Market Information, Bank Holding Company Risk, and Market Discipline

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Abstract

This paper assesses the timing and magnitude of equity market valuations of bank holding companies (BHCs) in relation to changes in their risk assessments, as proxied by changes in supervisory ratings for these organizations. In particular, equity market indicators such as market-to-book value, abnormal returns, return volatility, market valuation, price covariance, and trading volume are used to determine if they can provide timely market signals as well as add incremental value to models predicting changes in supervisor-assigned BOPEC ratings of bank holding company risk. To analyze this issue, we took 3,974 bank holding company inspections from a sample of bank holding companies whose stock was publicly traded on major exchanges over the 1988–2000 period. We specify two statistical models: (1) an ordered logistic model, which is used to test the ability of lagged financial market variables, lagged financial accounting data, and past supervisory assessments to predict BOPEC rating changes; and (2) an OLS model, which is used to test the relationship of lagged BOPEC rating changes and lagged financial accounting ratios to predict financial market variables. These models taken jointly are used to test the hypotheses that (1) equity market information adds to the ability to forecast changes in banking company risk, as measured by changes in BOPEC ratings, and (2) supervisory risk ratings have the ability to lead stock market valuations of banking companies' performance. The analysis is conducted for three distinct economic and banking periods: recession and banking crisis (1988–1992), economic recovery (1993–1995), and economic expansion (1996–2000).

The findings for the first model show that financial markets can add forecast value to financial accounting data and supervisory factors in predicting future BOPEC ratings. The results reveal a relationship between market indicators and supervisory rating changes of BHCs, reflecting risk conditions that flow from market valuations to supervisory rating changes. The findings for the first model were statistically significant for all three of the periods studied. Out-of-sample forecasts show that market information sometimes improves the ability of the models to forecast upgrades, downgrades and no-rating changes. This suggests that a multiple-model approach may be superior to one using a single model to forecast BHC risk assessments. The findings for the second model reveal that regressing financial market variables on lagged BOPEC changes and lagged financial accounting information is only moderately suggestive of a relationship between lagged supervisory rating changes and equity market variables. In summary, the findings provide empirical support for the presence of market discipline to the extent that the hypothesized market variables add incremental value to the model in predicting changes in bank holding company risk ratings. To this extent, the financial markets appear to be providing some degree of independent oversight to BHC management, besides the oversight provided by bank supervisors and holding company directors.

Introduction

The prospects of using market information for the identification of risk in banking organizations have become a focus of bank supervision in recent years. This concern has arisen in part because of the rapid growth of large, global banking organizations whose portfolios and global operations have become increasingly complex in scope and increasingly opaque to supervisors and financial markets.[1] In this regard, bank supervisors are attempting to glean any information that may assist them in identifying the changing risk structures of these firms. This interest in turning to markets for assistance has been accelerated by empirical research that suggests bank supervision might benefit from using information embedded in the capital market valuation of banking organizations' debt and equity securities.[2] This work has found that financial market information can be used to supplement and complement the traditional supervisory practices of on-site examinations and off-site monitoring. If markets are meaningfully efficient and investors are able to monitor and/or anticipate emerging risks of organizations, then investors' expectations become embedded in financial market information.[3] Market assessment and the pricing of risky management policies may restrain risky behavior (direct market discipline) and/or assist supervisors in the monitoring process by providing timely signals on the changing risk patterns of these firms (indirect market discipline). The potential use of the signaling features of markets for modern bank supervision and discipline offers

[1] Another reason is that the increasing size and scope of banking organizations have contributed to the organizations' ability to cause a systemic event that would have catastrophic market effects.

[2] For some recent studies on this issue, see Flannery and Sorescu (1996); Flannery (1998, 2000); Berger and Davies (2000); Berger, Davies, and Flannery (2000); Curry, Elmer, and Fissel (2001); Krainer and Lopez (2001, 2003); Gunther, Levonian, and Moore (2001); and Evanoff and Wall (2001).

promise, as evidenced by the calls for including market indicators into the supervisory process that are being voiced at the highest levels of the U.S. bank regulatory agencies and the U.S. Congress and, on the international front, by the Basel Committee on Bank Supervision.[4]

The interest in using market information to assist in bank supervision is a fairly recent phenomenon in the United States. Historically, bank supervisory officials have questioned the ability of outsiders such as uninsured depositors, other unsecured creditors, Wall Street analysts, capital market investors, or other market participants to accurately evaluate the risks of bank portfolios without the confidential information acquired through on-site examinations. Bank supervisors have access to highly sensitive information, such as the payment histories of performing and nonperforming loans, the level of loan classifications, the adequacy of loan-loss reserves and bank capital, and a close-up view of managerial abilities and expertise. During intervals between examinations, regulators depend primarily on quarterly, unaudited financial statements submitted by commercial banking companies to monitor changes in financial condition. While supervisors expend considerable resources uncovering idiosyncratic information on bank financial condition, there are limitations to the process. On-site examinations take place only at widely spaced times, usually every 12 to 18 months, and the information may become outdated after only brief intervals.[5] Also, bank examinations generally document past occurrences, such as changes in the credit quality of loan portfolios. In addition, accounting data used in off-site monitoring programs are reported with several months' delay, are

