Value Relevance of Disaggregated Information:
An Examination of the Rate and Volume Analysis of Bank Net Interest Income

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SYNOPSIS: A potentially important form of financial information disaggregation is to segregate the change in an income measure into its underlying performance drivers. In this study, we perform a comprehensive analysis of the usefulness of such disaggregation to investors. We utilize the volume and rate analysis in banks' 10-K filings, in which banks disaggregate annual changes in net interest income into changes in the balances ("volume variance") and changes in the rates ("rate variance") of assets and liabilities. We document that volume and rate variances are associated with bank characteristics, including market power, funding sources, and credit risk. We find volume and rate variances are predictive of future net interest income and are positively associated with stock returns and prices, suggesting the disaggregated information is value relevant. Our study informs regulators and users by showing that disaggregated information along volume and rate dimensions has predictive and confirmatory value.

Keywords: disaggregated information; banking; net interest income; value relevance

INTRODUCTION

Disaggregating financial statement measures provides additional information to help users better understand the effects of business strategies on financial performance and position. Disaggregation takes many forms. Firms disaggregate net income into revenues and expenses, by recurring and nonrecurring components, by operating and financing activities, and by reportable segments. A potentially important form of disaggregation is to segregate the change in an income measure into its underlying performance drivers. For example, does gross profit change because the firm sold more products during the period, because the firm raised prices and/or cut costs, or some combination of these underlying performance drivers? The answer to this question will likely enhance investors' ability to map accounting fundamentals into expectations of future earnings, cash flows, and stock prices.

We are motivated to study disaggregation in part by standard setters' and regulators' attention to this issue. For example, the Financial Accounting Standards Board (FASB) currently has an active project on *Financial Performance Reporting—Disaggregation of Performance Information* (FASB 2018), which intends to improve the decision-usefulness of the income statement through disaggregation. Disaggregation may provide greater transparency to financial statement users, enabling them to better understand the impact of strategic decisions on current performance and the amount, timing, and uncertainty of future cash flows. However, disaggregation may not contain incremental information, potentially due to information overload and additional costs, as investors have limited attention and information-processing capacity (Hirshleifer and Teoh 2003; Tuttle and Burton 1999). In this study, we examine the firm characteristics associated with disaggregated information, the relation between disaggregated

information and future performance outcomes, and the extent to which disaggregated information is reflected in equity valuation.

The banking industry provides a rich setting for studying financial information disaggregation because publicly traded banks are required by the Securities and Exchange Commission's (SEC) Industry Guide 3, *Statistical Disclosure by Bank Holding Companies*, to present a volume and rate analysis, which disaggregates annual changes in net interest income into (1) changes in volume of interest-earning assets and interest-bearing liabilities, or "volume variance," and (2) changes in asset yields and funding rates, or "rate variance" (SEC 1990).[1] By disaggregating changes in net interest income into volume and rate variances, a bank reports the contribution of changes in balances and in interest rates of assets and liabilities to the growth of net interest income, which is a key earnings measure that represented over 66 percent of all U.S. commercial banks' total operating income in 2017 (Federal Deposit Insurance Corporation [FDIC] 2018).

We conduct our analysis based on hand-collected volume and rate variances of net interest income as disclosed in the Management Discussions and Analysis (MD&A) section of banks' 10-K filings from 1997 to 2013. To begin, we evaluate the extent to which a bank increases net interest income by volume (i.e., expanding the balances of assets relative to liabilities) and by rate (i.e., widening the interest rate differentials between assets and liabilities).

We document that on average, volume and rate variances account for 9.0 percent and -1.3 percent, respectively, of the prior year's net interest income (on a tax-equivalent basis), which suggests that banks tend to increase net interest income by volume rather than by rate. That is, to

[1] The volume and rate analysis of changes in net interest income is similar to the quantity and price analysis in management accounting. In the banking industry, net interest income is the difference between interest income earned on loans and securities, and interest expense incurred on deposits and other borrowings.

grow net interest income, bank managers tend to focus on expanding the balances of loans and investments relative to deposits and borrowings, rather than widening the spread between the rates on interest-earning assets and on interest-bearing liabilities. Further, we find that a bank's market power, funding source, credit risk, interest rate sensitivity, and loan composition are associated with the volume and rate components of changes in net interest income.

Next, we investigate whether disaggregating changes in net interest income into volume and rate components provides information that predicts future net interest income and whether the disaggregated information is value relevant. We first document a positive relation between volume and rate variances and one-year-ahead net interest income. We then use both stock price changes and levels specifications to find volume variance and rate variance are value relevant. In additional analyses, we find evidence that the informativeness of volume and rate variances is higher for banks with more traditional banking activities and for larger banks, and it is lower during periods of economic recessions and uncertainty. Together, the empirical analyses demonstrate that the disaggregation of net interest income along the volume and rate dimensions has predictive and confirmatory value, and it reflects the information used by investors in stock valuation.

Our study has implications for standard setters, regulators, investors, and researchers. First, for standard setters such as the FASB, our findings show that disaggregating the change in a performance measure into its underlying drivers conveys information that has predictive ability and is value relevant. These findings are relevant to the ongoing FASB project on *Financial Performance Reporting—Disaggregation of Performance Information*, which intends to improve the decision-usefulness of the income statement through disaggregation. Our study suggests that

a similar quantity and price analysis might be considered for nonbanking industries to provide investors with additional information that reflects an entity's earnings strategy.[2]

Second, the SEC has requested comments regarding the disclosures mandated in Industry Guide 3, including the volume and rate analysis (SEC 2017). One of the questions in the SEC's *Request for Comment* is whether the volume and rate analysis provides useful information about banks' operations.[3] Our study provides timely evidence on the usefulness of the volume and rate analysis to equity investors by showing that the disaggregated information presented in the volume and rate analysis relates to important bank attributes, predicts future net interest income, and is associated with stock valuation. This suggests that while many developments and changes have occurred in the banking industry in the years since implementation of Industry Guide 3, the volume and rate analysis remains relevant to investors.[4] Hence, it seems there is merit in the requirement for banks to provide the volume and rate analysis, so that investors would not have to produce the information themselves.

Third, because net interest income is a primary source of a bank's operating income, it is critical for investors to understand the reasons for its changes when evaluating a bank's operations and stock valuation (SEC 2017). Prior literature on banks' earnings disaggregation focuses on the components of net interest income and noninterest income (DeYoung and Rice 2004) and on earnings before securities transactions and from securities transactions (Warfield and Linsmeier 1992; Jaggi and Zhao 2002). However, no previous study has examined whether disaggregating changes in net interest income into volume and rate variances provides useful

[2] We acknowledge that nonbanking firms might argue that proprietary and preparation costs of the disaggregated information would be too high. We leave the question regarding this cost and benefit trade-off to future research.
[3] In Question #8, the SEC asks whether the volume and rate analysis, as well as other statistical disclosures, provides investors with information upon which they base investment and voting decisions (SEC 2017).
[4] In this regard, we find no evidence of mispricing of volume and rate variance information based on hedge returns in the year following the disclosure, in support of providing this disclosure as part of Industry Guide 3.

information to investors. Our study provides new insights that volume and rate variances convey useful signals about bank earnings growth strategies and performance outcomes.

Finally, our study contributes to the literature on the value relevance of disaggregated accounting data. Prior research suggests that greater disaggregation increases the precision of information in the financial statements and provides users with more information for equity valuation (Lipe 1986; Ohlson and Penman 1992; Fairfield, Sweeney, and Yohn 1996; Street, Nichols, and Gray 2000; Ertimur, Livnat, and Martikainen 2003; Esplin, Hewitt, Plumlee, and Yohn 2014; Chen, Miao, and Shevlin 2015). Different from the existing studies that disaggregate financial data into the components that are reported in a company's financial statements and notes, we present novel evidence on disaggregating a company's earnings growth into the quantity and price components.

The structure for the rest of the paper is as follows. In the next section, we discuss prior research and institutional background. Then, we develop empirical predictions and research designs. This is followed by sections in which we report the sample and descriptive statistics, the main empirical results, and additional analyses. The final section concludes.

PRIOR RESEARCH AND INSTITUTIONAL BACKGROUND

Prior Research on Disaggregating Financial Statement Items

The purpose of disaggregating financial statement information is to provide greater transparency on a firm's business activities and performance. The FASB and International Accounting Standards Board (IASB) have undertaken many projects that, in some capacity, have focused on the disaggregation of performance information and sought to structure the performance statement into categories and subtotals, such as operating income and financing

income (FASB 2017; IASB 2017). The FASB and IASB also require firms to disaggregate financial statement information by operating segments, determined based on the information that a chief operating decision maker uses for resource allocation (FASB 1997; IASB 2006).

Extant research documents that disaggregating a current performance measure improves earnings forecasts (Fairfield et al. 1996; Chandra and Ro 2008), consistent with the notion that certain income components provide more information about future profitability due to fewer measurement errors or higher predictive ability of the component. Capital markets also find disaggregation important, as the stock market reactions to different earnings components vary significantly (Lipe 1986; Ohlson and Penman 1992; Ertimur et al. 2003; Chen et al. 2015). Furthermore, prior literature suggests that disaggregating financial statement information based on a firm's business activities—such as disaggregating financial statements into operating and financial activities (Esplin et al. 2014), and disaggregating information by business segments under SFAS No. 131 (Street et al. 2000; Ettredge, Kwon, Smith, and Zarowin 2005; Chen and Liao 2015)—improves users' understanding of firm performance.

Although disaggregation generally enhances the understandability of a firm's financial information, it may also introduce costs for financial statement users. Prior studies show that investors have limited attention and information-processing capability, and they could be overwhelmed by large quantities of information (Hirshleifer and Teoh 2003; Tuttle and Burton 1999; Elliott, Hodge and Jackson 2008). Such information overload experienced by investors can negatively affect their judgments and decisions, resulting in investors ignoring disaggregated details or fixating on a single amount such as earnings (Bloomfield, Hodge, Hopkins, and Rennekamp 2015; Kelton and Murthy 2016). Mindful of the potential costs, standard setters have

warned that an entity shall not disaggregate information in a manner that obscures useful information (IASB 2014).

In the bank setting, one strand of research disaggregates bank earnings into earnings before securities transactions and earnings from securities transactions, and documents the differential information content of these components (Barth, Beaver, and Wolfson 1990; Warfield and Linsmeier 1992; Jaggi and Zhao 2002). Other research examines the different levels of persistence and informativeness of net interest income versus noninterest income, classified based on traditional and nontraditional banking activities (Du and Hsu 2017).

While existing studies disaggregate financial statements in various ways, they do not consider a potentially important form of disaggregation: segregating the change in an income measure into its underlying drivers, such as quantity and price. This disaggregation conveys information about a firm's strategic decisions and performance outcomes. For example, growing revenue by increasing the quantity may reflect a firm's productivity and/or customer responsiveness, and raising prices might indicate a firm's product differentiation and/or market power. Given that information on underlying performance drivers potentially improves investors' assessments of future earnings and cash flows, we hypothesize that the disaggregation of changes in income by quantity and by price is useful in predicting future profitability and is reflected in stock valuation. At the same time, increasing levels of detail and complexity could lead to information overload, preventing investors from incorporating the disaggregated information. In this paper, we utilize the volume and rate analysis disclosed by banks to explicitly test whether this disaggregation provides value-relevant information to investors.

Institutional Background on Banks' Volume and Rate Analysis

The banking industry provides an appealing setting to examine the usefulness of disaggregating the change in a performance measure into quantity and price components because no other industry discloses such disaggregated information.[5] A publicly traded bank is required by the SEC's Industry Guide 3, *Statistical Disclosure by Bank Holding Companies*, to disaggregate changes in net interest income into volume (quantity) and rate (price) variances in the MD&A section of 10-K filings (SEC 1990). Specifically, Industry Guide 3 requires banks to report a volume and rate analysis that disaggregates changes in interest income and interest expense for the last two fiscal years into (1) changes in volume (change in volume multiplied by the old rate, or "volume variance") and (2) changes in rate (change in rate multiplied by the old volume, or "rate variance"). The changes attributable to the combined impacts of volume and rate should be allocated proportionately to volume and rate variances.[6] Banks further calculate the difference between volume and rate variances of interest income and those of interest expense, hence arriving at volume and rate variances of net interest income.[7]

In drafting Industry Guide 3, the SEC staff considered investors' need to assess uncertainties and changes in risk characteristics (SEC 2017). The SEC believes that disclosure of the disaggregated statistical information on a periodic basis assists investors in assessing banks'

[5] We note that except for banks, the volume and rate analysis is not required by Generally Accepted Accounting Principles (GAAP) or other SEC rules.

