Deposit Supply and Bank Transparency

Liangliang Jiang, Ross Levine, Chen Lin, and Wensi Xie†

January 2019

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, suggesting that deposit windfalls relax the incentives for managers to disclose information to attract funds.

Keywords: Bank Transparency; Information Production; Deposit Supply.

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

† Corresponding author, Levine: Haas School of Business, University of California, Berkeley. Email: rosslevine@berkeley.edu. Jiang: School of Accounting and Finance, the Hong Kong Polytechnic University. Email: liangliang.jiang@polyu.edu.hk. Lin: Faculty of Business and Economics, the University of Hong Kong. Email: chenlin1@hku.hk. Xie: CUHK Business School, the Chinese University of Hong Kong. Email: wensixie@cuhk.edu.hk. We are grateful to Scott Baker, Alon Brav, Andrew Ellul, Diego Garcia, Yaniv Konchitchki, Scott Liao, Andres Liberman, Shivaram Rajgopal, Mikhail Simutin, Kelly Shue, and Sheridan Titman for their helpful comments and suggestions.

I. Introduction

In this paper, we evaluate the impact of external financing constraints on a bank's voluntary disclosure of information. Three lines of research motivate this inquiry. First, an extensive body of research shows that banks shape the growth and stability of firms, industries, and the aggregate economy (e.g., the reviews by Levine 1997, 2005, and Popov 2018), underscoring the value of identifying the determinants of bank performance. Second, research suggests that bank opacity influences bank performance. That is, informational asymmetries between bank insiders and outside investors help account for the governance, efficiency, stability, and valuation of banks (e.g., Caprio, Laeven, and Levine 2007, Laeven and Levine 2009, Fahlenbrach and Stulz 2011, Bushman and Williams 2015, Huizinga and Laeven 2012, and Beatty and Liao 2014). Thus, it is vital to identify the factors shaping banks' information disclosure. Third, despite financial disclosure regulations, banks remain opaque (e.g., Morgan 2002, Flannery, Kwan, Nimalendran 2004, 2013, and Huizinga and Laeven 2012), which emphasizes the importance of understanding the determinants of voluntary information disclosure—the disclosure of information beyond regulatory mandates. Notwithstanding these motivations, we are unaware of previous studies of how external financing constraints shape bank information disclosure. This gap is surprising since the foundational theoretical research triggered by Myers and Majluf (1984) highlights connections between informational asymmetries and capital market access.

Theory highlights the benefits and costs to bank managers from voluntarily disclosing information to the public. Reducing informational asymmetries can ameliorate agency problems, improve the governance and performance of banks, and lower the costs of raising external funds (e.g., Jensen and Meckling 1976, and Myers and Majluf 1984). In terms of the costs to managers, Verrecchia (1983) and Darrough and Stoughton (1990) note that disclosure might release information that aids competitors, Diamond and Dybvig (1983), Morris and Shin (2002), and Dang et al. (2017) emphasize that transparency can make banks more vulnerable to depositor withdrawals, and Leuz and Wysocki (2016) note that transparency can limit the ability of managers to extract private rents. Thus, bank managers must weigh the expected benefits from voluntarily disclosing information—such as facilitating access to capital markets—against the potential costs—such as providing competitors with valuable information, increasing fragility, and making it more difficult for them to extract private rents.

In examining how changes in external financing constraints influence information disclosure, we focus on shocks to the supply of bank deposits, which account for over 75 percent of U.S. commercial bank liabilities (Hanson et al. 2015). To the extent that deposit windfalls relax a bank's external financing constraints, this will tend to reduce the expected benefits to bank managers from voluntarily disclosing information to facilitate access to capital markets. Put differently, by reducing the marginal benefits of accessing capital markets, deposit windfalls that ease external financing constraints encourage managers to reduce the costs of information disclosure, such as providing valuable information to competitors, increasing bank fragility, and restricting private rent extraction, by disclosing less information.[1] Thus, we evaluate whether a shock to the supply of bank deposits materially influences voluntarily information disclosure.

To estimate the impact of an economic shock that boosts bank deposits on information disclosure, 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 guidance issued by bank managers. Although the SEC mandates that the MD&A discusses particular themes, managers have flexibility over the breadth 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

[1] More than half of bank deposits in large banks are uninsured and deposit flows respond to information about bank conditions (e.g., Calomiris and Kahn 1991, Diamond and Rajan 2001, Peria and Schmukler 2001, and Hanson et al. 2015).