[3] The issue of the opacity of bank assets has been studied extensively in the academic literature. The weight of the evidence suggests that investors in debt and equity securities do price changes in bank risk, although some studies disagree. For a review of some of this literature, see Krainer and Lopez (2003).
[4] See Tanoue (2001). Also, the Gramm-Leach-Bliley Act of 1999 directed the Federal Reserve Board and the Treasury Department to analyze the value of requiring large banking organizations to issue subordinated debt. See also the comments from Federal Reserve Board Governor Lawrence Meyer (1998a, 1998b, 1998c, 1998d).
[5] See Cole and Gunther (1998).

released as of a single date, are usually unaudited, and often require considerable analysis and screening to yield a meaningful interpretation of financial condition.[6]

Financial markets, on the other hand, are fluid and forward looking in their appraisal of financial condition and, unlike the extended cycles between examinations, continuously incorporate and discount new information into security prices. While markets may not have access to extensive amounts of confidential information about financial condition as bank inspectors do, markets may be more timely and accurate in evaluating public information released in financial statements.[7] Markets also have the ability to garner information about financial condition from a vast array of other sources, such as an institution's board of directors, market analysts, and industry observers. For these reasons, it has been suggested that markets may have information similar to the information of bank supervisors and may update it continuously, and that market participants have the profit incentive to expend resources to better forecast banking company profitability and risk taking.

The goal of this paper is to assess the timing and magnitude of equity market valuations of bank holding companies (BHCs) in relation to changes in supervisory ratings for these organizations. In particular, market indicator variables are used to determine if they can provide timely market signals as well as add incremental value in predicting changes in regulatory assigned BOPEC ratings for institutions whose stock was traded on major exchanges over the 1988–2000 period.[8] To accomplish this, we conducted a univariate statistical analysis and

[6] For example, it has been shown that there is a correlation between bank examinations and the level of loss recognition for commercial loans. Also, enhanced loan-loss charge-offs have been associated with the timing of examinations of commercial banks. This suggests that accounting information contained in the publicly available quarterly financial statements may not always capture the risk profile of the reporting bank. See Dahl, O'Keefe, and Hanweck (2000); Gunther and Moore(2003).

[7] There is some evidence for this statement. See Berger, Davies, and Flannery (2000).

[8] The bank holding-company-system rating is the acronym *BOPEC,* assigned by the Federal Reserve Board, and it stands for *B*anking subsidiaries, *O*ther (nonbanking) subsidiaries, *P*arent company, consolidated *E*arnings, and

specified an ordered logistic model to test for time lags in the relationship between measures of financial market valuation and the assignment of supervisory ratings, using methods similar to those presented by Berger, Davies, and Flannery (2000) and Gunther, Levonian, and Moore (2001). In addition, to investigate the possibility that supervisory changes are reflected in future market indicators—a reverse causality—we developed OLS regression models of market variables on changes in BOPEC ratings and financial statement variables used in the logistic models.

The main hypothesis tested is that, like rating assignments by Moody's and Standard and Poor's, BOPEC rating evaluations lag by several quarters changes in the financial condition of bank holding companies. This occurs because of recognition, decision, and implementation lags associated with the examination process. For example, time is required to recognize the changing condition of banking companies, schedule special or extraordinary examinations or visitations, revise examination ratings, share the results with management, and rechart bank policies. Because of these lags, it has been suggested that market indicator variables such as price volatility, abnormal returns, return volatility, trading volume, and others may be observed to lead BOPEC rating changes.

Conversely, it is possible that early monitoring by supervisors leads to changes in the financial condition of the organization that are reflected in the next quarterly report so that a change in a BOPEC rating is nearly concurrent with changes in financial performance as shown in the financial reports. Also, banking companies may attempt to manage their financial reporting so that supervisors and markets are not alerted to deleterious changes that could trigger

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*C*onsolidated capital. A rating from 1 to 5 is assigned for each component, with 1 being the best and 5 the worst. A composite rating also from 1 to 5 is assigned, reflecting the overall condition of the organization.

a review or even a downgrade. For these reasons, changes in market indicators may not lead changes in BOPEC ratings.

Most previous studies that have examined market signaling and discipline focused on the subordinated debt (subdebt) markets. It was generally thought that concerns of investors in these markets were more closely aligned with those of bank supervisors. It has also been suggested that equity market prices are unsuitable for monitoring purposes because the relationship between equity prices and bank default risk is not as readily apparent as that of the pricing of unsecured subdebt.[9] However, the equity markets may have some advantages over the debt markets. These markets are generally deeper and more liquid than the debt markets. They are generally thought to be more efficient in pricing behavior than the debt markets, with liquidity premia playing a smaller role in the pricing of the securities. Also, data are more readily available from the equity markets with many more financial institutions being publicly traded than issuing traded subordinated debt securities.