[6] In spite of this requirement, approximately 30 percent of our sample bank-years report "combined volume/rate variance" to reflect changes of net interest income that are impacted by both volume and rate. For comparability, we allocate "combined volume/rate variance" proportionately to volume variance and rate variance of net interest income. Untabulated analysis suggests that there is no significant difference in the value relevance of volume and rate variances for banks that report "combined volume/rate variance" and banks that do not do so. Further, we do not find evidence that "combined volume/rate variance" is value relevant.

[7] In a volume and rate analysis, banks report net interest income on a tax-equivalent basis in order to provide comparisons of interest income for all interest-earning assets. When calculating net interest income on a tax-equivalent basis, interest income from tax-exempt loans to states and political subdivisions as well as interest income from tax-exempt securities issued by these subdivisions are increased by an amount equivalent to the taxes that would have been paid if such income were taxable at statutory rates.

future earning potential and enables investors to compare bank holding companies. Despite the SEC's disclosure requirement initiated in 1990, there is scarce empirical evidence demonstrating that the volume and rate analysis is informative for users. In this study, we formally test whether volume and rate variances of net interest income are predictive of future earnings and are value relevant to investors. Our analyses inform the SEC and accounting standard setters of the continued relevance of the volume and rate analysis and of the usefulness of disaggregating the change in a performance measure into its underlying drivers.

Appendix A provides the volume and rate analysis reported by U.S. Bancorp. The increase in net interest income from 2011 to 2012 was $621 million, consisting of a positive amount of volume variance ($1,062 million) and a negative amount of rate variance (-$441 million). This suggests that U.S. Bancorp's growth in net interest income from 2011 to 2012 is driven by volume variance through the expansion of interest-earning assets relative to interest-bearing liabilities, and is offset by rate variance due to the shrinking interest rate spread between asset yields and liability rates. Overall, it appears that U.S. Bancorp implemented a strategy of growing net interest income by increasing the size of the balance sheet, rather than by widening the interest rate spread.

PREDICTIONS AND RESEARCH DESIGNS

In this section, we first explore the underlying firm characteristics associated with disaggregated information. Next, we develop tests of the value relevance of the disaggregated information.

Bank Attributes Associated with Volume and Rate Variances

Our first objective is to examine whether volume and rate variances capture important bank attributes. We estimate the following equations:

$$\Delta NII\ Volume_{i,t}/Assets_{i,t-1} = \beta_0 + \beta_1 Lerner\ index_{i,t-1} + \beta_2 Noninterest\text{-}bearing\ deposit_{i,t-1} + \beta_3 Capital\ ratio_{i,t-1} + \beta_4 NPL_{i,t-1} + \beta_5 Loan\ to\ core\ deposit_{i,t-1} + \beta_6 Gap_{i,t-1} + \beta_7 Gap_{i,t-1} * Rate\ decrease_t + \beta_8 RE\ loan_{i,t-1} + \beta_9 CI\ loan_{i,t-1} + \beta_{10} LAsset_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (1)$$

$$\Delta NII\ Rate_{i,t}/Assets_{i,t-1} = \beta_0 + \beta_1 Lerner\ index_{i,t-1} + \beta_2 Noninterest\text{-}bearing\ deposit_{i,t-1} + \beta_3 Capital\ ratio_{i,t-1} + \beta_4 NPL_{i,t-1} + \beta_5 Loan\ to\ core\ deposit_{i,t-1} + \beta_6 Gap_{i,t-1} + \beta_7 Gap_{i,t-1} * Rate\ decrease_t + \beta_8 RE\ loan_{i,t-1} + \beta_9 CI\ loan_{i,t-1} + \beta_{10} LAsset_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (2)$$

The subscripts *i* and *t* indicate firm and year. In equations (1) and (2), the dependent variables are volume and rate variances of net interest income ($\Delta NII\ Volume_{i,t}$ and $\Delta NII\ Rate_{i,t}$) scaled by lagged total assets ($Assets_{i,t-1}$), respectively. Increasing net interest income by volume expands the volume of interest-earning assets (loans and securities) relative to the volume of interest-bearing liabilities (deposits and other borrowings). Increasing net interest income by rate involves earning higher interest rates on assets relative to paying interest rates on liabilities. Below we discuss the bank attributes (explanatory variables) in detail.

Market Power and Deposit Funding Source

A bank with stronger market power has a greater ability to expand the volume of its balance sheet and to set loan and deposit interest rates to its own advantage (Hannan and Berger 1991). Hence, we expect that market power is positively associated with volume and rate variances. We use $Lerner\ index_{i,t-1}$ (see Appendix B for estimation details) to proxy for market power (Beck, De Jonghe, and Schepens 2013; Berger, Klapper, and Turk-Ariss 2009).

Noninterest-bearing deposits enhance a bank's ability to increase net interest income by expanding interest-earning assets relative to interest-bearing liabilities (FDIC 2013), resulting in a positive association between noninterest-bearing deposits and volume variance. Further,

because noninterest-bearing deposits reduce funding cost, a bank may charge lower lending rates, leading to a negative association between noninterest-bearing deposits and rate variance. The variable *Noninterest-bearing deposit*$_{i,t-1}$ is defined as noninterest-bearing deposits divided by total liabilities at the beginning of a year (Schaeck 2008).

Components in "CAMELS" Rating

Next, we consider aspects of the "CAMELS" rating of a bank's overall condition.[8] Banks with greater capital adequacy ("C") are more likely to grow their loans (Beatty and Liao 2011), resulting in a positive association between capital adequacy and volume variance. Further, a less well-capitalized bank may widen its interest rate spread to reduce the risk of capital inadequacy (Gambacorta 2008), leading to a negative association between capital adequacy and rate variance. The Tier 1 capital ratio (*Capital ratio*$_{i,t-1}$) measures capital adequacy.

The primary factor affecting bank asset quality ("A") is the credit risk of loan portfolios (FDIC 2012). As banks suffering losses from existing loan portfolios are generally unwilling or unable to lend (Shrieves and Dahl 1995; Beatty and Liao 2011), we expect a negative association between credit risk and volume variance. Turning to rate variance, banks charge a higher lending rate to compensate for higher credit risk (Gambacorta 2008), suggesting a positive association between credit risk and rate variance. We use the percentage of nonperforming loans ($NPL_{i,t-1}$) to proxy for asset quality.

[8] The "CAMELS" rating consists of six performance components: capital adequacy ("C"), asset quality ("A"), management ("M"), earnings ("E"), liquidity ("L"), and sensitivity to interest rate risk ("S"). In this subsection, we discuss four of the six components: capital adequacy ("C"), asset quality ("A"), liquidity ("L"), and sensitivity to interest rate risk ("S"). The proxy for market power, *Lerner index*, partly captures earnings ("E"). Additionally, in untabulated analysis, we follow DeYoung and Rice (2004) and measure management ("M") using the relative return-on-equity ratio during the past three years (*Relative ROE 3yr*). As *Relative ROE 3yr* is highly correlated with *Lerner index*, we use *Relative ROE 3yr* in place of *Lerner index* in bank attribute regressions, and find the signs and significance levels of the estimated coefficient on *Relative ROE3yr* are similar to those on *Lerner index*.

Liquidity ("L") reflects a bank's ability to fund illiquid investments with stable funds and to meet financial obligations with liquid assets (FDIC 2015).[9] We measure liquidity with the loan-to-core-deposit ratio (*Loan to core deposit*$_{i,t-1}$) (DeYoung and Jang 2016). Traditionally, a bank with higher liquidity tends to have the funding capacity to support faster asset growth (Webb 2000), suggesting a positive relation between liquidity and volume variance. However, in recent years, banks with low liquidity tend to obtain large shares of wholesale funding, which enable them to overcome liquidity constraints and to more fully exploit lending opportunities (Huang and Ratnovski 2011; Dinger and Craig 2014). As a result, the association between liquidity and volume variance is ambiguous, and we do not have a directional prediction. Regarding rate variance, *ex ante*, it is unclear whether liquidity is related to rate variance, so we do not form a prediction.

The literature on bank interest rate risk suggests that a bank's interest rate sensitivity ("S") influences rate variance (e.g., Angbazo 1997; Wilkinson 2004). A widely used measure to assess a bank's sensitivity to interest rate risk from the earnings perspective is the "maturity gap" (Office of the Comptroller of the Currency 1997; Angbazo 1997).[10] The theoretical association between interest rate sensitivity and rate variance of net interest income depends on whether interest rates decrease or increase; i.e., when interest rates increase (decrease), there is a positive (negative) association between the maturity gap and rate variance. To capture the interest rate-contingent relation, we define: (i) $Gap_{i,t-1}$ as the maturity gap, which measures a bank's interest rate sensitivity following prior literature (Flannery and James 1984) (Appendix B provides

[9] Stated differently, maintaining liquidity involves holding liquid assets (cash and short-term securities) to service short-term liabilities, which is equivalent to holding stable funds (core deposits) to support illiquid assets (loans) (Tirole 2011; DeYoung and Jang 2016).

[10] The term "maturity gap" is used interchangeably with "repricing gap," or simply "gap". In this paper, we use the term "maturity gap" (e.g., Angbazo 1997; Purnanandam 2007).

estimation details), and (ii) *Rate decrease*$_t$ as an indicator variable equal to one if the annualized one-year LIBOR decreases from year $t - 1$ to t, and zero otherwise.[11]

The interaction term $Gap_{i,t-1}$*$Rate\ decrease_t$ measures the expected negative association between the maturity gap and volume or rate variances when interest rates decrease ($Rate\ decrease_t = 1$), and the variable $Gap_{i,t-1}$ measures the expected positive association between the maturity gap and volume or rate variances when interest rates increase ($Rate\ decrease_t = 0$). Because the literature provides little guidance on volume variance, we do not have a prediction on the association between interest rate sensitivity and volume variance.

Loan Composition and Bank Size

We control for the composition of loan portfolios, because the loan composition directly affects interest income (DeYoung and Rice 2004). The variables $RE\ loan_{i,t-1}$ and $CI\ loan_{i,t-1}$ measure the composition of loan portfolios. Bank loan portfolios can be classified into three major categories: real estate loans, commercial and industrial loans, and others (such as consumer and agriculture loans). We define $RE\ loan_{i,t-1}$ ($CI\ loan_{i,t-1}$) as the percentage of real estate loans (commercial and industrial loans) in total loans. We also control for bank size ($Size_{i,t-1}$), defined as the natural log of lagged total assets, because size reflects banks' business operations in generating net interest income (Demsetz and Strahan 1997).

[11] More specifically, a maturity gap (*Gap*) comprises the differences in the amount and re-pricing/maturity intervals between rate-sensitive assets (*RSA*) and rate-sensitive liabilities (*RSL*). Holding the volume of assets and liabilities constant and assuming rates on *RSA* and *RSL* change by the same amount, the theoretical relation between the maturity gap (*Gap*) and the change in net interest income (ΔNII) is expressed in the following equation (Matz 2000; Wilkinson 2004): $\Delta NII = (RSA \times \Delta i) - (RSL \times \Delta i) = (RSA - RSL) \times \Delta i = Gap \times \Delta i$, where Δi is the change in rates on *RSA* and *RSL*. This equation indicates that a positive or negative change in net interest income (ΔNII) depends on two underlying factors: (i) whether the maturity gap (*Gap*) is positive or negative (i.e., whether more rate-sensitive assets re-price/mature compared to rate-sensitive liabilities), and (ii) whether interest rates (Δi) decrease or increase.

