Deposit Supply and Bank Transparency

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Abstract

Given the importance of transparency for the governance, efficiency, and stability of banks, we evaluate whether economic shocks that relax a bank's external funding constraints alter the cost-benefit calculations of bank managers concerning voluntary information disclosure. We measure information disclosure based on 10-K filings, 8-K filings, earnings guidance, and stock market liquidity. As a funding shock, we use unanticipated technological innovations that triggered shale development and deposit booms. Greater exposure to shale development reduced information disclosure and increased insider lending and trading, suggesting that deposit windfalls relax the incentives for managers to disclose information to attract funds.

Keywords: Bank Transparency; Information Production; Deposit Supply; Insider Trading and Lending.

JEL codes: G31; G21; D83; D82; G14

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I. Introduction

Given the opaqueness of banks and the impact of informational asymmetries on bank performance (e.g., Berger et al., 2000; Berger, Davies, and Flannery, 2000; Morgan, 2002; Flannery et al., 2004; Huizinga and Laeven, 2012; Acharya, 2014; Beatty and Liao, 2014; Acharya and Ryan, 2016), we examine the decision by bank managers to voluntarily disclose information to the public. Bank managers face benefits and costs with respect to information disclosure. In terms of benefits, reducing informational asymmetries can ameliorate agency problems, improve the governance and performance of banks, and lower the costs of raising external funds.[1] This agency-based approach also highlights a potential cost to managers of voluntarily disclosing information: Even if disclosure boosts bank performance, greater transparency might limit the ability of managers to extract private rents from the bank (Leuz and Wysocki, 2016). Research identifies other potential costs. Verrecchia (1983) and Darrough and Stoughton (1990) note that disclosure might release information that aids competitors, and Diamond and Dybvig (1983), Morris and Shin (2002), and Dang et al. (2017) emphasize that transparency can make banks more vulnerable to depositor withdrawals, impeding the effective intermediation of savings. Thus, beyond information disclosure mandated by regulations, bank managers must weigh the benefits of greater voluntary information disclosure—such as facilitating access to capital markets—against the potential costs of disclosure—such as making the extraction of private rents more difficult, providing competitors with valuable information, and increasing fragility.

[1] Jensen and Meckling (1976) and Myers and Majluf (1984) provide foundational contributions on informational asymmetries and agency problems, and Morgan (2002) and Flannery (2004) show that despite bank disclosure regulations, banks are not more transparent than nonfinancial firms. Levine (1997, 2005), Beatty and Liao (2014), and Acharya and Ryan (2016) review the literature on how information asymmetries and agency problems affect bank performance, valuations, and risk. For example, researchers examine how agency problems influence bank valuations and performance (e.g., Caprio, Laeven, and Levine, 2007) and risk taking (e.g., Laeven and Levine, 2009; Fahlenbrach and Stulz, 2011).

In this paper, we provide the first assessment of whether economic shocks that relax a bank's external funding constraints alter the cost-benefit calculations of bank managers concerning voluntary information disclosure. Specifically, we evaluate the impact of an economic shock that increases bank deposits on information disclosure. To the extent that deposit windfalls relax a bank's external financing constraints and therefore lower the benefits of using information disclosure to facilitate access to capital markets, bank managers will tend to reduce the release of information following deposit windfalls, so that they can limit the potential costs of disclosure, such as impeding their ability to extract private rents, releasing proprietary information to competitors, and making the bank less stable.[2] There are, however, potentially countervailing influences. For example, economic shocks that increase deposits might also alter the economic opportunities facing banks and prompt them to change their strategies with respect to branching, asset allocation, and off-balance sheet activities. Each of these changes will tend to spur greater information disclosure. We assess the net impact of a shock the boosts bank deposits and economic activity on the information disclosure decisions of bank managers. In this way, we contribute novel evidence on the relationship between the external financing constraints of banks and bank transparency.

To estimate the impact of an economic shock that boosted bank deposits on information disclosure by bank managers, we need (1) to quantify information disclosure and (2) to identify an exogenous source of variation in deposits. We quantify voluntary information disclosure using three data sources: (a) the Management Discussion and Analysis (MD&A) section of banks' 10-K filings, (b) voluntary disclosures in 8-K filings, and (c) forward-looking earnings

[2] More than 50 percent of deposits in large banks are uninsured and deposit flows are positively related to bank performance and informational asymmetries (e.g., Calomiris and Kahn 1991; Diamond and Rajan 2001; Peria and Schmukler 2001; and Hanson et al. 2015). Thus, the impact of deposits on information disclosure is an empirical question.

guidance issued by bank managers. Although the SEC mandates that the MD&A discuss particular themes, managers have flexibility over the breath and depth of information that they release to the public. Following Brown and Tucker (2011), we use textual analysis to construct measures of the length and information content of each bank's annual MD&A. Similarly, while the SEC mandates that 8-K filings provide information about particular corporate events, managers have latitude with respect to disclosing information about risk factors, litigation, new products, etc. within the "Regulation Fair Disclosure" and "Other Events" sections of 8-Ks. Following Boone and White (2015), we use these "voluntary disclosures" in 8-K filings to create three additional measures of the length, frequency, and market impact of each bank's voluntary information disclosures. Finally, we use data on banks' earnings forecasts to construct three additional measures of managerial information disclosure: the frequency of earnings forecasts, the precision of those forecasts, and the impact of the forecasts on market prices.

To identify an exogenous source of variation in deposits, we exploit the unanticipated large-scale extraction of shale gas and oil triggered by technological breakthroughs at the end of 2002, i.e., "fracking." These unexpected innovations materially lowered the costs of extracting gas and oil from shale deposits. This technology shock led energy companies to sign mineral leases with landowners in promising areas and immediately drill wells to assess the viability of extracting resources from those lands. These leases provided landowners with large initial payments and a share of any profits after drilling and extraction. After receiving these payments, landowners deposited much of the funds into local bank branches, inducing an unexpected surge in deposits (Plosser, 2014; and Gilje, Loutskina, and Strahan, 2016). Although we do not have data on how much of the payments each individual landowner deposited in local banks, we do have annual information on the number of shale wells drilled in each county. For each bank holding company (BHC) in each year, we measure its exposure to shale drilling activities by combining information on the geographic location of the BHC's branches and the number of wells drilled in each county.

Thus, our empirical strategy proceeds as follows. We first confirm the findings by Plosser (2014), and Gilje, Loutskina, and Strahan (2016) in our sample: There is a strong positive impact of a BHC's exposure to shale development and bank deposits. We also find that a BHC's exposure to shale development is negatively associated with the price of deposits, suggesting that this increase in bank deposits from shale development represents a shock to the supply of deposits, and not a shift in demand. Second, we evaluate the impact of a BHC's exposure to shale development on information disclosure by its managers. We do not use shale development as an instrument for bank deposits because shale development also altered economic conditions in shale-boom areas. Thus, although shale development represents an exogenous economic shock that boosted bank deposits, it is not a valid instrument for bank deposits in assessing information disclosure because it does not satisfy the exclusion restriction. Since changes in economic conditions tend to trigger the release of more information about those changes, we assess the net impact of exposure to the shale boom on information disclosure by bank managers and use this to draw inferences about the strength of the relaxation of external financing constraints induced by the increase in bank deposits. Third, we evaluate two mechanisms suggested by our simple benefit-cost framework: Relaxing external financing constraints (1) should have a bigger impact on information disclosure by banks in more competitive environments, where there are especially high costs to disclosure and (2) should increase private rent extraction by bank managers as the bank becomes less transparent.

We first discover that a BHC's exposure to shale development—which boosted the supply of bank deposits—materially reduced voluntary information disclosure by bank managers. In particular, exposure to shale development significantly reduced voluntary disclosure as measured by (a) the four MD&A disclosure indicators, (b) the three 8-K filing measures, and (c) the three earnings guidance indicators. Furthermore, all of these results hold when using either the full sample of BHCs or a sample that excludes the largest BHCs, i.e., a handful of the largest banks that account for 80% of total banking industry assets. We exclude the largest banks to address concerns that shale-induced surges in deposits did not have much of an impact on the largest BHCs. The estimated coefficients suggest a large economic impact of exposure to shale development on information disclosure. Consider a bank that receives a one-standard-deviation shale-induced shock, the estimated coefficients suggest that (a) the length of MD&A text-based disclosures would drop by 15% and (b) the impact of voluntary 8-K filings on stock returns would drop by 14%, consistent with the view that voluntary 8-K filings become less informative when a BHC is exposed to shale development shocks.

One identification concern with our empirical strategy is that banks might choose the location of their branch networks to gain access to the deposit boom triggered by shale developments. We address this concern in two ways. First, considerable research suggests that the technological advancements in fracking were unanticipated. As emphasized by Plosser (2014), and Gilje, Loutskina, and Strahan (2016), neither financial markets nor energy experts foresaw the breakthroughs that lowered the costs of extracting oil and gas from shale. Furthermore, energy companies moved very quickly to purchase shale mineral leases in promising areas following the technological breakthroughs. Thus, it is unlikely that banks altered their branch networks to gain greater exposure to expected deposit gains from fracking. Second, we employ an instrument variable strategy and confirm the results. In particular, as an instrument for a BHC's actual exposure to the shale boom, we use each BHC's exposure to shale development based only on its pre-shale boom branch network, i.e., based on its branch network in 2002. The first-stage regressions indicate the instrument is powerful. The second-stage results show that a positive shock to the BHC's exposure to shale development significantly reduced its voluntary information disclosure.