Our univariate results show that changes in bank holding company BOPEC ratings clearly track changes in financial condition as reflected in quarterly bank accounting and market data. They also show that the dominant BOPEC rating assignment for the three different periods analyzed was "no change" in rating. This finding indicates that in specifying models that attempt to predict regulatory rating changes, the no-rating-change option must be accounted for simultaneously with the other supervisory options of rating downgrades and upgrades. This has generally not been done in previous studies that have examined this issue; they have principally focused on the market effects of downgrades.

[9] However, Levonian (2001) has shown that equity and debt market information should produce similar results. See also Hanweck and Spellman (2002).

The results from the ordered logistic regressions show that one-quarter lags of market data add to the identification of bank holding company BOPEC changes for all three of the periods examined when these data are used in conjunction with quarterly financial data and past rating information. On the basis of these results, we conclude that equity market data provide an independent source of timely information and/or a different perspective in predicting BOPEC rating changes beyond those provided by quarterly accounting and other supervisory data for the three periods examined. Considering the comprehensive sample used in this study, our findings support those reported in the most recent empirical literature and extend them to periods primarily before FDICIA and during the recent banking expansion.[10] We go further to provide extensive out-of-sample tests and show that market information improves the ability of the models to forecast upgrades and downgrades. We also show that, with the use of financial data alone for common 2001 out-of-sample data, models based on 1993–1995 data improve forecasts for upgrades, and models using 1996–2000 data substantially improve forecasts for downgrades. This suggests that a multiple-model approach to identifying banking company risk conditions may be superior to an approach using a single combined model.

To further investigate the timeliness of supervisory versus market assessments of BHC condition, we pose the additional hypothesis that supervisory rating changes can forecast changes in market variables (the reverse of the above analysis). The direction of influence, from markets to supervisory action or vice versa, is important because it establishes the timing, which may be concurrent, of the influence of supervisory rating changes. As noted in Berger, Davies, and Flannery (2000), supervisory and market assessments may be concurrent, implying that each may be emphasizing or finding different information. This direction of influence from markets to regulatory actions or vice versa is not a matter of exogeneity or endogeneity but is important

[10] See Gunther, Levonian, and Moore (2001) and Krainer and Lopez (2001, 2003a, 2003b).

to identify in order to establish any significant role of supervisory rating changes influencing market variables. We accomplish this by regressing market variables against lagged BOPEC rating changes and financial ratio variables (in other words, information that the market would know from the published financial reports of the BHC). The results suggest that lagged BOPEC ratings are statistically significant, at least at the 10 percent level, in only 6 of 15 possible tests (five separate market variables for three periods). Although a Granger causality test could not be directly performed, these results indicate that the predominant relationship is one of market information as predicting future banking company risk rather than changes in supervisory ratings predicting market variables. This finding reveals a relationship between financial market data and bank risk assessment—a necessary and fundamental condition for market discipline to be effective.

The next section discusses the empirical literature. The subsequent section presents an overview of BOPEC ratings migration behavior over the 1988–2000 period. This is followed by an overview of the general conceptual approach of this study. The data and sample are then discussed, followed by a presentation of the univariate results. The final sections present the ordered logistic regression and OLS models, the findings, and the conclusions.

Empirical Literature

As mentioned above, most studies that have examined the usefulness of market signaling and discipline have focused on the subordinated debt markets.[11] The empirical evidence shows that subordinated debt spreads generally increase as a bank's risk increases. More recent work

[11] See Flannery (1998), Flannery and Sorescu (1996), Evanoff and Wall (2001), and the Federal Reserve Board of Governors and U.S. Treasury Department (2001).

focuses on equity market valuations, which generally support the notion that equity market variables do add value in providing timely information. Berger and Davies (1998) use event study methodology and find that the equity market anticipates upgrades in regulatory ratings but follows downgrades. Berger, Davies, and Flannery (2000), using a sample of 184 bank holding companies over the period 1989:Q4 to 1992:Q2, find that regulators acquire information sooner than bond rating agencies and the equity markets, but the regulatory assessments are less accurate in predicting the future performance of bank holding companies than either stock or bond market indicators unless the regulatory ratings have been recently assigned.

Several studies have incorporated market data into traditional default or bankruptcy models to determine if the information adds value in identifying troubled institutions. For example, Elmer and Fissel (2000), with a sample of 93 failed banks for the years 1989–1995, found that equity market variables can be used to augment accounting-related information to predict bank failures several years before failure. Curry, Elmer, and Fissel (2001) found that equity market variables when combined with bank financial data help predict downgrades and upgrades in bank and thrift CAMEL ratings. Krainer and Lopez (2001, 2003) find that equity market variables, such as stock returns and equity-based expected default frequencies, can be useful to bank regulators for assessing the financial condition for bank holding companies over the 1990–1999 period. Using event study methodology, they found that equity market measures provide timely information by anticipating supervisory rating changes by up to four quarters. However, they found no evidence that combining supervisory and market data improves the out-of-sample forecasting of BOPEC ratings in a statistically significantly way. Gunther, Levonian, and Moore (2001) found that a measure of financial viability based on equity market data

periods, including the recession and banking crisis of the late 1980s and early 1990s, the recovery in the middle 1990s, and the prosperity of the late 1990s. From the start to the end of these periods, financial statements showed significant improvement. Earnings and capital increased significantly, loan-loss risk declined, and firm liquidity improved. However, strong loan growth was being fueled in part from increases in volatile uninsured liabilities on the balance sheet. Financial markets also responded favorably to the changes in firm condition over this period, as witnessed by significant increases in firm valuations as recognized by the market-to-book value ratios and a slightly reduced volatility of share prices and earnings.