Value Relevance of Volume and Rate Variances

As the purpose of disaggregating financial information is to assist investors in better assessing firms' future earnings and cash flows, we hypothesize that the disaggregation of bank net interest income changes into volume and rate variances conveys value-relevant information to investors. However, if such disaggregation does not provide incremental information or leads to information overload, then we may not find volume and rate variances to be value relevant.

An accounting amount is deemed value relevant if it has a significant association with stock price changes or levels, i.e., the accounting amount reflects information used by equity investors (Barth, Beaver, and Landsman 2001). To formally test the value relevance of volume and rate variances, we start by assessing the ability of volume and rate variances to predict one-year-ahead net interest income, because predictability is an important factor that underlies the value relevance of earnings (Kohlbeck and Warfield 2007). Next, we use both stock price changes and levels specifications to test the value relevance of volume and rate variances (Venkatachalam 1996; Aboody and Lev 1998; Ahmed, Kilic, and Lobo 2006). Existing studies suggest that econometric trade-offs exist between stock return and price models, and that in many contexts, both stock price changes and levels models are useful when testing the economic hypothesis of interest (Kothari and Zimmerman 1995; Barth et al. 2001).[12]

Predictive Ability of Volume and Rate Variances for Future Net Interest Income

Several studies have examined the predictability of financial statement information for future earnings in the bank setting. Evans, Hodder, and Hopkins (2014) find that fair value adjustments for investment securities are positively associated with future income from those

[12] In the banking setting, researchers have examined the value relevance of investment securities disclosures (Barth 1994; Barth, Beaver, and Landsman 1996; Song, Thomas, and Yi 2010; Goh et al. 2015), derivatives disclosures (Venkatachalam 1996; Ahmed et al. 2006), loan loss provisions disclosures (Wahlen 1994; Morris, Kang, and Jie 2016), as well as statement of cash flows disclosures (Burke and Wieland 2017).

investments. Dong, Ryan, and Zhang (2014) find that accumulated unrealized gains and losses in available-for-sale securities, when realized, relate to future comprehensive income. Bratten, Causholli, and Khan (2016) find that the inclusion of fair value adjustments in other comprehensive income predicts future earnings. This study differs from the existing research in several respects. First, we examine the predictability of net interest income, a primary component of bank net income. Second, we examine the underlying drivers of the change in net interest income—volume and rate variances. Information on banks' strategies to grow net interest income by volume and/or by rate likely improves the forecast of future earnings.

Following the approach of prior literature (Bratten et al. 2016), we estimate the following equation to test the predictive ability of volume and rate variances for future net interest income:

$$NII_{i,t}/TA_{i,t} = \beta_0 + \beta_1 NII_{i,t-1}/TA_{i,t-1} + \beta_2 \Delta NII\ Volume_{i,t-1}/TA_{i,t-1} + \beta_3 \Delta NII\ Rate_{i,t-1}/TA_{i,t-1} + \beta_4 LAsset_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (3)$$

where $t - 1$ spans 1997–2012 and t spans 1998–2013. $NII_{i,t}/TA_{i,t}$ is net interest income scaled by total assets. $\Delta NII\ Volume_{i,t-1}/TA_{i,t-1}$ and $\Delta NII\ Rate_{i,t-1}/TA_{i,t-1}$ are volume and rate variances of net interest income scaled by total assets, respectively. We control for the natural log of total assets ($LAsset_{i,t-1}$) because size may affect banks' business operations in generating net interest income (Bhagat, Bolton, and Lu 2015; Bratten et al. 2016).

In equation (3), we expect to find positive coefficients on $\Delta NII\ Volume_{i,t-1}/TA_{i,t-1}$ and $\Delta NII\ Rate_{i,t-1}/TA_{i,t-1}$. An increase in volume variance indicates a larger balance of loans and securities to generate interest income relative to deposits and other borrowings to pay interest expense, leading to higher future net interest income, holding rates constant. Likewise, an increase in rate variance indicates widening interest rate differentials on loans and securities relative to deposits and borrowings, which result in higher future net interest income, holding volumes constant.

Stock Return Model

To examine the association of volume and rate variances with stock returns, we begin with a model that regresses stock returns on both earnings levels and changes (Easton and Harris 1991; Biddle, Seow, and Siegel 1995):

$$Returns_{i,t} = \beta_0 + \beta_1 Earnings_{i,t}/MV_{i,t-1} + \beta_2 \Delta Earnings_{i,t}/MV_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (4)$$

where $t - 1$ spans 1996–2012, and t spans 1997–2013. $Returns_{i,t}$ is the annual buy-and-hold bank stock returns minus value-weighted market returns, cumulated from nine months before fiscal year-end through three months after the fiscal year-end. Earnings levels ($Earnings_{i,t}$) and changes ($\Delta Earnings_{i,t}$) are scaled by market value of equity at the beginning of a year ($MV_{i,t-1}$).

We expand equation (4) by partitioning the levels and changes of earnings into those of earnings components—net interest income, noninterest income, loan loss provisions, and noninterest expense. This yields the baseline stock return model:[13]

$$Returns_{i,t} = \beta_0 + \beta_1 \Delta NII_{i,t}/MV_{i,t-1} + \beta_2 NII_{i,t}/MV_{i,t-1} + \beta_3 Noninterest\ Income_{i,t}/MV_{i,t-1} + \beta_4 \Delta Noninterest\ Income_{i,t}/MV_{i,t-1} + \beta_5 LLP_{i,t}/MV_{i,t-1} + \beta_6 \Delta LLP_{i,t}/MV_{i,t-1} + \beta_7 \Delta Noninterest\ Expense_{i,t}/MV_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (5)$$

In equation (5), NII (ΔNII) denotes net interest income (the change in net interest income) obtained from the income statement. The variables related to noninterest income, loan loss provisions, and noninterest expense effectively control for the effects of nontraditional banking activities, credit loss, and operational efficiency on a bank's stock returns.

Further, we separate the change in net interest income ($\Delta NII_{i,t}/MV_{i,t-1}$) into volume and rate variances ($\Delta NII\ Volume_{i,t}/MV_{i,t-1}$ and $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$), arriving at the following model:

[13] We do not include $Noninterest\ Expense_{i,t}/MV_{i,t-1}$ ($Noninterest\ expense\ PS_{i,t-1}$) in the stock return (price) model because the Pearson correlation coefficient between $NII_{i,t}/MV_{i,t-1}$ and $Noninterest\ Expense_{i,t}/MV_{i,t-1}$ ($NII\ PS_{i,t-1}$ and $Noninterest\ expense\ PS_{i,t-1}$) is greater than 0.90, and an examination of the variance inflation factors (VIF) values of the explanatory variables reveals that the VIF of $Noninterest\ Expense_{i,t}/MV_{i,t-1}$ ($Noninterest\ expense\ PS_{i,t-1}$) is greater than 10, suggesting multicollinearity is a serious concern.

$$Returns_{i,t} = \beta_0 + \beta_1 \Delta NII\ Volume_{i,t}/MV_{i,t-1} + \beta_2 \Delta NII\ Rate_{i,t}/MV_{i,t-1} + \beta_3 NII_{i,t}/MV_{i,t-1} + \beta_4 Noninterest\ Income_{i,t}/MV_{i,t-1} + \beta_5 \Delta Noninterest\ Income_{i,t}/MV_{i,t-1} + \beta_6 LLP_{i,t}/MV_{i,t-1} + \beta_7 \Delta LLP_{i,t}/MV_{i,t-1} + \beta_8 \Delta Noninterest\ Expense_{i,t}/MV_{i,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (6)$$

Finding significant and positive coefficients on $\Delta NII\ Volume_{i,t}/MV_{i,t-1}$ and $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$ indicates that volume and rate variances are captured by stock returns.[14]

Stock Price Model

To evaluate whether volume and rate variance information is reflected in stock price, we utilize a modified Ohlson (1995) model, as developed in Collins, Pincus, and Xie (1999). In this model, price is expressed as a function of earnings per share at year-end and book value of common equity per share at the beginning of a year.[15] Similar to prior literature (e.g., Song, Thomas, and Yi 2010), we partition earnings per share into multiple components: net interest income per share ($NII\ PS_{i,t}$), noninterest income per share ($Noninterest\ Income\ PS_{i,t}$), and loan loss provisions per share ($LLP\ PS_{i,t}$). Further, we partition net interest income per share in year t ($NII\ PS_{i,t}$) into the change in net interest income from year $t - 1$ to year t ($\Delta NII\ PS_{i,t}$) and the level of net interest income in year $t - 1$ ($NII\ PS_{i,t-1}$). Note that NII (ΔNII) denotes net interest income (the change in net interest income) obtained from the income statement. These partitions yield the following baseline stock price model:

$$Price_{i,t} = \beta_0 + \beta_1 \Delta NII\ PS_{i,t} + \beta_2 NII\ PS_{i,t-1} + \beta_3 Noninterest\ Income\ PS_{i,t} + \beta_4 LLP\ PS_{i,t} + \beta_5 BVPS_{i,,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (7)$$

where all variables are measured per share (PS) and adjusted for stock splits and dividends. $Price_{i,t}$ is stock price per share three months after year-end. Earnings components other than net

[14] In estimating equations (5) and (6), when we use annual buy-and-hold raw returns (not adjusted for market returns), our results are similar. Additionally, in the stock return (price) model, when we use net interest income on a tax-equivalent basis in place of $NII_{i,t}/MV_{i,t-1}$ ($NII\ PS_{i,t-1}$) to be consistent with the tax-equivalent basis of volume and rate variances, our inferences are similar.

[15] The advantage of this modified Ohlson model is that it does not require an estimation of abnormal earnings, which involves an estimate of long-term return on equities.

interest income control for the effects of nontraditional banking activities (proxied by *Noninterest Income* $PS_{i,t}$) and loan loss provisions (*LLP* $PS_{i,t}$) on a bank's equity valuation.

We partition $\Delta NII\ PS_{i,t}$ in equation (7) into volume and rate variances per share (ΔNII *Volume* $PS_{i,t}$ and ΔNII *Rate* $PS_{i,t}$), arriving at equation (8):

$$Price_{i,t} = \beta_0 + \beta_1 \Delta NII\ Volume\ PS_{i,t} + \beta_2 \Delta NII\ Rate\ PS_{i,t} + \beta_3 NII\ PS_{i,t-1} + \beta_4 Noninterest\ Income\ PS_{i,t} + \beta_5 LLP\ PS_{i,t} + \beta_6 BVPS_{i,,t-1} + Year\ fixed\ effects + \varepsilon_{i,t} \quad (8)$$

Finding significant and positive coefficients on ΔNII *Volume* $PS_{i,t}$ and ΔNII *Rate* $PS_{i,t}$ indicates the value relevance of volume and rate variances. We expect positive coefficients on the income variables (*NII* $PS_{i,t-1}$ and *Noninterest Income* $PS_{i,t}$) and negative coefficients on the expense variable (*LLP* $PS_{i,t}$). We expect a positive coefficient on $BVPS_{i,t-1}$ because prior literature demonstrates the value relevance of book values (Collins et al. 1999).

SAMPLE SELECTION AND DESCRIPTIVE STATISTICS

In this section, we discuss sample selection and report descriptive statistics.