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 cash windfalls into local bank branches, inducing an unexpected surge in deposits. Following Plosser (2014) and Gilje, Loutskina, and Strahan (2016), we measure each bank holding company’s (BHC) exposure to deposit windfalls generated by shale drilling activities by combining information on the geographic location of the BHC’s branches and the number of wells drilled in each shale boom county.

We take shale development as an exogenous economic shock that boosted bank deposits for the following three reasons. First, as emphasized by Plosser (2014), and Gilje, Loutskina, and Strahan (2016), (a) technological advancements in fracking were unanticipated, so that neither financial markets nor energy experts had foreseen the breakthroughs that lowered the costs of extracting oil and gas from shale and (b) energy companies moved very quickly to purchase shale mineral leases in promising areas following the technological breakthroughs, so that banks did not alter their branch networks before these leases were signed and initial payments were distributed. Second, we show that there are no differential “pre-trends” in (a) changes in deposits, (b) changes in the number of branches, or (c) information disclosure in banks that are ultimately exposed to shale booms. Third, besides confirming earlier findings that exposure to shale development materially boosts bank deposits, we also find that a BHC’s exposure to shale development is negatively associated with the price of deposits (i.e., interest payments on deposits). These findings suggest that the increase in bank deposits from shale development is dominated by a shock to the supply of deposits, and not a shift in demand.

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 reduced (a) the MD&A disclosure indicators, (b) the 8-K filing measures, and (c) the 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. 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 large economic impacts of exposure to shale development and bank deposits on information disclosure as we discuss below. For example, to assess the economic impact of deposits on bank disclosure, we instrument bank deposits with bank exposure to shale development. The estimated coefficients indicate that in response to a positive 10 percentage point shock to bank deposits, (a) the length of MD&A text-based disclosures would drop by about 10% of the sample mean, (b) the frequency of voluntary 8-K filings would drop by about 50% of the sample mean, and (c) the frequency of issuing managerial earnings guidance forecasts would decrease by 47% of the sample mean.

Besides examining the voluntary component of information disclosure contained in 10-Ks, 8-Ks, and projected earnings, we also confirm the findings using market-based 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) and Bushman, Hendricks, and Williams (2016), we construct a bank-specific measure of competition using textual analyses of banks' 10-K filings. Compared with other competition measures based on industry/market-power concentration, this text-based measure (a) captures managers' perceptions of the competitive pressures facing their banks arising from any sources such as potential entrants or nonbank competitors, and (b) requires no assumptions on market and industry boundaries.

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 and evaluate another predictions suggested by our simple cost-benefit framework. If deposit windfalls resulting from shale development reduce information disclosure by diminishing the value of maintaining access to capital markets, then the shale shocks should have a more pronounced effect among banks with greater pre-shale shock reliance on capital market financing. Our findings are in line with this prediction: we find that the disclosure-reducing effects of shale exposure are stronger among banks that relied more heavily on capital markets for external financing during the pre-shale boom period. This is consistent with the view that the shale boom shock reduces bank information disclosure by easing banks' external financing constraints and reducing the benefits of using information disclosure to attract funds.

It is worth emphasizing that our focus is distinct from a large, related body of research on how disclosure shapes access to external finance among nonfinancial firms (e.g., Diamond and Verrecchia, 1991; Frankel, McNichols, and Wilson, 1995; Lang and Lundholm, 2000; Healy and Palepu, 2001 Kothari, Li, and Short, 2009; Barth, Konchitchki, and Landsman 2013). In contrast, we provide the first evaluation of the impact of shocks to one source of external funds—deposits—on voluntary information disclosure by bank managers. As stressed above, dissecting the determinants of voluntary information disclosure is important because informational asymmetries between bank insiders and outside investors shape the governance, efficiency, and stability of banks, which in turn influence firms, industries, and national living standards (e.g., Levine 1997, 2005, Beck, Levine, and Levkov 2010, and Popov 2018).

Our work also contributes to research on the determinants of 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), and Beatty and Liao (2014) review research on financial accounting within the banking industry. We examine whether economic shocks that relax a bank's external financing constraints alter the cost-benefit calculations of bank managers concerning voluntary information disclosure. As noted above, we focus on banks because of their pivotal role in the economy and focus on the relaxation of external financing constraints since theory suggests that access to capital markets shapes information disclosure. In this way, our paper also contributes to recent research on the linkages between macroeconomics and financial accounting (e.g., Konchitchki and Patatoukas, 2014).

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 IV discusses our empirical strategy and reports our results. Section V 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 unlikely that banks opened branches before these leases were signed and initial payments were distributed. 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 years 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. As discussed below, the results are robust to using alternative definitions of the "small" sample.