The ordered logistic regression equation follows the following format:

$$BOPEC\ Change_{it} = \alpha_1 + \alpha_2 + \beta_1 Firm\ Size_{iit-1} + \sum_{j=2}^{7} \beta_j \left(Past\ Supervisory\ Ratings_{jit-1}\right) + \sum_{j=8}^{16} \beta_j \left(Financial\ Accounting\ Variables_{jit-1}\right) + \sum_{j=17}^{21} \beta_j \left(Financial\ Market\ Variables_{jit-1}\right) + e_{it} \quad (1)$$

where α_1 and α_2 are constants estimated for the ordered logit with three groups (downgrades, upgrades, and no change),[24] β_1 is the coefficient for firm size, β_2, …β_7 are coefficients for a vector of variables representing past supervisory opinions unique to each BHC_i , β_8…β_{16} are coefficients for a vector of variables for financial condition based on quarterly accounting information for each BHC_i, and β_{17} …β_{21} are coefficients for a vector of variables for selected market measures for each BHC_i. The e_{it} is assumed to be distributed as a logit function. The regression results are estimated for the three different economic cycles: recession and banking crisis (1988–1992), recovery (1993–1995), and expansion (1996–2000). As a forecasting model,

[24] Two constant terms are estimated under the assumption that the proportional odds among the groups are independent of the explanatory variables such that the slope parameters are the same for each group. In general, to separate three groups (downgrade, no change, and upgrade) requires two planes (or hyperplanes for more than three dimensions). In the case of the ordered logit that we estimate, the planes are parallel. This means that the probability of observation it's belonging to group 1, conditional on the explanatory variables, is $CL(\alpha_1+\beta'X_i)$, the conditional probability of its belonging to group 2 is $CL(\alpha_2+\beta'X_i) - CL(\alpha_1+\beta'X_i)$, and the conditional probability of its

all independent variables are lagged relative to the BOPEC rating of the event quarter that is being predicted. As mentioned, we ordered the logistic regression model by relating the specified variables to the probability or likelihood of receiving a BOPEC downgrade.[25]

The empirical results for the logistic models are shown in tables 7–9. Specification 1 for each table provides a traditional default or rating downgrade prediction model by specifying past supervisory information and quarterly accounting data. These variables are accompanied in each specification by information that accounts for firm size. Specification 2 in each table launches the analysis of equity market variables by isolating the predictive power of these variables in the absence of the financial data but including past supervisory information. Specification 3 combines both financial and market data into one equation to determine if market information adds incremental predictive value to the financial and supervisory data in identifying firms likely to be downgraded. Although the equity market variables need not dominate the traditional ratio-based model, a minimum level of competence is required to justify a conclusion that market-related variables are a meaningful addition to traditional analysis. In the absence of incremental predictive value, market signals may be viewed as redundant information with little supervisory value. Also as mentioned, the variables in each regression are lagged for one quarter before the event quarter, which is the quarter when a new inspection rating is assigned—the rating that the model is attempting to predict.

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belonging to group 3 is $[1 - CL(\alpha_2+\beta'X_i)]$, where CL() is the cumulative logit function. Throughout our analysis the constant terms are found to be significantly different.

[25] The model can be "ordered" to estimate the probability of a rating downgrade, no change, or upgrade. However, the results presented in the tables refer to the likelihood of a downgrade's occurring.

1988–1992 Results

Specification 1 for the 1988–1992 period shows that institution size (LN_ASSET) is important and that, as expected, larger institutions are less likely to be downgraded (table 7). Also, past supervisory information is highly associated with the likelihood of future BOPEC downgrades when firms with the best ratings are most likely to be downgraded (BOPEC-1 to -4). The dummy variable representing the previous CAMELS rating of the lead bank (PROB_BK) of the holding company shows that when lead banks have problem CAMELS ratings, the result is a significantly higher likelihood of the holding companies' being downgraded. Contrary to what most previous literature predicts, the time lapsed from the previous inspection (INSP_AGE) is not a significant predictor of future downgrades. The financial accounting variables in the model perform largely as expected, with eight of the nine variable coefficients significant at mostly the 1 percent level. The Max-Rescaled R^2, a measure of goodness of fit, for the model is 0.58.[26] Since specification 1 provides a working downgrade prediction model, specified with the traditional capital, asset-quality, earnings, and liquidity ratios along with past supervisory information, it is used as a benchmark equation for comparing the predictive content of the market-based variables.