Sample Selection

Table 1 reports the sample selection process. We obtain the initial sample of bank holding companies with 4th quarter FR-Y9C data from 1996 to 2013, merged with the CRSP-Compustat Merged linking table and the SEC EDGAR's 10-K filing index files. Next, we remove 597 bank-years with a fiscal year-end other than December so that the fiscal year in 10-K filings and the fiscal year in FR Y9-C of the 4th quarter are aligned.[16] We further remove 780 bank-years that do not have two consecutive years of data to calculate the change variables for the period 1997–2013. We hand-collect volume and rate variances of net interest income from

[16] The 4th quarter data of FR Y9-C include year-to-date income statement variables.

banks' 10-K filings via the SEC EDGAR database.[17] In this process, 495 bank-years not disclosing the volume and rate analysis are removed. We eliminate 95 bank-years with missing data needed to calculate regression variables. The final sample has 3,747 bank-years and 498 unique banks from 1997 to 2013, ranging from 132 banks in 1997 to 240 banks in 2013.[18] All variables are winsorized at the 1st and 99th percentiles to reduce the influences of outliers.[19]

Annual Changes in Net Interest Income by Volume and by Rate

We calculate banks' annual changes in net interest income by volume ($\Delta NII\ Volume_{i,t}/NII_{i,t-1}$) and by rate ($\Delta NII\ Rate_{i,t}/NII_{i,t-1}$), where $\Delta NII\ Volume_{i,t}/NII_{i,t-1}$ and $\Delta NII\ Rate_{i,t}/NII_{i,t-1}$ are defined as volume variance and rate variance, respectively, of net interest income scaled by last year's net interest income on a tax-equivalent basis. We present the annual mean values of $\Delta NII\ Volume_{i,t}/NII_{i,t-1}$ and $\Delta NII\ Rate_{i,t}/NII_{i,t-1}$ from 1997 to 2013 in Figure 1. Figure 1 shows that from 1997 to 2013, the means of volume variance are greater than zero every year, whereas only in five years out of the 17 years were the means of rate variance greater than zero. Figure 1 also displays the mean values of the sum of volume and rate variances ($\Delta NII\ Rate\ \&\ Volume_{i,t}/NII_{i,t-1}$) by year, where $\Delta NII\ Rate\ \&\ Volume_{i,t}/NII_{i,t-1}$ is defined as the change in net interest income on a tax-equivalent basis divided by last year's net interest income on a tax-equivalent basis. For the entire sample of 3,747 bank-years, untabulated analysis suggests that on average, net interest

[17] It was difficult to extract volume and rate variances automatically using a computer program (e.g., SAS or Perl) because the disclosure varies greatly by bank. For example, banks tabulate the volume and rate analysis with various table formats and put the analysis at different places in the MD&A. Furthermore, asset and liability categories used to segregate interest income and expense are not uniform, and the level of detail presented differs across banks. Lastly, we note that the volume and rate analysis information is not collected by academic/commercial databases, possibly because it is located in MD&A rather than in the financial statements and accompanying notes, it is only reported by one industry, and it lacks a uniform disclosure format.

[18] The sample starts in 1997, the first year all public domestic companies were required to make their filings on EDGAR. The sample ends in 2013, the last year for which we hand-collected data for volume and rate variances.

[19] Effective March 2006, the Federal Reserve Bank increased the asset-size threshold for FR Y9-C from $150 million to $500 million. In untabulated analysis, we require that banks have total assets over $500 million, and find our key inferences are qualitatively similar.

income on a tax-equivalent basis grows by 7.5 percent per year (mean of $\Delta NII\ Rate\ \&\ Volume_{i,t}/NII_{i,t-1}$ = 0.075), consisting of an average volume variance of 9.0 percent and an average rate variance of -1.3 percent (mean of $\Delta NII\ Volume_{i,t}/NII_{i,t-1}$ = 0.090, mean of $\Delta NII\ Rate_{i,t}/NII_{i,t-1}$ = -0.013). Collectively, the analyses suggest that banks tend to increase their net interest income by expanding bank size (i.e., expanding the volumes of loans and securities relative to deposits and other borrowings)—as reflected by the positive sign of volume variance—rather than by increasing rate differentials (i.e., increasing the asset yields relative to borrowing costs)—as reflected by the negative sign of rate variance.[20]

MAIN EMPIRICAL RESULTS

In this section, we conduct regression analyses to test the predictions on bank attributes related to volume and rate variances, and on the value relevance of volume and rate variances.

Bank Attributes Associated with Volume and Rate Variances

We first present the results on bank attributes associated with volume and rate variances. Table 2, Panel A reports the variable distributions. On average, the change in net interest income due to volume (rate) as a percentage of lagged total assets is 0.33 percent (-0.05 percent). Table 2, Panel B reports Pearson correlation coefficients. No pairs of variables exhibit correlation

[20] In untabulated analysis, we examine the combinations of volume and rate variances, and find considerable variations in volume and rate variances at the bank level over time. Specifically, we classify bank-years into four categories based on the signs of volume and rate variances: (1) $\Delta NII\ volume > 0$ and $\Delta NII\ rate < 0$ (57.0 percent), (2) $\Delta NII\ volume > 0$ and $\Delta NII\ rate > 0$ (27.4 percent), (3) $\Delta NII\ volume < 0$ and $\Delta NII\ rate > 0$ (9.0 percent), and (4) $\Delta NII\ volume < 0$ and $\Delta NII\ rate < 0$ (6.6 percent). We then examine the percentages of bank-years change from one category to another from year $t-1$ to year t ($t = 1998–2013$). We find 48.8 percent of bank-years migrate between categories, with the highest percentage being 15.1 percent changing from $\Delta NII\ volume > 0$ and $\Delta NII\ rate > 0$ in year $t-1$ to $\Delta NII\ volume > 0$ and $\Delta NII\ rate < 0$ in year t. For bank-years staying in the same category for two years, 36.8 percent have $\Delta NII\ volume > 0$ and $\Delta NII\ rate < 0$, whereas 10.8 percent have $\Delta NII\ volume > 0$ and $\Delta NII\ rate > 0$ in both years.

coefficients greater (less) than 0.5 (-0.5), with the exception of three pairs ($Gap_{i,t-1}$ and $Gap_{i,t-1}$*$Rate\ decrease_t$, $RE\ loans_{i,t-1}$ and $CI\ loans_{i,t-1}$, as well as $NPL_{i,t-1}$ and $Lerner\ index_{i,t-1}$).[21]

Table 2, Panel C reports the ordinary least squares (OLS) estimates from the regressions of volume and rate variances on bank attributes. Column (1) reports the results from equation (1), which tests the association between bank attributes and volume variance of net interest income. As expected, greater market power (coefficient on $Lerner\ index_{i,t-1}$ = 0.0041) enables a bank to grow net interest income by expanding the volume of its balance sheet. The prediction that a higher percentage of noninterest-bearing deposits allows banks to invest in interest-earning assets is supported by the positive and significant coefficient of $Noninterest\text{-}bearing\ deposit_{i,t-1}$ (0.0040). We do not find a significant association between capital adequacy ($Capital\ ratio_{i,t-1}$) and volume variance. The negative and significant coefficient on $NPL_{i,t-1}$ (-0.0474) indicates that banks with a high proportion of nonperforming loans are unable or unwilling to increase credit supply. The coefficient on $Loan\ to\ core\ deposit_{i,t-1}$ (0.0003) is positive and weakly significant at the ten percent level, suggesting that banks with low liquidity likely obtain wholesale funding to support asset growth. The coefficient on $Gap_{i,t-1}$ (0.0017) also is positive and weakly significant, suggesting a bank with a large maturity gap is likely to expand the volume of assets relative to liabilities when market interest rates rise. Moreover, we find that banks with high proportions of real estate loans and commercial and industrial loans ($RE\ loan_{i,t-1}$ and $CI\ loan_{i,t-1}$) are more likely to increase net interest income by volume. Lastly, bank size ($LAsset_{i,t-1}$) is negatively and significantly related to volume variance. [22]

[21] When estimating the regressions, we examine the VIF for each explanatory variable to detect multicollinearity. In all estimated regressions, the VIF values are less than 5, suggesting multicollinearity is not a serious concern.
[22] For brevity, we do not report the estimated intercepts in the tables.

Column (2) in Panel C of Table 2 reports the results from equation (2), which tests the association between bank attributes and rate variance of net interest income. Contrary to our expectation, we find a significant and negative association between the Lerner index and rate variance (coefficient on *Lerner index*$_{i,t-1}$ = -0.0010). One possible explanation is that the Lerner index relates to marginal profits for the prior year, and prior research shows gross margin is mean-reverting (Abarbanell and Bushee 1997). The negative and significant coefficient on *Noninterest-bearing deposit*$_{i,t-1}$ (-0.0015) suggests that banks pass through lower funding costs to borrowers. Credit risk (coefficient on $NPL_{i,t-1}$ = 0.0077) is positively and significantly associated with rate variance, likely stemming from banks adjusting lending rates upwards to compensate for higher potential credit losses on riskier loans. The positive (negative) and significant coefficients on $Gap_{i,t-1}$ ($Gap_{i,t-1}$*$Rate\ decrease_t$) is consistent with our prediction that rate variance increases (decreases) with the maturity gap when interest rate rises (falls). The coefficient estimates on other variables are not significant.

Overall, Table 2 suggests that disaggregating the change in net interest income into volume and rate variances captures banks' fundamental characteristics as related to future net interest income. Importantly, finding opposite signs for key variables (e.g., *Noninterest-bearing deposit* and *NPL)* between the results for equations (1) and (2) further supports the merits of disaggregation, as these differences could be masked by the aggregate measure.

Value Relevance of Volume and Rate Variances

In this subsection, we first provide initial evidence of the value relevance of volume and rate variances using a Ball and Brown (1968) style analysis. Next, we estimate regression models to examine the predictability of volume and rate variances for future net interest income, and the association of volume and rate variances with stock returns and prices.

Descriptive Evidence Using a Ball and Brown (1968) Type Analysis

To provide preliminary evidence that the stock market incorporates volume and rate variances into price, we perform a Ball and Brown (1968) type analysis. We group bank-year observations into portfolios based on positive and negative volume variance or rate variance, in addition to portfolios of positive and negative changes in net income. We then calculate cumulative abnormal returns for each portfolio during the year.[23] Figure 2 reveals that banks with positive (negative) annual net income changes experienced average abnormal returns of 4.6 percent (-14.0 percent), similar to Ball and Brown (1968, 169). More relevant to the current study, banks with positive (negative) volume variance exhibited cumulative abnormal annual stock returns of 0.5 percent (-8.8 percent), a difference of 9.3 percent, and banks with positive (negative) rate variance exhibited returns of 3.2 percent (-3.4 percent), a difference of 6.6 percent, suggesting volume and rate variances explain a large portion of excess returns. Overall, Figure 2 provides initial evidence that the disaggregated financial data contain value-relevant information that the stock market incorporates in valuation.

Predictive Ability of Volume and Rate Variances for Future Net Interest Income

We report the estimation results from equations (3) and (4) in Table 3. In Panel A, we present the variable distributions. The sample size is reduced from 3,747 to 3,177 because we require one-year-ahead data. Net interest income scaled by total assets (NII_t/TA_t) has a mean of 3.41 percent and standard deviation of 0.65 percent. Volume and rate variances scaled by total assets ($\Delta NII\ Volume_{t-1}/TA_{t-1}$ and $\Delta NII\ Rate_{t-1}/TA_{t-1}$) have mean values of 0.29 percent and -0.04 percent, and standard deviations of 0.34 percent and 0.24 percent, respectively.

[23] Specifically, for each of the portfolios each year, we cumulate abnormal returns (i.e., bank returns minus value-weighted market returns) beginning 12 months prior to and continuing to the month in which banks release SEC annual reports (defined as month 0). We define the month in which a bank releases an SEC 10-K filing as month 0 because a volume and rate analysis is disclosed in the MD&A section of a 10-K filing.

Table 3, Panel B reports the OLS regressions results. In Column (1), the estimated coefficient on NII_{t-1}/TA_{t-1} is positive and significant, as expected. In Column (2), which estimates equation (3), the coefficient estimates on $\Delta NII\ Volume_{t-1}/\ TA_{t-1}$ and $\Delta NII\ Rate_{t-1}/TA_{t-1}$ are positive and significant at the one percent level, suggesting that volume and rate variances are predictive of future net interest income, after controlling for the level of net interest income. Vuong's test comparing these two models indicates the superior explanatory power of the extended model in Column (2). These results show that volume and rate variances provide *incremental* information for predicting future profitability.