Besides examining the voluntary component of information disclosure contained in 10-Ks, 8-Ks, and projected earnings, we also confirm the findings using measures of overall bank transparency. In particular, theoretical and empirical research suggests that greater informational asymmetries between a firm and the market tend to reduce the liquidity of the firm's securities (Leuz and Verrecchia, 2000; Easley and O'Hara, 2004). Thus, we use three measures of the illiquidity of each BHC's stock that are widely used as proxies of overall informational asymmetries (e.g., Flannery, Kwan and Nimalendran, 2004, 2013): (1) the bid-ask spread (Stoll, 1989), (2) the Amihud illiquidity measure (Amihud, 2002), and (3) the proportion of zero-return days in a year (Lesmond, Ogden, and Trzcinka, 1999). We find that BHCs with greater exposure to shale development experience a greater increase in stock market illiquidity, consistent with the view that deposit windfalls reduce bank transparency.

We next extend the analyses and assess whether the impact of shale development on information disclosure varies across banks in a theoretically predictable manner. As noted by Verrecchia (1983), information disclosure provides valuable information to competitors. Thus, BHCs in more competitive environments might be more reluctant to release information to the public. This suggests that the adverse impact of shale development on information disclosure might be more pronounced among BHCs facing stiffer competition. Following Li, Hundholm, and Minnis (2013), we use textual analyses of banks' 10-K filings to construct measures of managers' perceptions of the competitive pressures facing their banks at the start of the sample period. We discover that the disclosure-reducing effects of shale development are greater among BHCs facing more intense competition. This finding is consistent with the view that (a) information disclosure provides valuable information to competitors, and (b) bank managers limit the release of such valuable information subject to other constraints, such as using information disclosure to maintain access to external funding sources.

We also extend the analyses by addressing an additional implication of the view that exposure to shale development reduces information disclosure by bank managers. If deposit windfalls resulting from shale development reduce the value of disclosing information to maintain access to capital markets, then this provides greater latitude to managers to reduce information disclosure to extract more private rents. Thus, shale development shocks that ease external financing constraints should intensify agency frictions and facilitate insider-trading and insider-lending activities. To assess this implication, we examine the total value of insider trading per each BHC, the value of insider trading per executive, and the amount of insider loans (loans to executive officers, directors, principal shareholders, and their related interests) as a share of total bank loans. We find that greater exposure to shale development increases insider trading and lending. The estimated impact is economically large. For example, a one-standard deviation increase in bank exposure increases the value of per person insider trading by 6% relative to unexposed banks.

Our study contributes to research into the factors determining information disclosure by bank managers as reviewed in Beatty and Liao (2014). Research examines how bank regulations, bank competition, and bank governance influence the information disclosure decisions of bank managers and bank performance more generally (e.g., Barth, Caprio, and Levine, 2006; Huizinga and Laeven 2012; Jiang, Levine, and Lin 2016). We contribute to this research by providing the first assessment of how a change in a bank's external financing constraints shape managerial decisions regarding information disclosure.

Our work also contributes to the broad literature on corporate information disclosure. Researchers have explored which factors shape disclosure in general (e.g., Diamond and Verrecchia 1991; Leuz and Verrecchia 2000; Healy and Palepu 2001; Graham, Harvey, and Rajgopal, 2005; Boone and White, 2015; and Leuz and Wysocki, 2016). We focus on banks because (1) a large literature demonstrates that banks play an especially important role in shaping economic growth and corporate performance (e.g., the literature review by Levine, 2005), and (2) although banks are subject to both corporate and bank regulatory financial report requirements, research demonstrates that banks are not more transparent than nonfinancial firms (Morgan 2002; Flannery, Kwan, Nimalendran 2004, 2013; and Huizinga and Laeven 2012). This highlights the value of understanding the determinants of agency problems within banks, including managerial decisions concerning information disclosure.

In the remainder of the paper, section II provides the institutional background of fracking and shale discoveries in the U.S. Section III describes the data, sample, and variable. Section III discusses our empirical strategy and reports our results. Section IV concludes.

II. Background on Fracking and Shale Discoveries

Although high-volume hydraulic fracturing and horizontal drilling had been invented before 1990s, it was not until the end of 2002 that Mitchell Energy discovered how to combine them to extract shale gas and oil at very low costs. This technological breakthrough, commonly known as “fracking,” revolutionized the U.S. oil and gas industry. According to the U.S. Energy Information Administration (EIA), shale oil and gas accounted for less than 2% of U.S. oil and gas production in 2000, and accounted for more than half of all U.S. oil and gas production by 2016.

Following these transformative and unexpected technological innovations, energy companies accelerated their purchases of mineral leases from landlords in areas with promising shale deposits and quickly began drilling operations to extract resources. These leases typically involved both a large initial payment and a royalty percentage based on the amount of oil and gas extracted from the land, providing enormous, unexpected windfalls to landowners. For example, the Times-Picayune (2008) reported that land with promising shale deposits could fetch from $10,000 to $30,000 an acre, so that a fortunate landowner who leased out only 100 acres of promising land could immediately receive an upfront bonus of $3 million regardless of the well’s ultimate productivity plus a future monthly royalty payment of 20% - 30% of the value of gas and oil extracted from the well. According to the estimate in Plosser (2014), some shale counties received leasing payments of one billion dollars a year over the 2003-2012 period. Landowners who received large upfront payments, and subsequent royalty checks, generally deposited a large share of these in their local bank branches, triggering a surge in deposits at exposed banks (e.g., Plosser (2014), Gilje, Loutskina, and Strahan (2016), and our analyses below).

Shale development provides a natural experiment for assessing how deposit windfalls affect information disclosure by bank managers. At least two factors suggest that the deposit windfalls resulting from shale development represent a deposit supply shock, plausibly exogenous to unobserved bank traits. First, as emphasized by Lake et al (2013), Plosser (2014), and Gilje, Loutskina, and Strahan (2016), neither financial markets nor energy industry experts anticipated the technological advancements in fracking that triggered the boom in shale development. Second, it was very difficult for banks to alter their branch networks to gain greater exposure to the shale shock because (a) as just noted, financial markets and industry experts did not predict the fracking boom, and (b) energy companies moved very quickly to purchase shale mineral leases from landlords in areas with prospective shale formations, making it is unlikely that banks opened branches before these leases were signed and initial payments were distributed. Nevertheless, as described in greater detail below, we address potential remaining concerns by using a BHC's pre-determined branch structure in 2002 to construct an instrument for the BHC's actual exposure to shale development. Thus, we exploit a BHC's exposure to shale development through its branch network to assess how an unexpected deposit supply shock affects information disclosure by bank managers.

III. Data and Sample

III.A. BHC Sample

Our sample comprises publicly listed U.S. BHCs, some of which have branches in counties experiencing a boom from shale development. The sample begins in 2000, which is three year before technological innovations triggered an explosion of shale development using fracking techniques, and runs through 2007. We use two samples of BHCs. Our primary sample contains 3,554 BHC-year observations involving 584 BHCs. Our small sample excludes the largest BHCs that together account for 80% of total banking assets, as measured in 2007. This reduces the number of BHCs by 12%. We examine both samples throughout the analyses to mitigate the concern that shale discoveries do not have much of an impact on the largest BHCs.

III.B. BHC Exposure to Shale-Induced Deposit Shocks

To measure the extent to which each BHC is exposed to the shale drilling boom, we first obtain information on the spud date, location, and well orientation of the wells drilled across the U.S over the 2003 – 2007 period from IHS Markit Energy's North American well database. We focus on horizontal wells, because after 2002 almost all horizontal wells were drilled to extract shale. This yields a sample of 15,265 wells with detailed locational information over the 2003 – 2007 period. We combine this information with data from the Federal Deposit Insurance Corporation's (FDIC's) Summary of Deposits (SOD) database on the location of each bank branch, deposits at each branch, and the branch's affiliated holding company.

For each BHC in a year, we then measure its exposure to shale drilling activities by combining information on the geographic location of bank branches across counties and information on the number of wells drilled in each county. More specifically,

$$Bank\ Exposure_{b,t} = \ln[1 + \textstyle\sum_j \left(Wells_{j,t} * Mktshr_{b,j,t}\right) / Branches_{b,t}], \qquad (1)$$

where subscripts *b*, *j*, and *t* denote bank, county, and year, respectively. $Wells_{j,t}$ equals the total number of shale wells drilled in county *j* from 2003 through year *t*, so that it measures the cumulative intensity of shale development in the county through year *t*. $Mktshr_{b,j,t}$ equals the share of total deposits in county *j* in year *t* held by bank *b*, i.e., the market share of bank *b* in county *j* in year *t*. Note that in counties where bank *b* has no branches, *Mktshr* equals zero. $Branches_{b,t}$ equals the total number of branches owned by BHC *b* in year *t* across all counties in the U.S. We multiply $Wells_{j,t}$ by $Mktshr_{b,j,t}$ to gauge the degree to which shale development in county *j* in year *t* influences BHC *b*. We divide by $Branches_{b,t}$ to make any given shale development shock, as captured by $\sum_j Wells_{j,t} * Mktshr_{b,j,t}$, scaled by the overall number of branches that BHC *b* has in the U.S.