Specification 2 contains only the size, supervisory factors, and stock market variables, excluding the financial accounting information discussed above. In this equation, institution size is negative and significant, indicating that larger-sized firms are less likely to be downgraded. As before, almost all the variables associated with previous supervisory evaluations are highly significant at the 1 percent level. Of the five market variables, four are significant: the volatility

of price (COVAR_PRICE), the value-weighted excess returns (EX_RETURN), the standard deviation of the returns (STD_RETURN), and the share turnover variable (TURNOVER), all of which are significant at the 1 percent level. The explanatory power of the regression is less than that of specification 1, with an Max-Rescaled $R^2 = 0.39$.

Specification 3 forces the stock market–based variables to compete with the financial accounting variables used in specification 1 to test for any added predictive power for the equation. As before, institution size continues to be statistically significant and negatively related to the prospects of future downgrades. The prior BOPEC rating and past supervisory assessments, with the exception of inspection age (INSP_AGE), continue to be highly significant, with almost all coefficients being significant at the 1 percent level. The financial variables continue to be strong, with seven of the eight also being highly significant.

For the market variables, four of the five have the correct signs and are statistically significant. The benchmark comparisons between specifications 1 and 3 are performed through a likelihood ratio test, which is a chi-square statistic. If the likelihood ratio statistic is positive and statistically significant, we can conclude that the financial and market variables when combined into a single equation cause it to possess a better fit than the equation it is tested against. The likelihood ratio test is positive and significant at the 1 percent level, which supports the contention that the market variables do add some explanatory power to the model in comparison with specification 1. In addition, other measures of the overall fit of the regression indicate improved results. The Max-Rescaled R^2 statistic of 0.60 is higher than that of specification 1. Also, the Akaike Information Criterion (AIC), which measures the overall fit of the equation, is lower for specification 3 relative to specifications 1 and 2, which indicates a greater association

[26] The Max-Rescaled R^2 statistic, like the pseudo-R^2, is a measure of goodness of fit. However, the pseudo-R^2 for discrete models has a maximum of less than 1.0. The Max-Rescaled R^2 statistic adjusts the pseudo-R^2 such that the

of the combined variable set with the BOPEC rating changes.[27] For the 1988–1992 period, we conclude that market variables provide an independent source of information and add significant explanatory power to known financial and supervisory data.

1993–1995 Results

The regression results for the 1993–1995 economic recovery period are displayed in table 8. The finding for the asset-size variable generally carries the expected negative sign but is significant only for specification 1. The coefficients for the past supervisory inspection variables for specifications 1–3 are similar to the previous period's results, with the BOPEC dummies and the problem-bank dummy of the lead bank all exhibiting the correct signs and all exhibiting statistical significance at the 1 percent level. Previous BOPEC ratings continue to indicate that firms with the most favorable past ratings are the most likely to be downgraded in the future relative to a BOPEC rating of 5. The inspection age variable (INSP_AGE) continues to be insignificant. The results for the financial variables in specification 1 for the 1993–1995 period are not as consistent as for the previous period. Of the nine variables measuring financial condition, five are significantly related to downgrades: the level of holding company equity (EQ_ASSET), past due 90 days (PD90_ASSET), nonaccrual loans (NA_ASSET), the return on assets (ROA), and large deposits (TD100_ASSET).

The market variables in specification 2 show that all variables have the correct signs and that three of the five variables are statistically significant from the 1–10 percent level: the coefficient of variation of price (COVAR_PRICE), the standard deviation of the returns

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statistic reaches a maximum of 1.0, in line with the standard notion of R^2 (SAS Institute, Inc. [1996], 414).

(STD_RET), and the market equity to book equity variable. The explanatory power of specification 2, with only the market variables, has a Max-Rescaled R^2 of 0.44, which is lower than the R^2 of 0.52 for specification 1. In addition, the AIC measure for the overall fit is higher for specification 2 than for specification 1, which indicates a lower overall fit for specification 2. These findings show that the market variables in isolation do not possess as much predictive power as do the financial variables by themselves.

Specification 3, which combines the financial with the market variables into one model for the 1993–1995 period, does improve upon specification 1. The Max-Rescaled R^2 is slightly higher for specification 3 relative to specification 1, the AIC variable is lower, and the log likelihood ratio test is again significant, indicating that this specification continues to improve the predictive power over the first specification. In summary, the findings for the 1993–1995 recovery period are similar to those of the 1988–1992 recession in that market data continue to add some value to the overall regression, but overall the results are not as strong as those for the earlier period.

1996–2000 Results

The results for 1996–2000, a period of substantial economic growth and banking expansion, are presented in table 9. The log of asset size has a consistently negative sign as expected, but only the first specification is it significantly related to the likelihood of being downgraded. The level of past BOPEC ratings remains the most consistent predictor of future downgrades in specifications 1–3, showing that institutions with the highest ratings are again the

[27] The AIC statistic is a goodness-of-fit statistic similar to the maximum likelihood ratio test, with a lower value indicating a better fit.

most likely to be downgraded. The prior CAMELS rating of the lead bank (PROB_BK) is also a reliable predictor of future downgrades and is consistent with the previous two periods analyzed. Contrary to expectations, the inspection age variable (INSP_AGE) is negative and significant for all three specifications. All of the financial variables in specification 1 have the correct signs, and most are significant at the 1 percent level. The Max-Rescaled R^2 of specification 1 is 0.45. In specification 2, four of the five market variables are significant from the 1–5 percent level. The Max-Rescaled R^2 for the equation is 0.35 percent, or slightly below the first specification, and the value for the AIC variable is higher, which indicates a less favorable overall fit for specification 2 relative to specification 1.