To further control for bank characteristics that potentially affect the level or change in net interest income, we add bank attributes from Table 2 to equation (3). We report the results in Column (3) of Table 3, Panel B. The coefficient estimates on $\Delta NII\ Volume_{t-1}/TA_{t-1}$ and $\Delta NII\ Rate_{t-1}/TA_{t-1}$ remain positive and significant at the one percent level, suggesting that the results on the predictive ability of volume and rate variances for future profitability are robust when controlling for other bank characteristics.[24]

Stock Return Model

The value relevance results from the stock return model are reported in Table 4. Panel A presents the variable distributions. The volume (rate) variance scaled by beginning-of-the-year market value has a mean of 0.020 (-0.002) and a median of 0.018 (-0.004). Table 4, Panel B, Columns (1) and (2), report the estimation results from equations (5) and (6), respectively. In Column (1), the coefficients on $\Delta NII_{i,t}/MV_{i,t-1}$ and $NII_{i,t}/MV_{i,t-1}$ are positive and significant,

[24] The OLS estimators may be biased in the presence of the lagged-dependent variable as an explanatory variable. To address this concern, we conduct a robustness test by estimating the models in Table 3, Panel B using the feasible generalized least squares (FGLS) technique with the error terms following a first-order autoregressive process (Davidson and MacKinnon 2004; Greene 2002). Untabulated analyses suggest that inferences based on the FGLS estimators are similar to those based on the OLS estimators. We thank an anonymous reviewer for pointing out this issue.

suggesting the change and level of net interest income obtained from the income statements are positively associated with stock returns. In Column (2), where the change in net internet income is separated into volume and rate variances, the coefficients on $\Delta NII\ Volume_{i,t}/MV_{i,t-1}$ (0.795) and $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$ (1.069) are positive and significant at the one percent level, suggesting that volume and rate variances are informative in explaining stock returns. The estimated coefficient of $NII_{i,t}/MV_{i,t-1}$ remains positive and highly significant.

Turning to the levels and changes of other earnings components, in both Columns (1) and (2), except for $\Delta LLP_{i,t}/MV_{i,t-1}$, the estimated coefficients on these control variables have the expected signs and are significant at the one percent level. Vuong's test comparing the adjusted R-squared values suggests the explanatory power of the regression in Column (2) is not significantly different from that in Column (1).

We also we consider the *incremental* informativeness of volume and rate variances with respect to returns by adding the variable $\Delta NII_{i,t}/MV_{i,t-1}$ to equation (6) to control for the change in net interest income obtained from the income statement.[25] We report the estimation results in Column (3). The coefficients on $\Delta NII\ Volume_{i,t}/MV_{i,t-1}$ and $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$ remain positive and significant, suggesting volume and rate variances are informative in explaining stock returns *beyond* the change in net interest income information from the income statement. This observation is confirmed by the Vuong's test, which indicates that explanatory power of the regression in Column (3) is significantly higher than that of Column (1).

Stock Price Model

[25] Note that the change in net interest income obtained from the income statements ($\Delta NII_{i,t}$) does not equal the sum of volume ($\Delta NII\ Volume_{i,t}$) and rate variances ($\Delta NII\ Rate_{i,t}$) due to the different adjustments on income from tax-exempt loans and securities.

In Table 5, we report the results from the value relevance model using the stock price specification. Panel A reports the variable distributions. The volume (rate) variance per share has a mean of 0.591 (-0.114) and a median of 0.322 (-0.075). Net interest income per share (*NII* $PS_{i,t-1}$) in year $t-1$ has a mean of 5.916 and a median of 4.456.

In Table 5, Panel B, Columns (1) and (2) report the estimates of equations (7) and (8), respectively. In Column (1), the coefficient estimates are significant and have the predicted signs. In Column (2), where the change in net internet income is separated into volume and rate variances, the estimated coefficients on $\Delta NII\ Volume\ PS_{i,t}$ (7.374) and $\Delta NII\ Rate\ PS_{i,t}$ (6.177) are positive and significant at the one percent level, suggesting that volume and rate variances reflect information used by investors in stock valuation. The estimated coefficients on the other variables have the expected signs and are significant at the one percent level. Vuong's test comparing the adjusted R-squared value indicates that the explanatory power of the regression in Column (2) is higher than that in Column (1).

Additionally, we investigate the *incremental* value relevance of volume and rate variances *beyond* the change in net interest income from the income statement. We add $\Delta NII\ PS_{i,t}$ to equation (8), where $\Delta NII\ PS_{i,t}$ is calculated using the change in net interest income obtained from the income statement. We report the results in Column (3). The estimated coefficients on $\Delta NII\ Volume\ PS_{i,t}$ and $\Delta NII\ Rate\ PS_{i,t}$ remain positive and significant. Vuong's test suggests that the explanatory power of the regression in Column (3) is higher than that of Column (1).

Collectively, the empirical results in Figure 2 and Tables 3 to 5 suggest that disaggregating the change in net interest income into volume and rate variances predicts future profitability, and it reflects information used by equity investors in their stock valuation decisions.[26]

[26] In Table 5, Panel B, the magnitude of the volume variance coefficient is greater than that on rate variance, whereas in Table 4 – Panel B, the magnitude of the volume variance coefficient is less than that on rate variance.

ADDITIONAL ANALYSES

In this section, we investigate how the usefulness of disaggregated information may vary with firm-specific and macroeconomic factors in the context of the banking industry.[27]

Moderating Effects of Bank Characteristics on Value Relevance

We examine whether the value relevance of volume and rate variances varies with two important bank characteristics: the degree of traditional banking activities and bank size. First, we predict volume and rate variances to be more informative in the stock valuation of banks with a higher level of traditional banking activities, because volume and rate variances reflect banks' net-interest-income growth strategies. Based on prior literature (DeYoung and Rice 2004; Stiroh 2004), we define two indicator variables to capture traditional banking activities: (i) $HighNII\%_{i,t-1}$ is an indicator variable equal to one if the percentage of net interest income in total operating income is greater than the annual median value, zero otherwise; (ii) $High\ loan\text{-}to\text{-}asset_{i,t-1}$ is an indicator variable equal to one if the ratio of net loans to total assets is greater than the annual median value, zero otherwise.

We include these indicator variables and their interactions with volume and rate variances in equations (6) and (8), and expect positive coefficients on the interaction terms. In the stock return regressions, the coefficient estimates on the interaction terms are not significant. In the stock price regressions, we find positive and significant coefficient estimates on $\Delta NII\ Rate\ PS_{i,t}*High\ NII\%_{i,t-1}$ and $\Delta NII\ Rate\ PS_{i,t}*High\ loan\text{-}to\text{-}asset_{i,t-1}$, suggesting the association between rate variance and stock prices is more pronounced for banks with more traditional

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The inconsistency is likely caused by the different scales of the volume and rate variances. To remedy this issue and properly compare the magnitudes, we rank the explanatory variables into quintiles each year and re-estimate equations (6) and (8). The untabulated results show that the associations of volume variance with stock returns and prices are significantly higher than the associations of rate variance with stock returns and prices, suggesting volume variance is more value relevant than rate variance. We thank an anonymous reviewer for the suggestion.

[27] For brevity, the regression results on additional analyses are untabulated, but they are available upon request. Please refer to Appendix B for details on the variable definitions.

banking activities.

Second, we investigate the moderating effect of bank size (Demsetz and Strahan 1997). On one hand, bank size may be negatively associated with the value relevance of volume and rate variances, as large banks tend to have less traditional banking activities and are likely to have better information environments (Collins and Kothari 1989). On the other hand, volume and rate variances might be more value relevant for larger banks due to higher predictability for future earnings.[28] We include $Large\ bank_{i,t-1}$, an indicator variable equal to one if a bank's total assets are greater than the annual median value, and its interactions with volume and rate variances in equations (6) and (8). In the stock return regressions, the coefficient estimates on the interaction terms are not significant. In the stock price regressions, we find a significant and positive coefficient estimate on $\Delta NII\ Volume\ PS_{i,t}*Large\ bank_{i,t-1}$, suggesting the positive associations between volume variance and stock prices are more pronounced for large banks than for small banks.

Taken together, we find evidence that the positive associations of volume and rate variances with stock prices are more pronounced for banks with more traditional banking activities and for larger banks.

Moderating Effects of Macroeconomic Factors on Value Relevance

Because macroeconomic cycles strongly influence bank financial conditions, we investigate the moderating effects of macroeconomic factors on the value relevance of volume and rate variances (DeYoung and Rice 2004; Goh, Li, Ng, and Yong 2015). In a recessionary economic environment (captured by high unemployment rates and decreasing interest rates) and

[28] Because larger firms are more mature and more stable than smaller firms, the predictability of earnings are more likely to be positively associated with size (Bathke, Lorek, and Willinger 1989; Hodgson and Stevenson-Clarke 2000). Indeed, untabulated results suggest that in our sample, the ability of volume and rate variances to predict one-year-ahead net interest income is significantly higher for large banks relative to small banks.

during the financial crisis and its subsequent years, banks may have less opportunities to grow net interest income by volume or by rate. Thus, we expect that the value relevance of volume and rate variances is lower for years with weak economic conditions than for years when the economy is strong, as accounting information is less informative when firms have fewer growth opportunities (Collins and Kothari 1989).

We define three indicator variables: (i) *High unemployment*$_t$ is an indicator variable equal to one if the annual unemployment rate in a year is higher than or equal to the median value during 1997–2013, zero otherwise; (ii) *Rate decrease*$_t$ is an indicator variable equal to one if the one-year LIBOR decreases from year $t-1$ to year t, zero otherwise; and (iii) *Post-financial crisis*$_t$ is an indicator variable equal to one (zero) for years 2008–2013 (1997–2007). We include each indicator variable and its interaction terms with volume and rate variances in equations (6) and (8). In the stock price regressions, we find negative and significant coefficients on the interaction terms of $\Delta NII\ Volume\ PS_{i,t}$ and the macroeconomic variables (*High unemployment*$_t$, *Rate decrease*$_t$, and *Post-financial crisis*$_t$), consistent with our prediction that the value relevance of volume variance is lower during economic recessions and during post-financial crisis years. The interaction terms of $\Delta NII\ Rate\ PS_{i,t}$ with the macroeconomic variables are not significant.

In the stock return regressions, as expected, we find negative and significant coefficient estimates on $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$*High unemployment$_t$, $\Delta NII\ Volume_{i,t}/MV_{i,t-1}$*Post-financial crisis$_t$, and $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$*Post-financial crisis$_t$. However, contrary to our prediction, the coefficient estimate on $\Delta NII\ Rate_{i,t}/MV_{i,t-1}$*Rate decrease$_t$ is positive and significant, suggesting that the value relevance of rate variance is higher during rate-decreasing years than during rate-increasing years. A possible explanation is that compared to rate-increasing years, in rate-decreasing years investors more highly value a bank's superior interest rate risk management

skills to grow net interest income by rate because declining market rates makes it challenging to maintain a wide interest rate spread (Matz 2000).

In general, the additional analyses suggest that the informativeness of volume and rate variances is lower during periods of economic recessions and uncertainty. We also find that rate variance is more highly associated with stock returns in rate-decreasing years.

CONCLUSION

The purpose of disaggregating information in financial statements is to provide enhanced information about firms' operations and performance. Disaggregation takes various forms, such as segregating earnings by whether an income item is recurring or by types of income, business lines, and geographic locations. A potentially important form of disaggregation is to disaggregate the change in a performance measure into its underlying drivers—quantity and price. In this study, we utilize the volume and rate analysis disclosed by banks and test whether this disaggregation conveys value-relevant information to investors.

The banking industry provides a good setting to conduct our analyses because banks are required by the SEC's Industry Guide 3 to disclose information about volume and rate variances of net interest income. We document that on average, banks tend to increase net interest income by volume rather than by rate, suggesting banks' earnings strategy centers on expanding the size on balance sheet, rather than on increasing the interest rate spread. Furthermore, we find that volume and rate variances are associated with a bank's market power, noninterest-bearing deposit funding, credit risk, interest rate risk, as well as loan composition.

In assessing the value relevance of the disaggregated information, we find that volume and rate variances are predictive of future net interest income and are associated with stock

returns and prices. Additionally, we find evidence that the value relevance of volume and rate variances is higher for banks with more traditional banking activities, and is lower during periods of economic recession. Collectively, our findings suggest that the disaggregated information along the volume and rate dimensions has predictive and confirmatory value and is value relevant.