Bank Exposure equals zero for (a) all BHCs in years before 2003, which is the year when large-scale shale development started, and (b) those BHCs that have no branches located in shale counties. This measure increases for a BHC as more wells are drilled in the counties in which the BHC has branches. Out of the primary sample of 584 BHCs, 154 were exposed to shale development at some point during the 2003 – 2007 period. As we show below, the degree of BHC exposure to shale development is positively associated with increases in deposits. *Bank Exposure* ranges from 0 to 5.5, with a standard deviation of 0.15. Among banks exposed to shale development, *Bank Exposure* has a sample mean of 0.1, with a standard deviation of 0.38. For the smaller sample of BHCs that excludes the largest BHCs, the sample mean of *Bank Exposure* for exposed banks equals 0.13.

We construct an instrumental variable for our key measure on bank-specific shale exposure to address the concern that banks adjust their branch networks to gain greater exposure to the shale boom. We construct this instrument in a similar way to the construction of *Bank Exposure* except that we use each bank's branch networks in 2002, the year before the onset of large-scale shale development. Specifically, the instrument variable for *Bank Exposure* is constructed as follows:

$$Bank\ Exposure, Preexisting\ Branch_{b,t} = \ln[1 + \textstyle\sum_j \left(Wells_{j,t} * Mktshr_{b,j,2002}\right)/Branches_{b,2002}], \quad (2)$$

where subscripts *b*, *j*, and *t* denote bank, county, and year, respectively. $Wells_{j,t}$, is defined the same as before. $Mktshr_{b,j,2002}$ equals the share of total deposits in county *j* in 2002 held by bank *b*, thereby capturing the market share of bank *b* in county *j* based on bank branch networks in 2002. $Branches_{b,2002}$ is the total number of branches owned by BHC *b* in 2002. Thus, *Bank Exposure, Preexisting Branches* captures the degree to which a BHC's pre-shale boom branch network is exposed to the post-2002 shale drilling boom; and, it does not capture additional changes arising from changes in the BHC's branch networks. We use *Bank Exposure, Preexisting Branches* as the instrument for *Bank Exposure* in our later 2SLS regressions.

III.C. BHC Disclosure Measures

To measure the extent to which a BHC's management voluntarily discloses information to the public, we construct three categories of measures based on (1) the Management Discussion and Analysis (MD&A) Section of annual reports (i.e., 10-K filings), (2) the voluntary items in 8-K filings, and (3) forward-looking earnings guidance provided by BHC managers.

The first category of BHC disclosure measures is based on data from the MD&A section of 10-K filings. Since 1980, the Securities and Exchange Commission (SEC) of the U.S. requires public firms to augment GAAP mandated disclosure with unaudited, narrative disclosures in their annual reports. These MD&A sections disclose information to the public that augments the numerical data provided in financial and other accounting statements. The SEC stipulates that MD&A disclosure should discuss and analyze the firm's operational performance, financial condition, and project trends, to improve the ability of investors to make informed predictions about the firm's prospects, and provide incremental information to other public financial statements (SEC 1980). Although the SEC requires MD&A disclosure, each firm's management has considerable discretion about the format and content of the information actually disclosed.

Following prior research (e.g., Brown and Tucker, 2011), we use textual analysis to construct four measures of information disclosure based on the MD&A section. First, for each BHC in each year, we calculate *MD&A Length*, which equals the natural logarithm of one plus the number of words in the MD&A section of the BHC's 10-K filings. We interpret higher values of *MD&A Length* as conveying more information. Second, using the cosine similarity method, we compute a year-over-year modification index (*MD&A Modification*) that equals the log transformation of one minus the similarity score from comparing MD&A sections between year *t* and year *t*-1 for the same BHC. The similarity score is calculated based on the Vector Space Model (VSM), an algorithm commonly used by Internet search engines to determine similarities between documents.[3] A higher value of *MD&A Modification* indicates a higher degree of modification in a BHC's MD&A section this year compared to that of last year, suggesting that the BHC's report in year *t* contains more new information. Furthermore, we measure *MD&A Exhibits* and *MD&A Numbers* as the natural logarithm of one plus the number of exhibits (numbers) in the MD&A section of each BHC's 10-K filings. We interpret higher values of *MD&A Exhibits* (*MD&A Numbers*) as more informative MD&A disclosures. As shown in Table 1, the average number of words, exhibits, and numbers in an MD&A for our sample of BHCs is 1736, 8, and 209, respectively, and the sample mean value of *MD&A Modification* equals 1.02.

8-K filings (or "current reports") provide the basis for the second category of BHC disclosure measures. In particular, the SEC mandates that publicly listed companies disclose material corporate events in 8-K filings in a timely manner, so that investors obtain a continuous stream of relevant information on corporate performance (Carter and Soo, 1999; Leuz and Wysocki, 2016). For example, the SEC requires that 8-K filings include information on acquisitions or dispositions of assets, entry into bankruptcy or receivership, changes in control of the registrant, changes in registrant's directors and officers, etc. Other types of disclosures—

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[3] The VSM model uses an n-dimensional vector to represent a document, and measures the similarity of any two documents by the angle between the two vectors representing the two documents. Specifically, consider a sample with *n* unique words, the VSM approach represents two documents using an *n*-dimension vector – v_1 for document 1 and v_2 for document 2, where $v_1 = (\tau_1, \tau_2, \dots \tau_{n-1}, \tau_n)$ and $v_1 = (\rho_1, \rho_2, \dots \rho_{n-1}, \rho_n)$,where τ_i and ρ_i are counts of each word $i \in (1, n)$. The similarity score is defined as: $\text{Similarity score} = \cos(\theta) = \frac{v_1}{\|v_1\|} \cdot \frac{v_2}{\|v_2\|}$, where θ denotes the angle between v_1 and v_2, and $\|v_1\|$ and $\|v_2\|$ represent the vector length of v_1 and v_2.

voluntary disclosures—are left to the discretion of management. Following Boone and White (2015), and others, we define "voluntary disclosures" as those 8-K filings under items "Regulation Fair Disclosure (Reg FD)" and "Other Events (Other)," which managers choose to disclose to investors. These voluntary disclosures include, for example, updated risk factors associated with a company's business or capital structure, exposure to actual or threatened litigation, the launch of new products or entry into new markets, and other agreements or appointments (Boone and White, 2015). We obtain the 8-K filings from the SEC's EDGAR database.

From the 8-K filings, we construct three measures of BHC disclosure. Specifically, for each BHC in each year, (a) *Voluntary 8-K Frequency* equals the logarithm of one plus the total number of 8-K filings reported under items Reg FD and Others; (b) *Voluntary 8-K Length* equals the logarithm of one plus the average length (in characters) of these voluntary 8-K filings; and (c) *Voluntary 8-K_CAR(-n, +n)* measures the market reaction to the release of these voluntary 8-K filings, and equals the three- or seven-day absolute value of the cumulative abnormal return (CAR) around the announcement day, where n = 1 or 3.[4] We estimate daily abnormal stock returns using a standard market model with an estimation window of [t-200, t-21], where t denotes the 8-K announcement date. Larger values of these three disclosure measures—*Voluntary 8-K Frequency*, *Voluntary 8-K Length*, and *Voluntary 8-K_CAR(-n, +n)* suggest greater voluntary information disclosure by BHC management. As shown in Table 1, BHCs in our sample release an average of 2.3 voluntary 8-K filings per year, with the average number of characters in each report equal to 353.

Our third category of BHC disclosure measures uses data on corporate earnings guidance, i.e., the official earnings forecast provided by bank managers. We obtain data on corporate

[4] Our results hold when using a five-day announcement return over [-2,+2].

earnings guidance from the Company Issued Guidance (CIG) database, which is contained in the First Call Historical Database (FCHD). We follow the standard procedures to clean the raw data. Specifically, we start with all entries of management forecasts of earnings per share (EPS) during the forecast period (which excludes pre-announcements of earnings). We further restrict our sample to banks that have issued earnings guidance at least once during the 2000 – 2007 sample period based on the CIG database to ensure that banks in our sample are covered by the CIG database. This ameliorates concerns that we may wrongly take uncovered firms as providing no forecasts.

We construct three measures of managerial information disclosure based on earnings guidance that are widely used in the literature (e.g., Healy and Palepu, 2001). First, for each BHC in each year, we calculate *Managerial Earnings Guidance Frequency*, which equals the logarithm of one plus the number of management earnings forecasts issued by the BHC in a given year. This frequency measure gauges the intensity with which managers provide information to outsider investors. Second, *Managerial Earnings Guidance Precision* gauges the precision of managerial earnings forecasts. Specifically, when the earnings forecast provides a precise point estimate, such as "next year's earnings per share is estimated to be $50," this is coded as one (the most precise). When the earnings forecast provides a range, such as "next year's earnings per share is estimated to be between $40 and $60," this is coded as 0.75. When the earnings forecast is more open-ended, such as "next year's earnings per share is estimated to exceed $40," this is coded as 0.5. Finally, when no earnings forecast is provided, this is coded as 0 (the least precise). Third, we follow the literature (Carter and Soo, 1999; Asquith, Mikhail, and Au, 2005; Loh and Stulz, 2011; Green et al., 2014) and measure the information content of management earnings forecast by examining instantaneous market reaction. *Managerial*

Earnings Guidance_CAR(-n, n) equals the absolute value of CARs associated with managerial earnings forecasts *n*-day(s) around the announcement date, where *n* =1 or 3. We estimate daily abnormal stock returns in the same manner as discussed above. Greater values of *Managerial Earnings Guidance_CAR(-n, n)* suggest that earnings guidance delivers more information to outside investors.