Specification 3 shows the combined model for all of the variables for the 1996–2000 period. In this equation, six of the nine financial variables and three of the five market variables are significant. The overall fit of the model in specification 3 is better than for either of the first two specifications. The Max-Rescaled R^2 is higher and the AIC variable is much lower than for either of the first two specifications, indicting an improved fit for the model. In addition, the likelihood ratio test, which compares the explanatory power of specification 3 with benchmark specification 1, is positive and significant at the 1 percent level, indicating improved predictive power. In summary, the empirical results for the 1996–2000 expansion period are similar to the other two periods but overall are relatively more robust than for the 1993–1995 transition period. They show that the market indicator variables contribute in the hypothesized direction to the identification of downgraded institutions for this period.

In-Sample Classification Results

Table 10 contains in-sample classification results for the ordered logit regressions summarized in tables 7–9. In the formation of these in-sample classifications, the a priori likelihood of being a downgrade, no change, or upgrade is the a priori frequency ratio of these outcomes in each classification category. We determined the critical level of probability for classifying each BOPEC change of a downgrade, no change, or an upgrade as correct or incorrect by taking the number of firms that experienced each of these BOPEC changes in the sample for each period analyzed and dividing by the number in the total sample. We then compared this critical level of probability or a priori probability with the predicted conditional likelihood of the model to determine the appropriate classifications. These classifications appear in each of the cells in table 10.

The in-sample predictive accuracy of the model for the 1988–1992 period shows that the correct classifications for the BOPEC downgrades increase slightly, going from 81 percent to 83 percent from specification 1 to specification 3, or an increase of six institutions with the addition of the market variables. The correct classification of those firms that had no change in ratings remained about the same at about 78 percent, while the identification of firms that were upgraded actually declined. For the 1993–1995 economic recovery period, the correct classifications for the downgrades improved, going from 56 percent to about 63 percent, while the no-change ratings and upgrade predictions were about the same. The in-sample classifications for the 1996–2000 period shows that the correct downgrade and upgrade predictions were about the same, but the no-change category improved from 64 percent to about 67 percent (34 additional institutions). While the overall results of the model show some improvement in classification

accuracy for all periods and for most groups, the differences are not generally large in percentage terms. The main contribution of the inclusion of market variables is the identification of the BOPEC rating downgrades for both the 1988–1992 and 1993–1995 periods, when the correct classifications increased from about 2 percentage points to 7.

Out-of-Sample Classification Analysis

The out-of-sample classification analysis provides a test of the accuracy and forecast potential for the model when equity market variables are added to the financial accounting variables. In performing the out-of-sample classifications, the a priori cutoff probabilities were calculated in a similar fashion as for the in-sample tests. Furthermore, when classifying the out-of-sample 1993–1995 period using the 1988–1992 model (panel A of table 11), we use the observed frequency ratio for the 1988–1992 sample to determine the cutoff probabilities. We chose this method because we did not want to bias the test, since in practice actual frequencies of future periods would not be known and an unbiased estimate of future frequencies is the frequency of the sample data of the prior period. The out-of-sample tests show that of the 18 classifications in table 11 (panels A–F)—six out-of-sample classification tests, each with three classifications groups—the addition of market variables shows an improvement in 11 classifications.

The out-of-sample classifications show that the FA, SM and the combined models mostly show improvement in the different categories of rating change, including the no-change category. For example, using the 1988–1992 model on the 1993–1995 and 1996–2000 out-of-sample data shows that the FA model (panels A and B in Table 11) is more accurate than the SM

or combined models in classifying upgrades, and the SM model is much more accurate than the FA or combined models in classifying downgrades. In addition, the combined model is more accurate than either in classifying no changes.

To further explore the differences in out-of-sample classification precision for each of the estimated models for the three periods examined (1988–1992, 1993–1995, 1996–2000), we apply each of the models to a common out-of-sample test using 2001 data as a common period (panels D–F of table 11). The findings indicate that the model that has the highest overall correct classifications varies according to the period in which the estimation occurred. For example, when the 1988–1992 model estimated from data for a recessionary and banking crisis period is used, the combined model has the most accurate overall classification (panel D), while for the 1993–1995 and 1996–2000 periods , the FA model overall does better than either the SM model or the combined model (panels E and F). In another example for specific categories rather than overall performance, the 1996–2000 model applied to the 2001 data (panel F) indicates that the FA model does the best in classifying downgrades (88 percent) and the SM model does the best in classifying upgrades (96 percent). These results provide further evidence that using financial accounting and/or market variables can improve forecasting changes in bank holding company risk assessments.