Our study should interest the FASB, SEC, investors, and researchers. Our findings are relevant to the ongoing FASB project on *Financial Performance Reporting—Disaggregation of Performance Information,* the goal of which is to improve the decision-usefulness of the income statement through disaggregation. For the SEC, which is assessing the efficacy of the volume and rate analysis, our results suggest that the disaggregation of changes in net interest income conveys value-relevant information about banks' earnings strategy and performance. For investors, we show that volume and rate variances provide information to predict a bank's future profitability and can help confirm or correct investors' prior assessments. For researchers, the paper adds novel evidence on disaggregating an entity's changes in earnings into quantity and price components.

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APPENDIX A

An Example of Volume and Rate Variances of Net Interest Income: U.S. Bancorp 10-K Filing for Year 2012

Year Ended December 31 (Dollars in Millions)	2012 v 2011 Volume	Yield/Rate	Total
Increase (decrease) in			
Interest Income			
Investment securities	$ 275	$ (316)	$ (41)
Loans held for sale	122	(40)	82
Loans			
Commercial	369	(272)	97
Commercial real estate	45	(29)	16
Residential mortgages	318	(123)	195
Credit card	54	101	155
Other retail	(14)	(147)	(161)
Total loans, excluding covered loans	772	(470)	302
Covered loans	(179)	77	(102)
Total loans	593	(393)	200
Other earning assets	(52)	53	1
Total earning assets	938	(696)	242
Interest Expense			
Interest-bearing deposits			
Interest checking	4	(23)	(19)
Money market accounts	3	(17)	(14)
Savings accounts	12	(58)	(46)
Time certificates of deposit less than $100,000	(14)	(28)	(42)
Time deposits greater than $100,000	26	(54)	(28)
Total interest-bearing deposits	31	(180)	(149)
Short-term borrowings	(38)	(52)	(90)
Long-term debt	(117)	(23)	(140)
Total interest-bearing liabilities	(124)	(255)	(379)
Increase (decrease) in net interest income	**$ 1,062**	**$ (441)**	**$ 621**

This table shows the components of the change in net interest income (*ΔNII*) by volume and rate variances on a tax-equivalent basis. Specifically, information is provided in each category with respect to (i) the changes attributable to changes in volume (changes in volume multiplied by prior rate), (ii) the changes attributable to changes in rate (changes in rate multiplied by prior volume), and (iii) the total change. The changes attributable to the combined impacts of volume and rate have been allocated proportionately to the changes due to volume and the changes due to rate. From this table, we obtain the following data for year 2012: ***ΔNII Volume* = 1,062 million, *ΔNII Rate* = −441 million.**

APPENDIX B
Variable Definitions

Variables in Figure 1 (Descriptive statistics)		
$\Delta NII\ Volume_{i,t}$ $/NII_{i,t-1}$	Volume variance of net interest income divided by the prior year's net interest income on a tax-equivalent basis (BHCK4519).	FR Y9-C, 10-K
$\Delta NII\ Rate_{i,t}$ $/NII_{i,t-1}$	Rate variance of net interest income divided by the prior year's net interest income on a tax-equivalent basis (BHCK4519).	FR Y9-C, 10-K
$\Delta NII\ Rate\ \&$ $Volume_{i,t}\ /NII_{i,t-1}$	The sum of volume and rate variances of net interest income, divided by the prior year's net interest income on a tax-equivalent basis (BHCK4519).	FR Y9-C, 10-K

Variables in Table 2 (Bank attributes of volume and rate variances)		
$\Delta NII\ Volume_{i,t}$ $/Assets_{i,t-1}$	Volume variance of net interest income divided by total assets at the beginning of a year (BHCK2170).	10-K, FR Y9C
$\Delta NII\ Rate_{i,t}$ $/Assets_{i,t-1}$	Rate variance of net interest income divided by total assets at the beginning of a year (BHCK2170).	10-K, FR Y9C
Lerner index$_{i,t-1}$	A measure of market power at the beginning of a year. Following the banking literature (e.g., Beck et al. 2013; Berger et al. 2009), the Lerner index for each bank year is calculated from the equation: $Lerner\ index = (P - MC)/P$ (A.1) where: P = the ratio of operating income (BHCK4107 + BHCK4079) to total assets (BHCK2170); MC = the marginal cost. We derived MC from the following translog cost function: $\ln C = a_0 + a_1 \ln Q + a_2(\ln Q)^2 + \beta_1 \ln W_1 + \beta_2 \ln W_2 + \beta_3 \ln W_3 + \beta_4 \ln W_1 \ln W_2 + \beta_5 \ln W_2 \ln W_3 + \beta_6 \ln W_1 \ln W_3 + \beta_7(\ln W_1)^2 + \beta_8(\ln W_2)^2 + \beta_9(\ln W_3)^2 + \gamma_1 \ln Q \ln W_1 + \gamma_2 \ln Q \ln W_2 + \gamma_3 \ln Q \ln W_3$ (A.2) where: C = total costs, measured by the sum of interest expense (BHCK4073), loan loss provision (BHCK4230), and noninterest expenses (BHCK4093) Q = total output, measured by total assets (BHCK2170); W_1 = the input price of labor, measured by wages (BHCK4135) divided by total assets (BHCK2170); W_2 = the input price of funds, measured by interest expense (BHCK4073) to total deposits (BHDM6631 + BHDM6636 + BHFN6631 + BHFN6636); W_3 = the input price of fixed capital, measured by the sum of noninterest expense other than wages (BHCK4093 − BHCK4135) and loan loss provision (BHCK4230) divided by total assets (BHCK2170). We estimate the translog cost function using all banks with available data to attain the predicted coefficients for each year from 1997 to 2013. After the estimation, we compute the marginal cost MC for each bank-year as: $MC = C/Q\ (a_1 + a_2 2\ln Q + \gamma_1 \ln W_1 + \gamma_2 \ln W_2 + \gamma_3 \ln W_3)$ (A.3) By inserting the estimated bank-year-specific measure of MC into equation (A.1), we then obtain the measure of market power, *Lerner index*.	FR Y9-C
Noninterest-bearing deposit$_{i,t-1}$	Noninterest-bearing deposit (BHDM6631 + BHFN6631) divided by total liabilities (BHCK2948) at the beginning of a year. Noninterest-bearing deposits includes total demand deposits and noninterest-bearing time and savings deposits.	FR Y9-C
Capital ratio$_{i,t-1}$	Tier 1 capital ratio at the beginning of a year. Starting year 2001, it is BHCK7204 divided by 100. Before year 2001, it is estimated as dividing BHCK8274 (Tier 1 capital) by total assets excluding intangible assets (BHCK2170 − BHCK3163 − BHCKB026 − BHCK5507 − BHCK3164).	FR Y9-C
$NPL_{i,t-1}$	Nonperforming loans (BHCK5525 + BHCK5526) scaled by total net loans (BHCK2122 − BHCK3123) at the beginning of a year.	FR Y9-C

Loan to core deposit$_{i,t-1}$	Loans and leases net of allowance (BHCK2125 for years before 2011, BHCKB529 starting 2001) divided by core deposits at the beginning of a year. Core deposits is estimated as the sum of demand deposits, NOW, ATS, and other transaction accounts, money market deposit accounts and other savings accounts, and time deposits of less than $100,000 (BHCB2210 + BHCB3187 + BHCB2389 + BHCK6648 + BHOD3189 + BHOD3187 + BHOD2389 + BHOD6648).	FR Y9-C
Gap$_{i,t-1}$	Maturity gap, constructed as rate-sensitive assets (*RSA*) minus rate-sensitive liabilities (*RSL*) at the beginning of a year. Rate-sensitive assets (*RSA*) is constructed by adding earning assets maturing or re-pricing within one year (BHCK3197) and trading assets (BHCK3545). Rate-sensitive liabilities (*RSL*) is constructed as follows: BHCK3296 (interest-bearing deposit liabilities that reprice or mature within one year) + BHCK3298 (long-term debt with a remaining maturity of more than one year but reprices within one year) + BHCK3408 (variable-rate preferred stock) + BHCK3409 (long-term debt that is scheduled to mature within one year) + BHCK2332 (other borrowed money with remaining maturity of less than one year) + BHCK2309 (commercial papers) + BHCK3548 (trading liability) + BHCK2920 (liability on acceptance executed and outstanding, reported before 2006) + BHDMB993 (fed fund purchased, reported since 2002) + BHCKB995 (securities sold under repo agreement, reported since 2002) + BHCK2800 (fed fund purchased and securities sold under repo agreement, reported before 2002) + BHCB2210 (demand deposit) + BHCB3187 (NOW, ATS, and other transaction accounts) + BHCB2389 (money market deposit account).	FR Y9-C
Rate decrease$_t$	An indicator variable equal to one if the change in one-year LIBOR from year $t-1$ to year t is negative, and zero otherwise.	FR Y9-C
RE loan$_{i,t-1}$	Loans secured by real estate as a percentage of total loans (BHCK1410/ BHCK2122) at the beginning of a year.	FR Y9-C
C&I loan$_{i,t-1}$	Commercial and industrial loans as a percentage of total loans ((BHCK1763 + BHCK1764)/ BHCK2122) at the beginning of a year.	FR Y9-C
LAsset$_{i,t-1}$	Natural log of total assets (BHCK2170) at the beginning of a year.	FR Y9-C

Variables in Table 3 (Predictability of future net interest income)		
ΔNII Volume$_{i,t-1}$ /*TA*$_{i,t-1}$	Volume variance of net interest income scaled by total assets (BHCK2170) in year $t-1$.	10-K, FR Y9-C
ΔNII Rate$_{i,t-1}$ /*TA*$_{i,t-1}$	Rate variance of net interest income scaled by total assets (BHCK2170) in year $t-1$.	10-K, FR Y9-C
NII$_{i,t}$/*TA*$_{i,t}$	Net interest income (BHCK4074) scaled by total assets (BHCK2170) in year t.	FR Y9-C

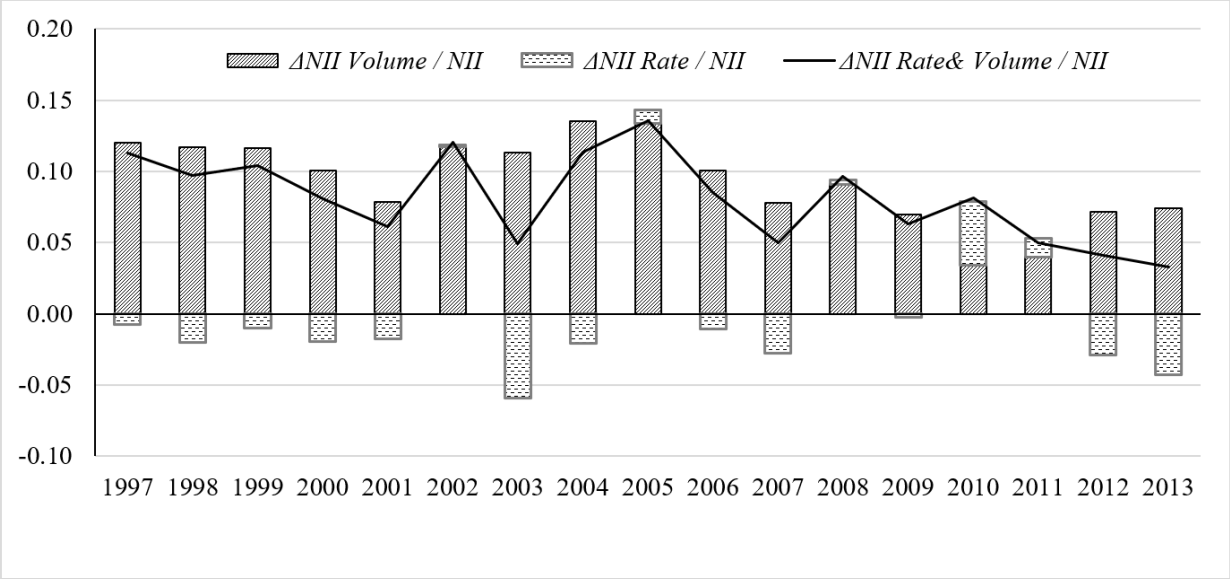
Variables in Table 4 (Stock return regressions)		
Returns$_{i,t}$	Compounded 12-month buy-and-hold bank returns (ret) minus value-weighted market returns (vwret), cumulated from nine months before fiscal year-end of year t through three months after it.	CRSP
MV$_{i,t-1}$	Market value of equity (prcc_f*csho*1000) in year $t-1$.	Compustat
ΔNII Volume$_{i,t}$	Volume variance of net interest income in year t.	10-K
ΔNII Rate$_{i,t}$	Rate variance of net interest income in year t.	10-K
ΔNII$_{i,t}$	Change in net interest income (BHCK4074 – lagged BHCK4074) from year $t-1$ to t.	FR Y9-C
NII$_{i,t}$	Net interest income (BHCK4074) in year t.	FR Y9-C
Noninterest income$_{i,t}$	Noninterest income (BHCK4079) in year t.	FR Y9-C
ΔNoninterest income$_{i,t}$	Change in noninterest income (BHCK4079 – lagged BHCK4079) from year $t-1$ to t.	FR Y9-C
LLP$_{i,t}$	Loan loss provisions (BHCK4230) in year t.	FR Y9-C