III.D. Stock Market Illiquidity

In addition to examining measures of voluntary information disclosure, we also examine three measures of overall bank opacity based on measures of the illiquidity of each BHC's securities. Theoretical and empirical research stresses that the liquidity of a firm's stock falls when informational asymmetries grow (Acharya and Johnson, 2007). For example, Leuz and Verrecchia (2000) argue the greater informational asymmetries boost adverse selection, widening the bid-ask spread. Easley and O'Hara (2004) explain that an increase in a firm's informational asymmetries intensifies the risk to uninformed traders of holding the asset, reducing their willingness to trade the firm's shares. Consequently, an extensive body of research uses measures of the illiquidity of BHC's equity to measure informational opacity (e.g., Flannery, Kwan and Nimalendran, 2004, 2013).

Specifically, we construct three equity market-based proxies for information asymmetry commonly used in the literature: (1) the bid-ask spread (Stoll, 1989), (2) the Amihud (2002) illiquidity measure, and (3) the fraction of zero-return days (Lesmond, Ogden, and Trzcinka, 1999). First, the *Bid-Ask Spread* is computed as follows: (a) use daily data on the closing bid and ask price for a BHCs equity and calculate daily bid-ask spreads as 100×(ask-bid)/[(ask+bid)/2] at the close of each day and (b) compute the median value of the daily observations of bid-ask spreads over the year. Larger values imply a more illiquid stock. The average value of *Bid-Ask Spread* in our sample is 1.48, with a standard deviation of 1.39. Second, we construct the Amihud (2002) measure of illiquidity, *Amihud Illiquidity*, by (a) using daily return, price, and volume data to compute 10,000,000×abs(return)/[abs(price)×volume] for a BHC for each day and (b) calculating the median value over the year. Larger values imply that the stock is more illiquid because a larger value indicates that there is greater price fluctuation per value of stock transaction. The average value of *Amihud Illiquidity* is 2.56, with a standard deviation of 4.29. Third, we compute *Proportion Zero-Return Days* as the fraction of trading days with zero returns for each BHC in each year, multiplied by 100. *Proportion Zero-Return Days* has a mean of 6.71 and a standard deviation 6.02. A larger value of *Proportion Zero-Return Days* implies the stock is more illiquid because it indicates the stock has more zero-return days.

III.E. Insider Activities

We further examine (a) insider trading by BHC officials and (b) credit extensions to bank insiders. We use two measures of insider trading activities by individuals: *Insider Trading Per Person* and *Insider Trading Total Value*. *Insider Trading Total Value* is defined as the natural logarithm of the value (‘000 USD) of stocks purchased or sold in the open market by all insiders (officers and directors) of each BHC in each year. *Insider Trading Per Person* is defined as the natural logarithm of the value (‘000 USD) of stocks purchased or sold in the open market by all insiders (officers and directors) divided by the number of officers and directors of each BHC in each year. As shown in Table 1, the average total insider trading value is around 4.4 million USD and the average insider trading value per person is about 0.5 million USD.[5] To examine the extension of credit to bank insiders, we use Call report data on insider lending. We calculate *Insider Loans* as the amount of credit extended to insiders (executive officers, directors, principal shareholders, and their related interests) relative to the total amount of loans extended by the BHC's subsidiaries aggregated to the BHC level. On average, 1% of loans in our sample are extended to bank insiders.

III.F. Other BHC Traits

In assessing the relationship between a BHC's exposure to shale development and information disclosure, we condition on an assortment of time-varying bank characteristics, including the BHC's size, loan loss provisions, earnings, and capital. Specifically, *Size* equals the natural logarithm of total BHC assets in millions of U.S. dollars. *LLP* equals the one year lagged value of loan loss provisions divided by total BHC loans. *Loss* is a dummy variable that equals one if bank net income is negative during the year and zero otherwise. *Cap* equals the ratio of the book value of equity to total assets. These variables are measured at the end of the prior year.

IV. Methods and Results

IV.A. Validity Tests: Shale Development and Deposit Supply

We begin our analyses by testing whether the degree of BHC exposure to shale development boosts the supply of BHC deposits. As argued by Plosser (2014), and Gilje, Loutskina, and Strahan (2016), (a) an unanticipated technological innovation at the end of 2002

[5] We examine these two measures of insider trading by individual bank officers and directors on common stocks. There can be other forms of insider trading. For example, Acharya and Johnson (2007) examine trading by a bank of credit derivatives of companies with which the bank has relationships.

made gas and oil extraction from shale economically profitable, (b) this "fracking" innovation triggered large financial windfalls to landlords in promising areas as energy companies purchased mineral leases and began drilling, and (c) a proportion of these windfalls were deposited in local branches, so that exposed banks—banks with branches in areas where landlords leased mineral rights to shale developers—experienced a surge in deposits. While these researchers find that BHC's exposed to shale development experienced deposit booms, we reassess this connection within the context of our research design. Specifically, we estimate the following regression:

$$Deposit\ Growth_{b,t} = \beta \cdot Bank\ Exposure_{b,t} + \gamma' \cdot X_{b,t-1} + \theta_b + \theta_t + \varepsilon_{b,t}, \quad (3)$$

where *Deposit Growth* $_{b,t}$ represents the annual growth rate of domestic deposits for BHC b in year t, and *Bank Exposure* $_{b,t}$ is the exposure of BHC b in year t to shale development. We also condition on a vector of time-varying BHC traits, $X_{b,t-1}$: *Size*, *LLP*, *Loss*, and *Cap*. Furthermore, the regression conditions on BHC and year fixed effects to account for time-invariant BHC characteristics and year-specific influences on deposit growth. The coefficient β, therefore, captures the effect of BHC exposure to shale development on banks deposit growth. We estimate equation (3) using OLS with heteroskedasticity-robust standard errors clustered at the BHC level.

As shown in Table 2, *Bank Exposure* enters positively and significantly at the 1% level, indicating that deposits grow faster in BHCs with greater exposure to shale development. This result holds for the full sample of BHCs and for the smaller sample that excludes the largest BHCs, i.e., the 12% of BHCs accounting for 80% of total BHC assets. To illustrate the economic magnitude, consider (a) a BHC with no exposure to shale development and a BHC with exposure that is one sample standard deviation greater than zero (i.e., *Bank Exposure* = 0.38) and (b) coefficient estimate from column 1 (0.054), which is for the full sample of BHCs. The estimate suggests the exposed BHC experiences deposit growth that is 2.1 (=0.38 × 0.054) percentage points faster than the unexposed BHC. This is equivalent to about 17% of the sample mean deposit growth rate, which equals 0.12.

To provide evidence on whether this increase in bank deposits from shale development represents a shock to the supply of deposits, and not a shift in demand, we examine prices. If the increase in bank deposits is driven by a positive supply-side shock, then price of deposits should decline. We measure the price of deposits, *Cost of Deposits*, as the ratio of interest expenses on deposits over interest-bearing deposits. We use the same specification as in equation (3) except the dependent variable is now *Cost of Deposits*. As shown in Table 2, BHCs with greater exposure to shale development offer comparatively lower interest payments on deposits., suggesting that shale development triggers a positive shock to the supply of deposits that lowers the price of deposits. As shown, these results hold for the full sample of BHCs (column 2) and for the sample that excludes the large BHCs (column 4). To illustrate the economic magnitude, we again compare a BHC with no exposure to shale development and a BHC with exposure that is one sample standard deviation greater than zero (i.e., *Bank Exposure* = 0.38). The coefficient estimates in column 2 indicate that the cost of deposits would drop by about 5.3 (=0.38 × 0.0014) basis points for the exposed BHC banks relative to an unexposed BHC. Overall, results in Table 2 confirm that the shale development leads to a large, positive deposit gains to exposed banks. That is, shale development boosts the supply of deposits, relaxing exposed bank’s external funding constraints.

IV.B. Baseline Results: Bank Exposure and Information Disclosure

Having confirmed that the degree of BHC exposure to shale development is positively associated with deposit growth, we turn to the question of whether these BHCs increase or decrease information disclosure. In particular, we estimate the following regression:

$$Bank\ Disclosure_{b,t} = \beta \cdot Bank\ Exposure_{b,t} + \gamma' \cdot X_{b,t-1} + \theta_b + \theta_t + \varepsilon_{b,t}, \quad (4)$$

where *Bank Disclosure* $_{b,t}$ denotes one of the four measures on MD&A disclosure in 10-K filings (i.e., *MD&A Length*, *MD&A Modification*, *MD&A Exhibits*, *MD&A Numbers*) for BHC *b* in year *t*. The key explanatory variable, *Bank Exposure*, denotes the BHC's exposure to shale development. We include the same set of time-varying BHC traits ($X_{b,t-1}$), namely *Size*, *LLP*, *Loss*, and *Cap*, as well as BHC (θ_b) and year (θ_t) fixed effects. Coefficient β captures the impact of unexpected shale development that boosts the supply of deposits on bank disclosure decisions. We report heteroskedasticity-robust standard errors clustered at the BHC level.

The regression results indicate that BHC exposure to shale development reduces information disclosure by managers. As shown in Table 3, *Bank Exposure* enters negatively and significantly in all regressions when the dependent variable is the length of MD&A disclosure in 10-K filings (*MD&A Length)*, the modification score of MD&A disclosure (*MD&A Modification*), counts of exhibits in the MD&A sections (*MD&A Exhibits)*, or counts of numbers in the MD&A disclosure (*MD&A Numbers*). Furthermore, the results hold when using either the full sample of BHCs or the smaller sample that excludes large BHCs. These results suggest that BHCs exposed to shale development through their branches in shale counties—which tends to induce sharp increases in BHC deposits as shown above—reduce their information disclosures in the MD&A section. To the extent that deposit windfalls relax a bank's external funding constraints and therefore lower the benefits of using information disclosure to facilitate access to capital markets, these results indicate that bank managers tend to reduce the release of information following a surge in the supply of deposits.