The implication of these results is that the models estimated from different periods in the economic and banking cycles can give different and sometimes improved forecasts of BOPEC rating changes and, by inference, risk assessments. One drawback to using different models to provide forecasts is that a BHC's inspection may be classified in each of the BOPEC change categories. When this arises, a simple rule would be to choose to classify an inspection in the group that, if a misclassification, is least costly from a supervisory perspective or in the group in

which its estimated likelihood of membership is greatest. This multiple-models approach to classification can provide improved forecasting and best integrates market data into the supervisory process.

BOPEC Risk Rating Changes and Financial Statement Variables as Predictors of Financial Market Factors

Berger et al. (2000) compared the timeliness and accuracy of when BHC supervisors assessed changes in BHC financial condition with the timeliness and accuracy of when the financial markets assessed the changes. In their analysis, they estimate models to forecast equity market assessments using lagged market variables and supervisory assessments.[28] They find that supervisory assessments add little to the prediction of market assessments.

We conduct a similar analysis by considering the relationship between BOPEC rating changes and lagged market variables when, unlike what happens in the analysis above, the lagged BOPEC rating changes become predictors of market variables. For the testing of this latter relationship, the market variables used in the logit models are specified as dependent variables and are regressed against the lagged BOPEC rating changes and lagged financial statement ratios, including the natural logarithm of BHC assets, as independent variables. Although some of the market dependent variables are bounded from below by zero, we use OLS estimation. However, OLS should provide reasonable estimates and should not cause serious

[28] Berger et al. use three equity market variables: abnormal quarterly return on a BHC's common stock (AR), quarterly change in the proportion of outstanding shares held by institutional investors (INST), and the quarterly change in the proportion of outstanding shares held by officers and directors (INSIDER). Our excess return variable, EX_RETURN, attempts to measure similar market conditions as AR, but our measure does not impose an estimated time series model to compute excess returns. However, our findings, which include book-value financial ratios in

problems because these variables are never observed to reach the lower bound. For the sake of brevity, we discuss only those results when there was a statistically significant relationship between the lagged BOPEC rating changes (BPchgL1) and the financial market variables. This occurs only five times for the three periods and for four variables: the standard deviation of quarterly returns (STD_RETURN), the quarterly value-weighted excess return (EX_RETURN), the market value of equity to book value equity ratio (MKT_BKEQ), and the covariance of price (COVAR_PRICE). Tables 12–16 show the regressions for each of the five market variables for each of the three periods. The model is identified as follows:

$$MarketVariable_{it} = \alpha + \beta_1 BPchgL1_{it-1} + \beta_2 LogFirmSize_{it-1} + \sum_{j=3}^{11} \beta_j \left(Financial\,AccountingVariables_{jit-1} \right) + \varepsilon_{it} \qquad (2)$$

where the financial accounting variables are those used in the logistic regressions and are defined above. The lagged BOPEC change, BPchgL1, takes on a value of 1 for a downgrade, 2 for no change, and 3 for a ratings upgrade. A negative sign for the BOPEC rating change coefficient, β_1, means that a movement toward a downgrade will increase the dependent variable compared with no change or an upgrade. All variables are defined in table 5.

The relationship between the standard deviation of return (STD_RETURN) and the change in the BOPEC rating (BPchgL1) has the hypothesized negative sign and is statistically significant for the 1988–1992 and 1996–2000 periods (table 12). The implication is that a prior BOPEC downgrade will be associated with a higher return volatility for a BHC, indicating a

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the regressions, show little forecasting power of equity market variables by supervisory variables and are similar to those of Berger et al.

worsening financial condition going forward. Additionally, most of the signs for the financial statement variables are according to expected relationships, and many are statistically significant. For example, a greater value of book equity to assets, EQ_ASSET, and ROA suggests that the STD_RETURN would be lower. Less leverage and greater earnings would be expected to reduce stock return volatility, ceteris paribus. The overall fit for this regression is statistically significant, with an Adjusted R^2 of 45 percent, 58 percent, and 17 percent in the 1988–1992, 1993–1995, and 1996–2000 periods, respectively.

The relationship between the quarterly value-weighted excess return (EX_RETURN) and the change in the BOPEC rating (BPchgL1) has the hypothesized positive sign and is statistically significant at the 5 percent level or better only for the 1988–1992 period (table 13). The implication of this relationship is that a prior BOPEC downgrade will be associated with a lower excess return, indicating a worsening financial condition. Additionally, some of the signs for the financial statement variables are according to expectations, and many are significant. However an interesting set of relationships is that of loans past due 90 days or more to assets (PD90_ASSET) and loan charge-offs (CHARG_ASSET). The estimates show different signs and are all statistically significant and imply that a greater value of PD90_ASSET indicates a decrease in EX_RETURN, whereas an increase in CHARG_ASSET will increase EX_RETURN. It would be expected that greater values for all of these variables would tend to be associated with lower excess returns because of the greater riskiness of the company that an increase in their values would indicate. One interpretation of the opposite signs is that greater reported past-due loans suggest greater future charge-offs, whereas greater actual charge-offs reflect recognized losses and are viewed by the market as getting bad assets off the books. It is also interesting to note that ROA carries the expected positive sign. The overall fit for this

regression is statistically significant but small, with an Adjusted R^2 of 9.1 percent for the 1988–1992 period.