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 shale boom county. More specifically,

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

where subscripts *b*, *j*, and *t* denote bank, county, and year, respectively. $\Delta Wells_{j,t}$ equals the total number of shale wells drilled in county *j* in year *t*, so that it measures the intensity of shale development in the county during 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. $1(Boom_{j,t})$ is an indicator variable that equals one if county *j* is categorized as a shale-boom county in year *t*, and zero otherwise. County *j* is treated as experiencing shale booms if the number of shale wells drilled in that county in year *t* is above the top quartile of the sample across all county-year observations. $Branches_{b,t}$ equals the total number of branches owned by BHC *b* in year *t* across all counties in the U.S. We multiply $\Delta Wells_{j,t}$ by $Mktshr_{b,j,t}$ to gauge the degree to which shale development in county *j* in year *t* influences BHC *b*. We further multiply by $1(Boom_{j,t})$ to account for shale development in shale-boom counties. We then scale the shale development shock to BHC *b* across shale-boom counties ($\sum_j Wells_{j,t} * Mktshr_{b,j,t} * 1(Boom_{j,t})$) by the number of branches that BHC *b* has in the U.S. ($Branches_{b,t}$).

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-boom 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, more than 10% 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 4.7, with a standard deviation of 0.12. Among banks exposed to shale development, *Bank Exposure* has a sample mean of 0.14, with a standard deviation of 0.54. For the smaller sample of BHCs that excludes the largest BHCs, the sample mean of *Bank Exposure* for exposed banks equals 0.23.

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., Li, 2008; Brown and Tucker, 2011), we use textual analysis to construct two primary measures of information disclosure based on the MD&A section of 10-K filings. 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.[2] 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. In robustness tests, we use two additional measures, *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, 9, and 210, 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—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

[2] 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: 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.

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.[3] 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 earnings guidance from the Company Issued Guidance (CIG) database, which is contained in the First Call Historical Database (FCHD). We start with all entries of management forecasts of earnings per share (EPS) during the forecast period and exclude 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

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

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 outside 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; Kothari, Shu, and Wysocki, 2009; 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 overall bank opacity based on three 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. 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. 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

We begin our analyses by addressing several concerns with using shale development as an exogenous source of variation in the supply of bank deposits. As argued by Plosser (2014), and Gilje, Loutskina, and Strahan (2016), (a) an unanticipated technological innovation at the end of 2002 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:

$$Deposit\ Growth_{b,t} = \beta \cdot Bank\ Exposure_{b,t} + \gamma' \cdot X_{b,t-1} + \theta_b + \theta_t + \varepsilon_{b,t}, \quad (2)$$

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 (2) 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 booms and a BHC with exposure that is one sample standard deviation greater than zero (i.e., *Bank Exposure* = 0.54) and (b) coefficient estimate from column 1 (5.61), which is for the full sample of BHCs. The estimate suggests the exposed BHC experiences deposit growth that is 3 (=0.54 × 5.61) percentage points faster than the unexposed BHC. This is equivalent to about 26% of the sample mean deposit growth rate, which equals 11.7 percentage points.

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 (2) 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* = 0.54). The coefficient estimates in column 2 indicate that the cost of deposits would drop by about 8 (=0.54 × 0.15) 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.

Next, we address the concern that shale was discovered in counties that for other reasons were experiencing banking system changes and it is these other reasons that explain subsequent changes in information disclosure. To evaluate this concern, we test whether there were differential "pre-trends" in (a) bank deposits, (b) bank branches, and (c) information disclosure in banks prior to shale developments that affected those banks. Specifically, we run the following regressions:

$$Y_{b,pre} = \lambda_1 Bank\ Exposure_b + \lambda_2 X_b + e_b, \quad (3)$$

where $Y_{b,pre}$ either equals (a) deposit growth at BHC b averaged over the pre-shale discovery period from 2000-2002, (b) the growth rate of branches at BHC b averaged over the pre-shale discovery period from 2000-2002, and (c) information disclosure by BHC b during the pre-shale period over 2000-2002 as measured by both *MD&A Length* and *MD&A Modification*. $Bank\ Exposure_b$ is the average exposure of BHC b to shale discoveries in the post-2002 period, and X_b includes the same vector of BHC specific control variables used above (*Size*, *LLP*, *Loss*, and *Cap*), measured over the 2000 to 2002 period.