The estimates indicate a large economic impact of bank exposure to shale development on information disclosure. For example, the point estimate in column 1 of Table 3 suggests that a one-standard deviation increase (0.38) in bank exposure to the deposit supply shock reduces the length of a bank's MD&A section by about 15% (=0.3926 × 0.38). When we consider the MD&A modification results reported in column 2, where the estimated coefficient on *Bank Exposure* is -0.1993, the estimated coefficients suggest that a one-standard deviation increase of bank exposure to deposit shocks reduces the bank's MD&A modification score by about 8% (=0.1993 × 0.38). In addition, the coefficients from columns 3 (4) imply that a one-standard deviation increase in a bank's exposure to shale development reduces the counts of exhibits (numbers) in the bank's MD&A section by 3.8% (11%). The economic magnitude becomes larger when using the smaller-BHC sample.[6]

IV.C. Instrumental Variable Estimation Results

Although we explained in Section II that the unanticipated technological innovations that triggered the shale boom and the rapid response of energy companies in signing mineral leases make it unlikely that banks strategically entered counties in anticipation of an increase in the

[6] We conduct two additional robustness tests. First, we use an alternative measure of a BHC's exposure to shale booms, where a county is weighted by whether it has experienced a shale boom or not. In particular, *Bank Exposure Alternative* for BHC b in year t equals $\ln[1 + \sum_j (Wells_{j,t} * Mktshr_{b,j,t} * 1(Boom_{j,t})) / Branches_{b,t}]$, where $1(Boom_{j,t})$ is an indicator equal to one if the number of shale wells drilled in county j in year t is in the top third of the sample across all county-year observations, and zero otherwise. Note that once a county is categorized as a shale-boom county, it retains that categorization in all subsequent years. Other variables are defined the same as in equation (1). As reported in Appendix Table A2, we continue to find that the exposure to shale development is negatively associated with a BHC's MD&A disclosure in terms of length and modification. Second, we re-estimate equation (4) after removing the 10 largest BHCs from our primary sample. (These ten largest BHCs are Citigroup Inc., Bank of America Corp., JP Morgan Chase Co., Wachovia Corp., Wells Fargo Co., Metlife Inc., US Bancorp., Suntrust Bank Inc., National City Corp., and BB&T Corp.) As shown in Appendix Table A3, the results hold.

supply of deposits due to shale development, concerns might remain. In particular, some unobserved factor might simultaneously induce a drop in information disclosure by bank managers and the expansion of bank branches into shale counties (counties where shale development ultimately occurs). Such an unobserved factor could confound our interpretation of the results presented in Table 3.

We address this concern by estimating an instrumental variable (IV) model in which we use each BHC's exposure to shale discoveries based only on its pre-shale boom branch network, i.e., based on its branch network in 2002 (*Bank Exposure, Preexisting Branches*) as an instrument for *Bank Exposure*. With regard to the validity of the instrument, we first note that the technological innovation that made fracking economically profitable was unanticipated by energy experts, so it is unlikely that banks predicted the shale boom and created new branches before 2002 in order to capture future increases in the supply of deposits due to shale development. Next, the first-stage results from the IV regressions suggest that the instrument is powerful. As reported in column 1 of Table 4, the instrument enters the first stage positively and significantly at the 1% level and the weak instrument test yields an F-statistic well above 30, further rejecting the null hypothesis that our instrument is irrelevant to the instrumented variable.

The second-stage results reported in Table 4 show that the negative relationship between exposure to shale development and information disclosure, as measured by *MD&A Length*, *MD&A Modification*, *MD&A Exhibits*, or *MD&A Numbers*, holds when conducting IV regressions. Consistent with the OLS results reported in Table 3, the coefficient estimates on bank exposure enter negatively and significantly. Moreover, the economic magnitudes of the IV estimates are not smaller than the OLS estimates. The IV results reduce concerns that the negative impact of exposure to the shale boom, and the corresponding surge in the supply of deposits, on bank information disclosure is driven by banks with less disclosure altering their branch networks to gain greater exposure to these deposit gains.

IV.D. Heterogeneous Effects, Differentiating by Competition

We next examine whether the impact of exposure to shale development on information disclosure varies across BHCs in a predictable manner. Existing research shows that voluntary disclosures could provide valuable information to competitors (Verrecchia, 1983; Darrough and Stoughton, 1990). Thus, BHCs facing more intense competitive pressures might be more concerned about the costs of providing information to competitors. This leads to a testable prediction: The negative impact of a BHC's exposure to shale development, and the resultant boom in its deposits, on its disclosure decisions should be more pronounced among BHCs facing more intense competition.

To empirically test this prediction, we construct a bank-specific measure of competition. Following Li, Hundholm, and Minnis (2013), we measure how managers perceive their banks' competition environment using textual analysis of banks' 10-K filings. For each BHC, we count the number of occurrences of the following words in its 10-K filings: "competition," "competitor," "competitive," "compete," "competing," while removing any occurrences where "not," "less," "few," or "limited" precedes the word by three or fewer words, and refer to this total as "competition words." We construct this competition index using each BHC's 10-K filing in 2003, so that subsequent shale development or the resulting boom in the supply of deposits does not influence the competition measure. Specifically, $Competition_{b,2003}$ equals the natural logarithm of competition words per thousand words in the BHC *b*'s 10-K filing in 2003.

To evaluate the heterogeneous effects of bank exposure to shale development on managerial disclosure across BHCs facing different degrees of competition, we estimate the following regression model:

$$Bank\ Disclosure_{b,t} = \beta \cdot Bank\ Exposure_{b,t} + \delta \cdot Bank\ Exposure_{b,t} \cdot Competition_{b,2003} + \gamma' \cdot X_{b,t-1} + \theta_b + \theta_t + \varepsilon_{b,t}, \quad (5)$$

where all of the variables have been defined above. Coefficient δ captures the differential impact of bank exposure on information disclosure by the intensity of competitive pressures facing the bank. If more intensive competition restrains managers from making informative disclosures, then we predict that $\delta < 0$. We estimate the model using OLS, and report heteroskedasticity-robust standard errors clustered at the BHC level.

As shown in Table 5, the negative impact of bank exposure to shale developments that increased the supply of deposits on MD&A disclosures is more pronounced among BHCs facing greater competition. In particular, the interaction between *Bank Exposure* and *Competition* enters negatively and significantly in all specifications. The results hold when using either of four MD&A disclosure measures. Table 5 results are consistent with the notion that greater competition induces managers to withhold information disclosure due to the potential proprietary costs associated with transparency, thereby aggravating the negative impact of deposit windfalls on information disclosure.

IV.E. Bank Exposure and Voluntary Disclosure in 8-K Filings

In this subsection, we examine the second category of information disclosure indicators. In particular, we examine the three measures of information disclosure based on the items within 8-K filings over which managers have considerable discretion (i.e. 8-K filings under items *Reg*

FD or *Other Events*): (i) the frequency of voluntary 8-K filings by each BHC during a year (*Voluntary 8-K Frequency*), (ii) the average length, in terms of the # of characters, of a BHC's voluntary 8-K filings (*Voluntary 8-K Length*), and (iii) the absolute value of the cumulative abnormal returns around the release of voluntary 8-K filings (*Voluntary 8K_CAR(-n,+n)*). The former two measures gauge the quantity of disclosure, while the latter gauges the impact of information disclosed by managers. We estimate a model specification that is similar to equation (4) where the dependent variable now becomes one of the 8-K related measures, and report the results in Tables 6 and 7.

As shown in Table 6, greater exposure to shale development reduces the *quantity* of information that banks voluntarily disclose via 8-K filings. As shown in columns 1 and 2, *Bank Exposure* enters negatively and significantly in both columns, suggesting that both the frequency and length of voluntary 8-K filings drop among BHCs receiving positive deposit gains from shale development. The impact is economically meaningful. The estimates from columns 1 and 2 using the sample of all BHCs indicate that a BHC that receives an exposure shock equal to the sample standard deviation value (i.e., *Bank Exposure* = 0.38) would reduce *Voluntary 8-K Frequency* and *Voluntary 8-K Length* by 7% and 40%, respectively. When using the sample of BHCs that excludes large BHCs, the results are similar as reported in columns 3 and 4.

Table 7 shows that these results also hold when examining *Voluntary 8K_CAR(-n,+n)*, which measures the impact of information disclosed in 8-K filings: Greater exposure to shale developments that boosted the supply of deposits reduces the impact of information that bank managers voluntarily disclose. We examine the CARs of BHCS within ±*n* days (where n=1 or 3) around the announcement of an 8-K filing. As shown in Table 7, *Bank Exposure* enters negatively and statistically significantly across all specifications. The results are consistent with the view that voluntary 8-K filings become less informative for BHCs exposed to shale development shocks. To interpret the economic sizes of the estimated coefficient, consider column 2 where we examine *Voluntary 8K_CAR(-3,3)* for the full sample of banks. The estimates indicate that *Voluntary 8K_CAR(-3,3)* drops by 0.85 percentage points when a BHC receives a one standard deviation increase in exposure, which is 14% of the sample mean value of *Voluntary 8K_CAR(-3,3).*

IV.F. Bank Exposure and Managerial Earnings Forecasts

We next examine the impact of exposure to shale development on information disclosure measured based on forward-looking earning guidance. As noted in the data section, we use three measures based on earnings guidance: *Managerial Earnings Guidance Frequency* measures how often managers provide information to outsider investors about earning projections; *Managerial Earnings Guidance Precision* measures the precision of managerial earning projections; and *Managerial Earnings Guidance_CAR(-n, n)* measures the impact of earnings guidance forecasts on the markets. We then use the same regression specification as in equation (4), except that we use *Managerial Earnings Guidance Frequency*, *Managerial Earnings Guidance Precision*, and *Managerial Earnings Guidance_CAR(-n, n)* as the dependent variables.