The relationship between the lagged change in the BOPEC rating and the market-to-book value variable (MKT_BK) is statistically significant at the 5 percent level or better and has the hypothesized positive sign for only the 1988-1992 period. The interpretation is that a bank holding company that had a previous rating downgrade will show a deteriorating market-to-book value in the following quarter. Furthermore, several financial statement variables are highly significant for each of the periods and usually have the expected signs. The variables loans on nonaccrual status (NA_ASSET) and ROA stand out in this regard. The overall fit for this regression is statistically significant, with an Adjusted R^2 of 20.9 percent in the 1988–1992 period and 16 percent and 33 percent for the other two periods.

The relationship between the lagged change in the BOPEC rating and the coefficient of variation of price (COVAR_PRICE) is statistically significant at the 5 percent level or better and has the hypothesized negative sign for only the 1996–2000 period. The interpretation of this relationship is that a bank holding company that had a previous rating downgrade will show a rising coefficient of variation of price in the subsequent quarter. Furthermore, several financial statement variables are highly significant for the period and usually have the hypothesized signs. The variables EQ_ASSET, LPROV_ASSET, and CHARG_ASSET stand out in this regard. The coefficient of variation is hypothesized to decline as EQ_ASSET increases, because of the decreased use of leverage. The interplay between loan-loss provisions (a prospective indicator of future charge-offs) and revealed charge-offs in the previous period is consistent with the hypothesis that taking charge-offs is current recognition of bad loans and will decrease price volatility, whereas higher provisions are an indicator of greater future charge-offs (a positive

sign). The overall fit for this regression is small but highly statistically significant, with an Adjusted R^2 of 5.1 percent in the 1996–2000 period.

The stock volume turnover variable, TURNOVER, showed no relationship for any period with BPchgL1. However, a number of the financial variables were statistically significant with anticipated signs. The overall fits were statistically significant for all periods and showed an R^2 of 27.1 percent, 25.1 percent, and 91 percent for the 1988–1992, 1993–1995, and 1996–2000 periods, respectively.

The conclusion that we draw from these results is that BOPEC rating changes have minimal predictive power for stock market variables. With statistical significance in only 6 of a possible 15 regressions and only 2 of these for the 1996–2000 period, this conclusion seems justified. However, there is ample evidence from these regressions that lagged financial statement variables, being readily known to the market before an inspection, have some consistent predictive power in every period. This in itself suggests that previous financial performance has some predictive power of equity market variables.

Conclusions

This paper explores the notion that financial market–based variables may be used to augment financial statements and past supervisory risk assessments for the purpose of predicting future supervisory risk assessments as embodied in BOPEC rating changes. This analysis is conducted with the use of a sample of publicly traded bank holding companies with 3,974 full-scope inspections over the 1988–2000 period. This period is characterized as representing three distinct economic and banking cycles: recession and banking crisis (1988–1992), economic recovery (1993–1995), and economic and banking expansion (1996–2000). Focusing on

different economic and banking climates allows for testing the stability of the model over these varying periods and permits a comparison of the findings with the previous literature. It should be noted that even though we are analyzing changes in BOPEC ratings arising from full-scope inspections, which are supervisory events, we are also implicitly analyzing changes in the stringency of regulatory regimes. It should be recalled that the 1988–1992 period was considered a "near-death" experience for commercial banking, while the 1996–2000 period witnessed an exuberant recovery, with market-to-book ratios often exceeding four for some of the larger banking companies.

To investigate the direction of causality from market variables to changes in BOPEC ratings or vice versa, two empirical models are estimated. The results for the first model (ordered logistic) show that market indicator variables were able to add value in predicting BOPEC rating changes when used in conjunction with lagged supervisory and financial accounting data for each of the three periods examined. These findings are consistent with earlier studies investigating the role of equity market indicators in identifying the changing patterns of bank financial risk, but the results show stronger relationships when analyzed by sub-periods. For example, through six different out-of-sample classification tests, we show that the use of stock market information generally improves out-of-sample forecasts.

A second model (OLS) was specified to determine if lagged BOPEC rating changes, when used with financial accounting information, were capable of predicting the equity market variables used in the ordered logistic model estimation. The results were only moderately successful in predicting the financial market variables and were statistically significant for only 6 of the possible 15 cases. We interpret these results as being supportive of an information flow from changes in equity market factors to changes in BHC supervisory risk ratings.

The findings in this paper provide some empirical support for the presence of market discipline to the extent that the hypothesized market variables add statistical and incremental value to the model in predicting changes in bank holding company BOPEC ratings. Thus, the results indicate that the market has been able to glean some independent information about BHC financial risk exposure in the period leading up to the inspection beyond the information that was known from publicly available financial reporting sources. To this extent, the financial markets appear to be providing some degree of independent oversight for management besides that of bank supervisors and holding company directors, thereby providing the fundamental conditions for market discipline to be effective.