$\Delta LLP_{i,t}$	Change in loan loss provisions (BHCK4230 – lagged BHCK4230) from year $t-1$ to t.	FR Y9-C
Noninterest expense$_{i,t}$	Noninterest expense (BHCK4093) in year t.	FR Y9-C
Δ*Noninterest expense*$_{i,t}$	Change in noninterest expense (BHCK4093 – lagged BHCK4093) from year $t-1$ to t.	FR Y9-C

Variables in Table 5 (Stock price regressions)		
Price$_{i,t}$	Stock price per share three months after fiscal year-end, adjusted for stock splits and dividends ([prccm+dvc/cshpri]/ajex), in year t.	Compustat
Δ*NII Volume PS*$_{i,t}$	Volume variance per share (ΔNII volume variance/[cshpri*ajex*1000]) in year t.	10-K, Compustat
Δ*NII Rate PS*$_{i,t}$	Rate variance per share (ΔNII rate variance/[cshpri*ajex*1000]) in year t.	10-K, Compustat
NII TE PS$_{i,t}$	Net interest income on a tax-equivalent basis per share (BHCK 4519) /[cshpri*ajex*1000]) in year t.	FR Y9-C, Compustat
Δ*NII PS*$_{i,t}$	Change in net interest income per share ([BHCK 4074 – lagged BHCK 4074] /[cshpri*ajex*1000]) in year t.	FR Y9-C, Compustat
NII PS$_{i,t-1}$	Net interest income per share (BHCK 4074) /[cshpri*ajex*1000]) in year $t-1$.	FR Y9-C, Compustat
Noninterest income PS$_{i,t}$	Noninterest income per share (BHCK 4079/[cshpri*ajex*1000])	FR Y9-C, Compustat
LLP PS$_{i,t}$	Loan loss provisions per share (BHCK 4230/[cshpri*ajex*1000]) in year t.	FR Y9-C, Compustat
Noninterest expense PS$_{i,t}$	Noninterest expense per share (BHCK4093/[cshpri*ajex*1000]) in year t.	FR Y9-C, Compustat
BVPS$_{i,t-1}$	Book value of common equity at the end of last fiscal year, divided by the number of common shares outstanding and adjusted for stock splits and dividends at the end of last fiscal year (BHCK3210/[cshpri*ajex*1000]) in year $t-1$.	FR Y9-C, Compustat

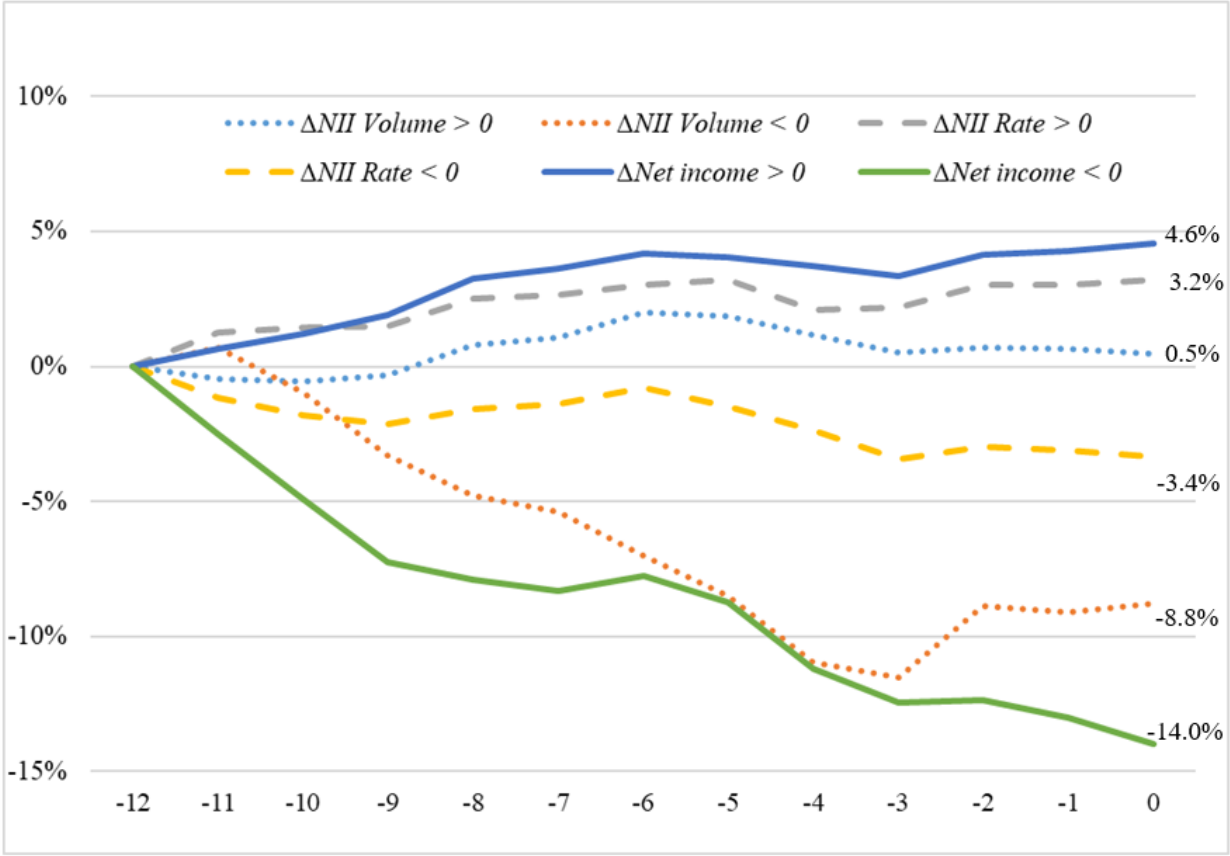
Variables in Additional Analyses (Untabulated)		
High NII%$_{i,t-1}$	An indicator variable equal to one if *NII%* in year $t-1$is greater than the annual median value, and zero otherwise. *NII%* is defined as net interest income (BHCK4074) divided by total operating income (BHCK4074 + BHCK4079) at the beginning of a year.	FR Y9-C
High Loan-to-asset$_{i,t-1}$	An indicator variable equal to one if *Loan-to-asset* in year $t-1$ is greater than the annual median value, and zero otherwise. *Loan-to-asset* is defined as loans and leases net of allowance (BHCK2125 for years before 2011, BHCKB529 starting 2001) divided by total assets (BHCK2170) at the beginning of a year.	FR Y9-C
Large bank$_{i,t-1}$	An indicator variable equal to one if a bank's total assets (BHCK2170) in year $t-1$ is greater than the annual median value, and zero otherwise.	FR Y9-C
High unemployment$_t$	An indicator variable equal to one if the annual unemployment rate in year t is higher than or equal to its median value during 1997–2013, and zero otherwise. Years coded with *High unemployment = 1* are: 2002–2004, 2008–2013.	Bureau of Labor Statistics
Rate decrease$_t$	An indicator variable equal to one if the change in one-year LIBOR from year $t-1$ to year t is negative, and zero otherwise. Years coded with *Rate decrease = 1* are: 1998, 2001–2003, 2007–2011, 2013.	Federal Reserve of St. Louis
Post-financial crisis$_t$	An indicator variable equal to one for years 2008-2013, and zero for years 1997–2007.	

FIGURE 1
Annual Changes in Net Interest Income by Rate and by Volume



This figure depicts the mean values of $\Delta NII\ Volume_{i,t}/NII_{i,t-1}$, $\Delta NII\ Rate_{i,t}/NII_{i,t-1}$, and $\Delta NII\ Rate\&Volume_{i,t}/NII_{i,t-1}$, which are volume and rate variances of net interest income, and the sum of volume and rate variances, all scaled by last year's net interest income on a tax-equivalent basis.

FIGURE 2
Cumulative Abnormal Returns for Different Portfolios



This figure depicts average cumulative abnormal returns (i.e., bank returns minus value-weighted market returns) beginning 12 months prior to and continuing to the month of banks releasing annual reports (month -12 through month 0) over the sample period for different portfolios.

TABLE 1
Sample Selection

	Obs.
Bank-holding companies with 4th quarter FR-Y9C data from 1996 to 2013, merged with the CRSP-Compustat linking table and the SEC EDGAR's 10-K filing index files	5,714
Less: bank-years with fiscal year-end other than December	-597
Less: bank-years that do not have two consecutive years of data to calculate change variables from 1997 to 2013	-780
Less: bank-years missing volume and rate variances in 10-K filings from 1997 to 2013	-495
Less: bank-years with missing data items to calculate regression variables	-95
Total number of bank-year observations (t = 1997 – 2013)	3,747
Number of unique bank holding companies	498

TABLE 2
Bank Attributes Associated with Volume and Rate Variances of Net Interest Income

Panel A: Distributions (N = 3,747)

	Mean	Std Dev	P25	Median	P75
$\Delta NII\ Volume_{i,t}/Assets_{i,t-1}$	0.0033	0.0043	0.0009	0.0028	0.0050
$\Delta NII\ Rate_{i,t}/Assets_{i,t-1}$	-0.0005	0.0026	-0.0019	-0.0007	0.0007
$Lerner\ index_{i,t-1}$	0.1818	0.1750	0.1490	0.2163	0.2720
$Noninterest\text{-}bearing\ deposit_{i,t-1}$	0.1414	0.0690	0.0957	0.1304	0.1727
$Capital\ ratio_{i,t-1}$	0.0905	0.0172	0.0790	0.0884	0.1004
$NPL_{i,t-1}$	0.0153	0.0181	0.0044	0.0083	0.0187
$Loan\ to\ core\ deposit_{i,t-1}$	1.5203	0.5569	1.1517	1.4348	1.7661
$Gap_{i,t-1}$	0.0265	0.1756	-0.0823	0.0277	0.1394
$Gap_{i,t-1}*Rate\ decrease_t$	0.0083	0.1342	-0.0126	0	0.0464
$RE\ loan_{i,t-1}$	0.7015	0.1573	0.6102	0.7284	0.8177
$CI\ loan_{i,t-1}$	0.1703	0.1030	0.0985	0.1488	0.2141
$LAsset_{i,t-1}$	14.6617	1.4952	13.5818	14.3258	15.4089

TABLE 2 (continued)

Panel B: Pearson correlation coefficients (N = 3,747)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
(1) ΔNII Volume$_{i,t}$ /Assets$_{i,t-1}$											
(2) ΔNII Rate$_{i,t}$ /Assets$_{i,t-1}$	**-0.161**										
(3) Lerner index $_{i,t-1}$	**0.299**	**-0.167**									
(4) Noninterest-bearing deposit $_{i,t-1}$	**0.108**	**-0.083**	**0.159**								
(5) Capital ratio $_{i,t-1}$	0.004	0.000	**0.050**	**0.125**							
(6) NPL $_{i,t-1}$	**-0.345**	**0.140**	**-0.572**	**-0.054**	**0.109**						
(7) Loan to core deposit$_{i,t-1}$	**-0.030**	**0.063**	**-0.145**	**-0.465**	**-0.030**	0.014					
(8) Gap$_{i,t-1}$	**0.090**	**-0.041**	**0.060**	**0.357**	**0.110**	-0.004	**-0.245**				
*(9) Gap$_{i,t-1}$*Rate decrease$_t$*	**0.043**	**-0.125**	**0.018**	**0.287**	**0.103**	**0.032**	**-0.217**	**0.758**			
(10) RE loan$_{i,t-1}$	**-0.031**	**0.061**	**-0.165**	**-0.232**	**0.142**	**0.142**	**0.187**	**-0.193**	**-0.159**		
(11) CI loan$_{i,t-1}$	**0.106**	**-0.047**	**0.073**	**0.301**	**0.028**	**-0.066**	**-0.146**	**0.274**	**0.215**	**-0.671**	
(12) LAsset $_{i,t-1}$	**-0.138**	-0.014	**0.099**	**0.129**	**-0.207**	**0.109**	**-0.087**	**0.193**	**0.166**	**-0.416**	**0.232**

Bolded values are statistically significant at the 5 percent level or less. Please see Appendix B for variable definitions.