Consistent with our previous finding, we find that greater exposure to shale development, and the resultant increase the supply of deposits, reduced (a) the frequency of managerial earnings forecasts, (b) the precision of earnings forecasts, and (c) the impact of earnings forecasts on abnormal stock returns. As shown in Table 8, *Bank Exposure* enters negatively and significantly in all specifications. The results hold for each of the measures and whether using the full sample of BHCs or the sample that excludes large BHCs. The evidence is consistent with the view that unanticipated shale discoveries boosted the supply of bank deposits, which relaxed banks' external funding constraints and reduced information disclosure by bank managers.

IV.G. Bank Exposure and Stock Market Illiquidity

We next examine stock market illiquidity measures of informational asymmetries between bank insiders and outside investors. Leuz and Verrecchia (2000), Easley and O'Hara (2004), Flannery et al., 2004, 2013) emphasize that such informational asymmetries reduce the liquidity of a firm's securities, advertising the value of measures of the illiquidity of a firm's stock as a proxy for its informational gap with outside investors. We therefore use three measures of the illiquidity of each BHC's stock: *Bid-Ask Spread*, *Amihud Illiquidity*, and *Proportion Zero-Return Days*. The details of the variable construction can be found in Section II and Appendix Table A1.

As shown in Table 9, we confirm the paper's core findings with these stock market illiquidity measures of informational asymmetries: BHCs experiencing a shale boom shock experience a sharp increase in stock market illiquidity, which suggests an increase in informational asymmetries. *Bank Exposure* enters positively and significantly across all specifications, suggesting that the illiquidity of BHC's stock increases for BHCs receiving shale development shocks that boost deposits. To interpret the economic magnitude of this impact, we use the estimation results in column 1 of Table 9 as an illustrative example. We find that a one-standard deviation increase (0.38) in bank exposure raises *Bid-Ask Spread* by 0.06, which is about 4% of the sample standard deviation of *Bid-Ask Spread* (1.39).

IV.H. Bank Exposure and Insider Activities

Finally, we explore an additional implication of the view that deposit windfalls reduce disclosure of information by bank managers. Namely, if exposure to the shale boom reduces managerial information disclosure and leads to more severe information asymmetries, this would intensify agency frictions and facilitate the extraction of private benefits by insiders. Thus, we examine the association between *Bank Exposure* and (a) insider trading activities and (b) lending to insiders. We use the value of insider trading to capture the intensity of insider trading activities, and the amount of credit extended to insiders to measure the magnitude of lending to insiders.

We discover that exposure to shale booms materially increases insider trading and insider loans. Table 10 provides the results. The dependent variable is *Insider Trading Per Person* in columns 1 and 4, *Insider Trading Total Value* in columns 2 and 5, and *Insider Loans* in columns 3 and 6. *Bank Exposure* enters positively and significantly in all specifications. Consistent with the earlier findings, these estimates suggest that both insider trading and insider loans increase when BHCs are exposed to shale development that boosts the supply of deposits. The impact is economically meaningful. For example, the estimates from column 2 using the full sample of BHCs indicate that a one-standard deviation increase (0.38) of bank exposure increases the value of per person insider trading by 6% (=0.1486 × 0.38) relative to unexposed banks. Given that an average bank's total insider trading value is $4.4 million, this represents an increase of about $0.3 million in insider trading. The estimates from column 3 indicate that a one-standard deviation increase of bank exposure increases insider loans by 0.1 percentage points, equivalent to 5% of the sample standard deviation of *Insider Loans*. Overall, the results are consistent with the view that exposure to the shale boom reduces managerial information disclosure and leads to more severe information asymmetries, which intensifies agency problems and increases benefits flowing to insiders.

V. Conclusions

In this study, we evaluate the impact of an economic shock that relaxed banks' external funding constraints on the voluntary disclosure of information by bank managers. In particular, we exploit the unanticipated technological innovations at the close of 2002 that made fracking economically profitable. This shock triggered a boom in shale development and a surge in bank deposits in affected counties. We examine whether the resultant relaxation of external funding constraints altered the cost-benefit calculations of bank managers with respect to voluntary information disclosure in theoretically consistent manner. In particular, the deposit windfalls and relaxation of funding constraints may have reduced the benefits of using voluntary information disclosure to attract funds. Given the costs of information disclosure to bank managers—potentially including reduced extraction of private rents, great release of valuable information to competitors, and increased bank instability, the drop in the benefits of information disclosure would incentivize bank managers to release less information. Since there might be countervailing effects from the shale development boom that encourage greater information disclosure, such as a more dynamic, changing local economy, we assess the net impact of exposure to the fracking boom on voluntary information disclosure.

We discover the following. First, banks with greater exposure to shale development experienced (a) faster deposit growth and (b) a fall in the price of deposits. These findings suggest that the increase in bank deposits from the shale boom represents a shock to the supply of deposits, and not a shift in demand. Second, greater exposure to shale development is associated with drop in voluntary information disclosure. This finding is consistent with the view that deposit windfalls relax a bank's external funding constraints and therefore lower the benefits to bank managers of voluntarily releasing information to facilitate fund raising. Third, consistent with the view bank managers weigh specific benefits and costs of voluntarily releasing information to the public, we find that greater exposure to shale booms (a) reduces voluntary information disclosure more among banks in more competitive environments and (b) materially increases insider trading and insider loans. Thus, our findings indicate that economic shocks that relax external funding constraints tend to reduce voluntary information disclosure, facilitating the extraction of private rents by bank managers.

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Table 1. Summary Statistics

This table presents the summary statistics for the key variables used in the paper. Columns 1-3 present summary statistics for all BHCs, and columns 4-6 present summary statistics for BHCs excluding the largest ones.

	(1)	(2)	(3)	(4)	(5)	(6)
	All BHCs			Exclude Large BHCs		
	N	Mean	SD	N	Mean	SD
Bank Exposure	3554	0.01	0.15	3017	0.01	0.16
Bank Exposure, exposed banks	535	0.10	0.38	344	0.13	0.46
MD&A Length	3554	7.46	3.47	3017	7.23	3.56
MD&A Modification	3554	1.02	0.69	3017	1.00	0.71
MD&A Exhibits	3554	2.26	1.18	3017	2.15	1.19
MD&A Numbers	3554	5.35	2.51	3017	5.18	2.58
Voluntary 8-K Frequency	3554	1.21	0.90	3017	1.15	0.88
Voluntary 8-K Length	3554	5.87	3.49	3017	5.73	3.52
Voluntary 8-K_CAR(-1,1)	3554	0.05	0.10	3017	0.05	0.10
Voluntary 8-K_CAR(-3,3)	3554	0.06	0.14	3017	0.06	0.14
Bid-Ask Spread	3221	1.48	1.39	2682	1.69	1.41
Amihud Illiquidity	3222	2.56	4.29	2683	3.06	4.54
Proportion Zero-Return Days	3222	6.71	6.02	2683	7.63	6.1
Insider Trading Per Person	3130	4.72	1.63	2643	4.43	1.48
Insider Trading Total Value	3130	6.32	1.99	2643	5.97	1.84
Insider Loans	3554	0.01	0.02	3017	0.02	0.02
Managerial Earnings Guidance Frequency	1113	0.50	0.68	742	0.42	0.62
Managerial Earnings Guidance Precision	1113	0.45	0.79	742	0.38	0.70
Managerial Earnings Guidance_CAR(-1,1)	1113	0.03	0.07	742	0.03	0.06
Managerial Earnings Guidance_CAR(-3,3)	1113	0.04	0.08	742	0.04	0.07
Size (in log)	3554	7.34	1.58	3017	6.91	1.17
LLP	3554	0	0	3017	0	0
Loss	3554	0.03	0.16	3017	0.03	0.17
Cap	3554	0.09	0.02	3017	0.09	0.02
Deposit Growth	3327	0.12	0.14	2802	0.12	0.14
Cost of Deposits	3327	0.03	0.01	2802	0.03	0.01
Competition	3554	-1.12	3.10	3017	-1.14	3.13

Table 2. Shale Exposure and Bank Deposit Gains

This table presents regression results of banks deposit growth and cost of deposits on bank exposure to shale development. The sample in columns 1 and 2 consists of all U.S. public BHCs from 2000 through 2007, and the sample in columns 3 and 4 excludes the largest BHCs that account for 80% of total banking assets. The dependent variables are *Deposit Growth* (columns 1 and 3) and *Cost of Deposits* (columns 2 and 4). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	All BHCs		Exclude Large BHCs	
Dep Var	Deposit Growth	Cost of Deposits	Deposit Growth	Cost of Deposits
Bank Exposure	0.0541***	-0.0014***	0.0477***	-0.0014***
	(0.0189)	(0.0003)	(0.0167)	(0.0003)
Size	-0.1869***	0.0050***	-0.1836***	0.0055***
	(0.0122)	(0.0006)	(0.0133)	(0.0006)
LLP	-1.9230***	0.0500	-2.1301**	-0.0045
	(0.7397)	(0.0308)	(0.8531)	(0.0261)
Loss	-0.0575***	0.0010**	-0.0456**	0.0012**
	(0.0185)	(0.0005)	(0.0184)	(0.0005)
Cap	0.8054***	-0.0190**	0.7494***	-0.0277***
	(0.2169)	(0.0094)	(0.2325)	(0.0097)
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3327	3327	2802	2802
R-sq	0.3936	0.8613	0.4076	0.8961

