bank disclosure. There were some spillover effects, including rival banks experiencing moderate stock price declines. However, these spillover effects were limited to banks in the same region with portfolio positions similar to that of the announcing bank.

Market signals regarding risk from banking-related, longer-term debt and equity generally are consistent with supervisory assessments and tend to predict changes in supervisory ratings. Also, the results from the in-sample tests show that market data have the potential to provide useful information to supervisors in assessing banking organizations. However, a more stringent test of the information content of market signals is the performance in out-of-sample predictions of supervisory ratings. When this higher hurdle is used, the performance of market signals is less impressive, though financial market signals still have scope for contribution in the bank supervision process. Moreover, a number of studies find that market signals for banking organizations tend to respond as if adverse supervisory information is revealed to the market. This is consistent with the supervision process uncovering negative information ahead of the market.

5. Response of Banking Organizations to Signals: Direct Market Discipline

While the weight of the research suggests that bank supervisors typically have some informational advantage, the fact that market signals generally are consistent with supervisory assessments indicates that they can help reinforce

these assessments. Moreover, monitoring market signals also would be useful in the supervision process to the extent that the markets' assessment of a BHC affects the environment in which the banking organization operates or affects management decisions. For example, a banking organization might respond to changes in market signals indicating increased concern about risk by adjusting its portfolio or sources of funding, increasing its capital, or perhaps changing its risk management practices. Market participants might also affect a bank's operations through its access to funding or through debt covenants tied to the performance of an issuing banking organization.

The research on the issue of whether the operations of a banking organization are affected by market signals is limited. Bliss and Flannery (2002) find no evidence that market assessments of risk lead to changes in bank risk-taking. However, Goyal (2003) finds that covenants in debt contracts are a source of discipline on banking organizations. In particular, the author finds that the charter value of a banking organization can affect the degree of restrictive covenants in its bond agreements. The idea is that a higher charter value provides a check on a banking organization's risk-taking—the charter value often is gauged by comparing a banking organization's market value to its book value.[25]

Other research indicating that market assessments affect the operating environment of banking organizations focuses on funding. One compelling study, Covitz et al. (2002), shows that adverse market conditions appear to affect the timing of debt issuance by banking organizations. Other studies such as Billet, Garfinkel, and O'Neal (1998) find that risk premiums on banking debt can affect the mix of funding, with higher risk leading to less reliance on uninsured liabilities compared to insured deposits. Hall, King, Meyer, and Vaughan (2002) find that yields and runoffs of large CDs are risk-sensitive, though they argue the effects are economically small and are not likely to put much pressure on banks to constrain risk. Jordan et al. (2000) also find that disclosure of supervisory actions tends to affect a bank's funding. Following formal enforcement actions, total deposits of affected banks declined modestly, an average of 2 percent, with the largest declines occurring in deposit categories that were not fully insured.

In an attempt to reconcile the findings regarding the market influence on banking organizations, it appears that feedback from the market through, say, bond covenants and risk premiums can affect banking organizations' choices of business strategies, with the choices varying among banking organizations. At the same time, an individual banking organization may not abruptly change its underlying business strategy in the wake of, say, a decline in asset quality. An important function of banking is taking risk. Even with sound risk management and ex ante underwriting practices, a banking organization can experience a "bad draw." That is, the realization of a low probability event might not lead to an overhaul of a banking organization's business plan. However, market assessments appear to have some impact on funding choices for banking organizations.

6. Improving the Quality of Market Signals

A recent line of research has examined whether supervisory or regulatory measures could improve the reliability of market signals. One area is improving public disclosure among banking organizations. While there is little empirical work on the effectiveness of increased public disclosures, several studies have identified areas for improvements.[26] The Basel Committee on Banking Supervision published several studies and the Federal Reserve Board of Governors Staff Study (2000) deals specifically with improving public disclosure among banking organizations. Improved disclosure also is part of Pillar 3 of the Basel II Accord.

Most of the empirical analysis relating to improving the reliability of market signals in banking has focused on the issuance of subordinated debt. The findings are relevant for addressing several of the shortcomings of market signals from banking-related subordinated debt from the perspective of bank supervision—limited issuance, infrequent issuance, and thin secondary market trading, especially for debt issued directly by commercial banks.

Research findings suggest some policy prescriptions. Summaries of various subordinated debt proposals are provided in Kwast et al. (1999). The main thrust of proposals for improving the quality and usefulness of market signals derived from banking-related subordinated debt is for policies to require regularly scheduled and relatively frequent issuance of banking-related debt. Other research mentioned earlier, for example, finds that market conditions can affect the timing of debt issuance by banking organizations. This supports requiring banking organizations to issue subordinated debt regularly so as to limit strategic issuance. Regarding the frequency of issuance, recent work by Evanoff and Jagtiani (2004) finds that market signals are most reliable when debt is issued. One reason may be

25. See Keeley (1990).

26. Spiegel and Yamori (2003) find that voluntary disclosures regarding market values of assets by Japanese banking organizations do improve transparency.

that public issuance involves publishing a prospectus with enhanced disclosures. Also, purchasing volumes are higher, which is likely associated with greater market research and analysis.

7. Conclusion

The use of market data in the Federal Reserve System is roughly consistent with the research findings to date. In general, market signals (debt and equity) tend to provide information that is consistent with supervisory assessments. Traditional measures of bank risk are found to be reflected in market measures of risk. Also, signals from banking-related debt and equity tend to predict changes in supervisory ratings. Furthermore, for within-sample estimates, signals from debt and equity markets tend to be statistically significant in explaining supervisory ratings. On the choice of equity versus debt, the greater depth and breadth of the market for BHC-issued equity compared to that for BHC-issued subordinated debt supports the growing use of equity signals in the bank supervision process.

On the other hand, when used in conjunction with other information available to bank supervisors, the out-of-sample predictive power of market signals, either equity or debt, is less robust. The usefulness depends to some extent on the trade-off one is willing to accept between missed signals of potential banking failures and false positives. These findings support the use of market information to help reinforce supervisory assessments of traditional banking organizations where supervisors would be expected to have an informational advantage, though it does not necessarily add significant information in terms of earlier warning signals for such institutions.

With financial deregulation, the informational advantage of bank supervisors is less clear for nontraditional banking organizations with activities dominated by securities underwriting, brokerage services, or insurance. Under the Gramm-Leach-Bliley Act, the federal banking agencies do not have direct oversight authority for securities and insurance affiliates of financial holding companies. While more research is needed on the transparency and reliability of market signals for securities and insurance firms, the current research suggests that market signals likely provide useful information to bank supervisors.

The research on the feedback of market signals on the behavior of banking organizations is somewhat limited. However, the evidence does suggest that market sentiment can affect the funding decisions of banking organizations, even if the impact on risk-taking is less evident. On balance, the research supports the monitoring and analysis of market information by bank supervisors to understand the environment in which a banking organization operates.

Finally, research suggests that the quality and usefulness of market signals for individual banking organizations might be improved. More complete disclosures by banking organizations could improve transparency. Others have proposed regulatory changes that would lead to more frequent issuance of and deeper markets for subordinated debt issued by banking organizations.

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