TABLE 2 (continued)

Panel C: Bank attribute regressions of volume and rate variances

	Column (1) **Dependent variable = *ΔNII Volume$_{i,t}$/Assets$_{i,t-1}$***		Column (2) **Dependent variable = *ΔNII Rate$_{i,t}$/Assets$_{i,t-1}$***	
	Pred.	Coeff (*t*-stat)	Pred.	Coeff (*t*-stat)
Lerner index$_{i,t-1}$	+	0.0041***	+	-0.0010***
		(6.52)		(-3.17)
Noninterest-bearing deposit$_{i,t-1}$	+	0.0040***	-	-0.0015**
		(2.66)		(-1.78)
Capital ratio$_{i,t-1}$	+	-0.0037	-	0.0007
		(-0.57)		(0.25)
NPL$_{i,t-1}$	-	-0.0474***	+	0.0077**
		(-6.49)		(2.32)
Loan to core deposit$_{i,t-1}$	?	0.0003*	?	0.0000
		(1.77)		(0.33)
Gap$_{i,t-1}$	?	0.0017*	+	0.0020***
		(1.96)		(4.53)
*Gap$_{i,t-1}$*Rate decrease$_t$*	?	-0.0003	-	-0.0037***
		(-0.37)		(-5.65)
RE loan$_{i,t-1}$	?	0.0042***	?	-0.0000
		(4.02)		(-0.06)
CI loan$_{i,t-1}$	?	0.0067***	?	-0.0004
		(4.15)		(-0.64)
LAsset$_{i,t-1}$	?	-0.0003***	?	-0.0000
		(-3.35)		(-0.29)
Year fixed effects		Yes		Yes
Adjusted R^2		0.196		0.136
N		3,747		3,747

This panel reports the regression results of bank attributes associated with volume and rate variances, respectively (t = 1997–2013). Significance levels are based on robust standard errors clustered by firm, and are one-tailed for directional predictions and two-tailed otherwise. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 3
Predictability of Future Net Interest Income

Panel A: Distributions (N = 3,177)

	Mean	Std Dev	P25	Median	P75
$NII_{i,t}/TA_{i,t}$	0.0341	0.0065	0.0299	0.0337	0.0377
$NII_{i,t-1}/TA_{i,t-1}$	0.0345	0.0066	0.0302	0.0341	0.0383
$\Delta NII\ Volume_{i,t-1}/TA_{i,t-1}$	0.0029	0.0034	0.0009	0.0026	0.0044
$\Delta NII\ Rate_{i,t-1}/TA_{i,t-1}$	-0.0004	0.0024	-0.0017	-0.0006	0.0008
$LAsset_{i,t-1}$	14.7593	1.4891	13.6797	14.4267	15.499

Panel B: Predicting future net interest income

Dependent variable = $NII_{i,t}/TA_{i,t}$	Pred.	Column (1) Coeff. (*t*-stat)	Column (2) Coeff. (*t*-stat)	Column (3) Coeff. (*t*-stat)
$NII_{i,t-1}/TA_{i,t-1}$	+	0.840***	0.827***	0.810***
		(61.84)	(58.98)	(45.73)
$\Delta NII\ Volume_{i,t-1}/TA_{i,t-1}$	+		0.144***	0.153***
			(5.95)	(5.77)
$\Delta NII\ Rate_{i,t-1}/TA_{i,t-1}$	+		0.241***	0.243***
			(7.82)	(7.73)
$LAsset_{i,t-1}$	?	-0.000***	-0.000***	-0.000***
		(-4.95)	(-4.34)	(-4.34)
Lerner index$_{i,t-1}$	?			-0.000
				(-0.05)
Noninterest-bearing deposit$_{i,t-1}$	?			0.002*
				(1.67)
Capital ratio$_{i,t-1}$	?			-0.000
				(-1.57)
$NPL_{i,t-1}$	?			0.017***
				(3.36)
Loan to core deposit$_{i,t-1}$	?			-0.000
				(-0.33)
$Gap_{i,t-1}$	?			0.002***
				(3.60)
$Gap_{i,t-1}$* *Rate Decrease*$_t$	?			-0.002***
				(-2.82)
RE loan$_{i,t-1}$	?			0.000
				(0.25)
CI loan$_{i,t-1}$	?			-0.000
				(-0.12)
Year fixed effects		Yes	Yes	Yes
Adjusted R^2		0.764	0.775	0.777
N		3,177	3,177	3,177
Vuong's test Z-statistic comparing Columns (1) and (2) = −5.393 (one-sided *p*-value < 0.001)				

This panel reports the regression results of volume and rate variances predicting future net interest income (*t* = 1998–2013). Significance levels are based on robust standard errors clustered by firm, and are one-tailed for directional predictions and two-tailed otherwise. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 4
Value Relevance Regressions of Stock Returns

Panel A: Distributions (N = 3,747)

	Mean	Std Dev	P25	Median	P75
$Returns_{i,t}$	-0.007	0.327	-0.195	-0.039	0.172
$\Delta NII\ Volume_{i,t}/MV_{i,t-1}$	0.020	0.049	0.006	0.018	0.034
$\Delta NII\ Rate_{i,t}/MV_{i,t-1}$	-0.002	0.033	-0.014	-0.004	0.005
$\Delta NII_{i,t}/MV_{i,t-1}$	0.019	0.048	0.000	0.014	0.034
$NII_{i,t}/MV_{i,t-1}$	0.347	0.301	0.199	0.261	0.364
$Noninterest\ income_{i,t}/MV_{i,t-1}$	0.114	0.113	0.053	0.083	0.129
$\Delta Noninterest\ income_{i,t}/MV_{i,t-1}$	0.009	0.048	-0.001	0.006	0.016
$LLP_{i,t}/MV_{i,t-1}$	0.066	0.158	0.007	0.017	0.045
$\Delta LLP_{i,t}/MV_{i,t-1}$	-0.008	0.125	-0.006	0.000	0.008
$\Delta Noninterest\ expense_{i,t}/MV_{i,t-1}$	0.017	0.092	0.003	0.014	0.032

Panel B: Value relevance regressions of stock returns

Dependent variable = $Returns_{i,t}$	Pred.	Column (1) Coeff. (*t*-stat)	Column (2) Coeff. (*t*-stat)	Column (3) Coeff. (*t*-stat)
$\Delta NII\ Volume_{i,t}/MV_{i,t-1}$	+		0.795***	0.442**
			(4.41)	(1.87)
$\Delta NII\ Rate_{i,t}/MV_{i,t-1}$	+		1.069***	0.684***
			(5.05)	(2.65)
$\Delta NII_{i,t}/MV_{i,t-1}$	+	0.981***		0.531**
		(6.53)		(2.34)
$NII_{i,t}/MV_{i,t-1}$	+	0.153***	0.162***	0.148***
		(4.01)	(4.41)	(3.92)
$Noninterest\ income_{i,t}/MV_{i,t-1}$	+	0.296***	0.290***	0.298***
		(3.75)	(3.69)	(3.83)
$\Delta Noninterest\ income_{i,t}/MV_{i,t-1}$	+	0.672***	0.701***	0.680***
		(3.83)	(3.96)	(3.84)
$LLP_{i,t}/MV_{i,t-1}$	-	-0.367***	-0.386***	-0.365***
		(-4.71)	(-5.08)	(-4.74)
$\Delta LLP_{i,t}/MV_{i,t-1}$	-	-0.095	-0.091	-0.101
		(-1.12)	(-1.08)	(-1.20)
$\Delta Noninterest\ expense_{i,t}/MV_{i,t-1}$	-	-0.212**	-0.175**	-0.209**
		(-2.33)	(-1.94)	(-2.29)
Year fixed effects		Yes	Yes	Yes
Adjusted R^2		0.463	0.464	0.465
N		3,747	3,747	3,747
Vuong's test Z-statistic comparing Column (1) and Column (2) = −0.20 (one-sided *p*-value = 0.419)				
Vuong's test Z-statistic comparing Column (1) and Column (3) = −1.34 (one-sided *p*-value = 0.091)				

This panel reports the value relevance regressions of stock returns on volume and rate variances (*t* = 1997–2013). Significance levels are based on robust standard errors clustered by firm, and are one-tailed for directional predictions and two-tailed otherwise. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

TABLE 5
Value Relevance Regressions of Stock Prices

Panel A: Distributions (N = 3,747)

	Mean	Std Dev	P25	Median	P75
$Price_{i,t}$	27.492	39.021	12.239	19.009	28.520
$\Delta NII\ Volume\ PS_{i,t}$	0.591	1.460	0.109	0.322	0.636
$\Delta NII\ Rate\ PS_{i,t}$	-0.114	0.700	-0.251	-0.075	0.083
$\Delta NII\ PS_{i,t}$	0.403	0.758	-0.003	0.250	0.602
$NII\ PS_{i,t-1}$	5.916	6.352	3.149	4.456	6.042
$Noninterest\ income\ PS_{i,t}$	2.417	3.052	0.792	1.472	2.586
$LLP\ PS_{i,t}$	0.925	1.814	0.131	0.320	0.812
$BVPS_{i,t-1}$	18.554	35.330	8.158	11.881	17.011

Panel B: Value relevance regressions of stock prices

Dependent variable = $Price_{i,t}$	Pred.	Column (1) Coeff. (*t*-stat)	Column (2) Coeff. (*t*-stat)	Column (3) Coeff. (*t*-stat)
$\Delta NII\ Volume\ PS_{i,t}$	+		7.374***	7.284***
			(6.64)	(4.50)
$\Delta NII\ Rate\ PS_{i,t}$	+		6.177***	6.043***
			(3.74)	(2.49)
$\Delta NII\ PS_{i,t}$	+	8.260***		0.251
		(6.38)		(0.13)
$NII\ PS_{i,t-1}$	+	1.384***	2.117***	2.103***
		(4.15)	(5.85)	(5.17)
$Noninterest\ income\ PS_{i,t}$	+	3.535***	3.112***	3.112***
		(5.27)	(4.79)	(4.79)
$LLP\ PS_{i,t}$	-	-4.575***	-4.775***	-4.766***
		(-5.14)	(-6.53)	(-6.41)
$BVPS_{i,t-1}$	+	0.579***	0.412***	0.413***
		(10.09)	(5.54)	(5.51)
Year fixed effects		Yes	Yes	Yes
Adjusted R^2		0.780	0.808	0.808
N		3,747	3,747	3,747
Vuong's test Z-statistics comparing Column (1) and Column (2) = −2.64 (one-sided *p*-value = 0.004)				
Vuong's test Z-statistics comparing Column (1) and Column (3) = −2.66 (one-sided *p*-value = 0.004)				

This panel reports the value relevance regressions of stock prices on volume and rate variances (*t* = 1997–2013). Significance levels are based on robust standard errors clustered by firm, and are one-tailed for directional predictions and two-tailed otherwise. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.