Table 3. Bank Exposure and Disclosure via Management Discussion &Analysis

This table presents regression results of banks MD&A disclosure on bank exposure to shale development. In columns 1-4, the sample consists of all U.S. public BHCs from 2000 through 2007. In columns 5-8, the sample excludes the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Length* (columns 1 and 5), *MD&A Modification* (columns 2 and 6), *MD&A Exhibits* (columns 3 and 7), and *MD&A Numbers* (columns 4 and 8). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All BHCs				Exclude Large BHCs			
Dep Var	MD&A Length	MD&A Modification	MD&A Exhibits	MD& Numbers	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure	-0.3926***	-0.1993***	-0.1021**	-0.2952***	-0.4283***	-0.2044***	-0.1112**	-0.3259***
	(0.1408)	(0.0360)	(0.0500)	(0.1029)	(0.1377)	(0.0381)	(0.0479)	(0.1014)
Size	2.4050***	0.3391***	0.7637***	1.7445***	2.7390***	0.4054***	0.8403***	1.9761***
	(0.2974)	(0.0709)	(0.0932)	(0.2112)	(0.3285)	(0.0796)	(0.1033)	(0.2343)
LLP	11.2488	1.6856	0.9987	6.6227	13.5817	0.5867	0.8883	8.2886
	(10.8628)	(3.3967)	(2.8806)	(7.7125)	(12.7384)	(3.7507)	(3.3412)	(9.0459)
Loss	-0.5193	0.1204	-0.0928	-0.3776	-0.3811	0.1595*	-0.0850	-0.2934
	(0.3552)	(0.0833)	(0.1160)	(0.2563)	(0.3632)	(0.0865)	(0.1190)	(0.2628)
Cap	1.8789	0.9172	0.4787	1.0831	2.0732	1.3214	0.5768	1.1866
	(5.1708)	(1.0148)	(1.6225)	(3.7636)	(5.6800)	(1.1255)	(1.7678)	(4.1185)
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	3554	3554	3554	3554	3017	3017	3017	3017
R-sq	0.7571	0.5246	0.7788	0.7580	0.7440	0.5306	0.7632	0.7436

Table 4. Bank Exposure and MD&A Disclosure: IV Estimation

This table presents the 2SLS regression results of banks MD&A disclosure on bank exposure to shale development. Columns 1-5 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 6-10 exclude the largest BHCs that account for 80% of total banking assets. Columns 1 and 6 report the first-stage regression results, where the dependent variable is *Bank Exposure* and the other columns report the second-stage results. The dependent variables in the second-stage results are *MD&A Length* (columns 2 and 7), *MD&A Modification* (columns 3 and 8), *MD&A Exhibits* (columns 4 and 9), and *MD&A Numbers* (columns 5 and 10). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. The instrumental variable, *Bank Exposure, Preexisting Branches*, is constructed in a similar way as *Bank Exposure* except that we use the BHC's branch structure in 2002, which is before the onset of shale development. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	All BHCs					Exclude Large BHCs				
	1st Stage	2nd Stage				1st Stage	2nd Stage			
Dep Var		MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers		MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure, Preexisting Branches	0.7912***					0.8040***				
	(0.0476)					(0.0483)				
Bank Exposure		-0.5333**	-0.1956***	-0.1370*	-0.3329**		-0.5200**	-0.1618**	-0.1834***	-0.3385**
		(0.2241)	(0.0744)	(0.0750)	(0.1515)		(0.2024)	(0.0646)	(0.0557)	(0.1446)
Weak Instrument Test *F*-statistic	145.45	-	-	-	-	145.45	-	-	-	-
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	3554	3554	3554	3554	3554	3017	3017	3017	3017	3017
R-sq	0.5377	0.0631	0.0196	0.0590	0.0633	0.5337	0.0721	0.0272	0.0661	0.0715

Table 5. Bank Exposure, MD&A Disclosure and Market Competition

This table presents regression results of banks MD&A disclosure on bank exposure to shale development and its interaction with market competition. Columns 1-4 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 5-8 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Length* (columns 1 and 5), *MD&A Modification* (columns 2 and 6), *MD&A Exhibits* (columns 3 and 7), and *MD&A Numbers* (columns 4 and 8).. The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. *Competition* is a bank-specific measure of competition. Following Li, Hundholm, and Minnis (2013), we measure how managers perceive their banks' competition environment using textual analysis of banks' 10-K filings. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All BHCs				Exclude Large BHCs			
Dep Var	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure × Competition	-1.2850***	-0.1372***	-0.3185**	-0.9961***	-1.2316***	-0.1179**	-0.3283***	-0.9484***
	(0.2272)	(0.0472)	(0.1288)	(0.1535)	(0.2340)	(0.0486)	(0.1088)	(0.1596)
Bank Exposure	0.2790	-0.1276***	0.0644	0.2254	0.2197	-0.1423***	0.0616	0.1731
	(0.2362)	(0.0433)	(0.1009)	(0.1667)	(0.2315)	(0.0454)	(0.0930)	(0.1645)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	3554	3554	3554	3554	3017	3017	3017	3017
R-sq	0.7578	0.5248	0.7792	0.7589	0.7448	0.5307	0.7637	0.7444

Table 6. Bank Exposure and Voluntary 8-K Filings

This table presents regression results of banks voluntary disclosure via 8-K filings on bank exposure to shale development. Columns 1 and 2 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 3 and 4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *Voluntary 8K Frequency* and *Voluntary 8K Length* in columns 1 and 3, and 2 and 4, respectively. The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	All BHCs		Exclude Large BHCs	
Dep Var	Voluntary 8K Frequency	Voluntary 8K Length	Voluntary 8K Frequency	Voluntary 8K Length
Bank Exposure	-0.1970**	-1.0901**	-0.1635*	-1.0607**
	(0.0984)	(0.4932)	(0.0911)	(0.4941)
BHC controls	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3554	3554	3017	3017
R-sq	0.6834	0.5081	0.6724	0.5037

Table 7. Bank Exposure and Market Reaction to Voluntary 8-K Filings

This table presents regression results of market reaction towards banks voluntary disclosure in 8-Ks on bank exposure to shale development. Columns 1 and 2 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 3 and 4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *Voluntary 8K_CAR(-1,1)* (columns 1 and 3) and *Voluntary 8K_CAR(-3,3)* (columns 2 and 4). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	All BHCs		Exclude Large BHCs	
Dep Var	Voluntary 8K _CAR(-1,1)	Voluntary 8K _CAR(-3,3)	Voluntary 8K _CAR(-1,1)	Voluntary 8K _CAR(-3,3)
Bank Exposure	-0.0129*	-0.0223***	-0.0114*	-0.0199***
	(0.0068)	(0.0071)	(0.0069)	(0.0069)
BHC controls	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3554	3554	3017	3017
R-sq	0.5633	0.5930	0.5618	0.5982

Table 8. Bank Exposure and Managerial Earnings Guidance

This table presents regression results of bank managerial earnings guidance on bank exposure to shale development. Columns 1-4 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 5-8 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *Frequency* (columns 1 and 5), *Precision* (columns 2 and 6), *CAR(-1,1)* (columns 3 and 7) and *CAR(-3,3)* (columns 4 and 8) associated with managerial earnings guidance. The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All BHCs				Exclude Large BHCs			
	Managerial Earnings Guidance				Managerial Earnings Guidance			
	Frequency	Precision	CAR(-1,1)	CAR(-3,3)	Frequency	Precision	CAR(-1,1)	CAR(-3,3)
Bank Exposure	-0.0789***	-0.1403***	-0.0175***	-0.0178***	-0.0936***	-0.1457***	-0.0176***	-0.0187***
	(0.0250)	(0.0235)	(0.0018)	(0.0022)	(0.0231)	(0.0194)	(0.0019)	(0.0021)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	1113	1113	1113	1113	742	742	742	742
R-sq	0.4989	0.3593	0.4753	0.4653	0.4878	0.4131	0.5012	0.4875

Table 9. Bank Exposure and Stock Market Liquidity

This table presents regression results of banks stock market illiquidity on bank exposure to shale development. Columns 1 and 2 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 3 and 4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *Bid-Ask Spread* (columns 1 and 4), *Amihud Illiquidity* (columns 2 and 5), and *Proportion Zero-Return Days* (columns 3 and 6). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	All BHCs			Exclude Large BHCs		
Dep Var	Bid-Ask Spread	Amihud Illiquidity	Proportion Zero-Return Days	Bid-Ask Spread	Amihud Illiquidity	Proportion Zero-Return Days
Bank Exposure	0.1493***	0.6540***	0.6120***	0.1548***	0.6926***	0.6782***
	(0.0461)	(0.1952)	(0.2264)	(0.0330)	(0.1705)	(0.2157)
BHC controls	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
N	3221	3222	3222	2682	2683	2683
R-sq	0.8075	0.7018	0.7546	0.8102	0.6989	0.7541

Table 10. Bank Exposure and Insider Activities

This table presents regression results of banks insider trading on bank exposure to shale development. Columns 1 and 2 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 3 and 4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *Insider Trading Per Person* (columns 1 and 4), *Insider Trading Total Value* (columns 2 and 5), and *Insider Loans* (columns 3 and 6). The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	All BHCs			Exclude Large BHCs		
	Insider Trading Per Person	Insider Trading Total Value	Insider Loans	Insider Trading Per Person	Insider Trading Total Value	Insider Loans
Bank Exposure	0.1433**	0.1486**	0.0025**	0.1115**	0.1036*	0.0024**
	(0.0567)	(0.0622)	(0.0012)	(0.0541)	(0.0613)	(0.0012)
BHC controls	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
N	3130	3130	3554	2643	2643	3017
R-sq	0.6646	0.6589	0.8026	0.5982	0.6040	0.8003

Appendix Table A1. Variable Definition

Variable Name	Definition
Bank Exposure	For each bank *b* in year *t*, we compute the following: $Bank\ Exposure_{b,t} = \ln[1 + \sum_j (Wells_{j,t} * Mktshr_{b,j,t}) / Branches_{b,t}]$, where subscripts *b*, *j*, and *t* denote bank, county, and year, respectively. $Wells_{j,t}$ equals the cumulative number of shale wells drilled in county *j* from 2003 through year *t*. $Mktshr_{b,j,t}$ equals the share of total deposits in county *j* in year *t* held by bank *b*, i.e., the market share of bank *b* in county *j* in year *t*. Note that in counties where bank *b* has no branches, *Mktshr* equals zero, implying that bank *b* has zero exposure to wells drilled in those counties. $Branches_{b,t}$ equals the total number of branches owned by BHC *b* in year *t* across the U.S. We multiply $Wells_{j,t}$ by $Mktshr_{b,j,t}$ to gauge the degree to which shale development in county *j* in year *t* influences BHC *b*. We divide by $Branches_{b,t}$ to scale any given shale development shock, as captured by $\sum_j Wells_{j,t} * Mktshr_{b,j,t}$, by the overall number of branches that BHC *b* has in the U.S. Source: IHS Markit Energy, FDIC's Summary of Deposits.
Bank Exposure, Preexisting Branches	We construct this measure in a similar way to *Bank Exposure*, except that we use $Mktshr_{b,j,2002}$ and $Branch_{b,2002}$ rather than $Mktshr_{b,j,t}$ and $Branch_{b,t}$. Thus, we use bank *b*'s branch structure in 2002, which is before the onset of the shale development. Source: IHS Markit Energy, FDIC's Summary of Deposits
MD&A Length	The length of the Management's Discussion and Analysis (MD&A) sections in 10-K filings, which equals Ln (1+ # of words in the MD&A section of 10-K filings in year *t*). Source: SEC EDGAR
MD&A Modification	The modification aspect of MD&A disclosure, which equals Ln (1+ MD&A modification score). MD&A modification score equals one minus the similarity score from comparing MD&A section for year *t* with year *t*-1, multiplied by 100. The similarity score is calculated using the Vector Space Model (VSM) with term frequency (TF) weighting after common words are removed. Common words are identified as words used in at least 95% of the sample documents. *MD&A Modification* measures the degree to which MD&A disclosure changed from year *t-1* to year *t*. Source: SEC EDGAR
MD&A Exhibits	Counts of exhibits in MD&A sections of 10-K filings, which equals Ln (1+ # of exhibits). Source: SEC EDGAR
MD&A Numbers	Counts of numbers in MD&A sections of 10-K filings, which equals Ln (1+ # of numbers). Source: SEC EDGAR
Voluntary 8K Frequency	The logarithm of one plus the total number of 8-K filings reported under items Reg FD and Others. Source: SEC EDGAR
Voluntary 8K Length	The logarithm of one plus the average length (in characters) of the 8-K filings reported under items Reg FD

	and Others. Source: SEC EDGAR
Voluntary 8K_CAR(-n, n)	Measures the market reaction to the release of voluntary 8-K filings, and equals the +-*n* day absolute value of the cumulative abnormal return around the announcement day, where n=1 or 3. We estimate daily abnormal stock returns using a standard market model with an estimation window of [*t*-200, *t*-21], where *t* denotes 8-K announcement date. Source: SEC EDGAR, CRSP
Bid-Ask Spread	For each bank in a year, we compute the bid-ask spread using the daily data on the closing bid and ask price We first calculate the daily spread using 100×(ask-bid)/[(ask+bid)/2], and then compute the median value of these daily spreads over the year. Source: CRSP
Amihud Illiquidity	For each bank in a year, we begin by computing Amihud's (2002) illiquidity in each trading day. Specifically, we use daily return, price, and volume to compute the ratio of absolute stock return to dollar volume, where Amihud Illiquidity= 10,000,000×abs(return)/[abs(price)×volume]. We then compute the median value of this daily illiquidity index over the year. Source: CRSP
Proportion Zero-Return Days	The proportion of trading days with zero returns for each BHC in each year, multiplied by 100 (Lesmond, Ogden, and Trzcinka, 1999). Source: CRSP
Insider Trading Per Person	The natural logarithm of the value ('000 USD) of stocks purchased or sold by BHC's insiders divided by the number insiders in each year. We obtain trade information by officers, directors, and beneficial owners of more than 10% of a firm's equity securities filed via SEC Form 4. Source: Thomson Reuters Insider Filings
Insider Trading Total Value	The natural logarithm of total value ('000 USD) of stocks purchased or sold by insiders in each year. We obtain trade information by officers, directors, and beneficial owners of more than 10% of a firm's equity securities filed via SEC Form 4. Source: Thomson Reuters Insider Filings
Insider Loans	The amount of credit extended to insiders (executive officers, directors, principal shareholders, and their related parties) as a share of total loans. Specifically, we sum the insider loans at all of a BHC's subsidiaries and divide by total loans of the BHC. Source: Call Report
Managerial Earnings Guidance Frequency	Ln (1+ # of management earnings forecasts issued during a given year). Source: Company Issued Guidance from the First Call Historical Database
Managerial Earnings Guidance Precision	The average precision score of management earnings forecasts issued by a bank in a year. The precision score equals 1 for a point estimate (the most precise), 0.75 for a range estimate, 0.5 for an open-ended estimate, 0.25 for a qualitative estimate, and 0 for no forecast (the least precise). Source: Company Issued Guidance from the First Call Historical Database
Managerial Earnings Guidance_CAR(-n, n)	The +-*n* day absolute cumulative abnormal return around the announcement of a corporate earnings guidance disclosure, where n=1 or 3. We estimate daily stock abnormal returns using a standard market model with an estimation window of [t-200, t-21], where *t* denotes the date of issuing guidance. Source: Company Issued

	Guidance from the First Call Historical Database, CRSP
Size	The natural logarithm of total assets in million $. Source: FRY-9C
LLP	Loan loss provision scaled by beginning-of-period total loans. Source: FRY-9C
Loss	A dummy variable that equals one if net income is negative, and zero. Source: FRY-9C
Cap	Book value of equity over total assets. Source: FRY-9C
Deposit Growth	The growth rate of total deposits. Source: FRY-9C
Cost of Deposits	Interest expense on domestic deposits divided by interest-bearing domestic deposits. Source: FRY-9C
Competition	The natural logarithm of competition words per thousand words in a BHC's 10-K filing in 2003. To compute the total competition words, we count the number of occurrences of the following words in a 10-K filing: "competition," "competitor," "competitive," "compete," "competing," while removing any occurrences where "not," "less," "few," or "limited" precedes the word by three or fewer words. Source: SEC EDGAR

Appendix Table A2. Bank Exposure and MD&A Disclosure: Alternative Bank Exposure Measure

This table presents robustness results of banks MD&A disclosure on bank exposure to shale development using an alternative bank exposure measure. Columns 1-4 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 5-8 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Length* (columns 1 and 5), *MD&A Modification* (columns 2 and 6), *MD&A Exhibits* (columns 3 and 7), and *MD&A Numbers* (columns 4 and 8). The key explanatory variable, *Bank Exposure Alternative*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities, while taking into account whether a county experienced a shale boom. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All BHCs				Exclude Large BHCs			
	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure Alternative	-0.3850***	-0.1973***	-0.1146**	-0.2918***	-0.3850***	-0.1973***	-0.1227**	-0.3192***
	(0.1313)	(0.0359)	(0.0519)	(0.0965)	(0.1313)	(0.0359)	(0.0492)	(0.0948)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
N	3554	3554	3554	3554	3554	3554	3017	3017
R-sq	0.7571	0.5245	0.7788	0.7580	0.7571	0.5245	0.7633	0.7436

Appendix Table A3. Bank Exposure and MD&A Disclosure: Alternative Sample

This table presents robustness results of banks MD&A disclosure on bank exposure to shale development using an alternative BHC sample that excludes the top ten largest BHCs from the full sample. The dependent variables are *MD&A Length*, *MD&A Modification*, *MD&A Exhibits*, and *MD&A Numbers*, in columns 1, 2, 3, and 4, respectively. The key explanatory variable, *Bank Exposure*, is the BHC-specific measure of the extent to which a BHC is exposed to shale drilling activities. BHC controls include *Size*, *LLP*, *Loss*, and *Cap*. Appendix Table A1 provides detailed variable definitions. Heteroskedasticity robust standard errors clustered at the BHC level are reported in parentheses. *, **, and *** indicate significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
Dep Var	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure	-0.3918***	-0.1987***	-0.0978**	-0.2949***
	(0.1396)	(0.0360)	(0.0481)	(0.1022)
BHC controls	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3484	3484	3484	3484
R-sq	0.7529	0.5227	0.7746	0.7537