As shown in Table 3, we find no evidence of "pre-trends" in bank deposits, bank branches, or information disclosure before shale discoveries. That is, a BHC's future exposure to shale discoveries is unrelated to changes in bank deposits, the number of bank branches, or information disclosure before shale discovery: *Bank Exposure, 2003-2007* enters insignificantly when examining either the growth rate of deposits, the growth rate of branches, or the degree of information disclosure in the period before the fracking boom. Taken together, these preliminary analyses are consistent with the view that shale development represents an exogenous boost to the supply of bank deposits.

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

In this subsection, we evaluate the impact of bank exposure to shale development on information disclosure. In particular, we estimate the following regression:

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

where $Bank\ Disclosure_{b,t}$ denotes one of the measures on MD&A disclosure in 10-K filings (i.e., *MD&A Length*, or *MD&A Modification*) 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 4, *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)*, or the modification score of MD&A disclosure (*MD&A Modification*). 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-boom 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 4 suggests that a one-standard-deviation increase in bank exposure to the deposit supply shock reduces the length of a bank's MD&A section by about 3% of the sample mean value of *MD&A Length*. When we consider the MD&A modification results reported in column 2, where the estimated coefficient on *Bank Exposure* is -0.2272, 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 12% of the sample mean of *MD&A Modification*. The economic magnitude becomes larger when using the smaller-BHC sample as shown in columns 3 and 4.

We conducted three additional robustness tests. First, we examined two alternative measures of information disclosure based on information in the MD&A section: (1) counts of exhibits in the MD&A sections (*MD&A Exhibits)* and (2) counts of numbers in the MD&A disclosure (*MD&A Numbers*). As reported in Appendix Table A2, we find that the exposure to shale development significantly reduces both of these alternative information disclosure measures. Second, we used an alternative measure of a BHC's exposure to shale booms, where the number of shale wells is weighted by (a) the one-year-lagged market share of BHC b in county j in year t, and (b) whether a county is experiencing a shale boom or not. In particular, *Bank Exposure Alternative* for BHC b in year t equals $\ln[1 + \sum_j(\Delta Wells_{j,t} * Mktshr_{b,j,t-1} * 1(Boom_{j,t}))/Branches_{b,t}]$, where $Mktshr_{b,j,t-1}$ equals the share of total deposits held by bank b in county j in year t-1. Other variables are defined the same as in equation (1). As reported in Appendix Table A3, we continue to find that the exposure to shale development is negatively associated with a BHC's MD&A disclosure in terms of length, modification, the number of exhibits, and counts of numbers. Third, we re-estimated 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 A4, the results hold.

IV.C. 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) and Bushman, Hendricks, and Williams (2016), we measure how managers perceive their banks' competition environment using textual analysis of banks' 10-K filings. Compared with market concentration measures, this text-based measure captures managers' perceptions of the competitive pressures from any sources, such as potential entrants or nonbank competitors. 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:

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

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 development 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 two 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.D. Heterogeneous Effects, Differentiating by Access to Capital Markets

We next examine whether the impact of exposure to shale development on information disclosure is stronger among BHCs that relies more heavily on capital markets prior to the shale shock. The main theoretical mechanisms suggest that banks receiving a shale shock that brings a surge in deposits substitute out of capital market financing and into deposit financing, reducing their incentives to disclose information. Put differently, the main theoretical mechanisms rely on (a) information disclosure imposing costs on bankers (such as providing competitors with valuable information, making the extraction of private rents more difficult, and increasing fragility), (b) the bankers being compelled to disclose information to maintain access to capital markets for fund raising and (c) the deposit shocks allowing them to substitute out of capital market financing. The ability to substitute out of capital market financing requires that they were relying on capital markets before the shale shock.

To test this implication, we measure the extent to which they depend on capital market financing using the total number of equity and bond issuance of each BHC over the five-year window prior to the shale shock. Thus, a higher value of *Access to Capital Markets* means greater dependence on capital markets financing. To evaluate the heterogeneous effects of bank exposure to the shale shock on information disclosure across BHCs with different degrees of capital market financing, we employ a regression model similar to equation 5, while replacing the bank-specific competition index, $Competition_{b,2003}$, with the proxy for ex-ante capital market financing, $Access\ to\ Capital\ Markets_{b,2003}$. If the shale-induced deposit shock indeed reduces information disclosure by easing banks' financing needs in capital markets, then we expect that $\delta < 0$.

As shown in Table 6, the negative impact of bank exposure to shale developments on MD&A disclosures is stronger among BHCs depending more on capital market financing. The interaction between *Bank Exposure* and *Access to Capital Markets* enters negatively and significantly in all specifications. Table 6 results are consistent with the view that the shale shocks allow banks to substitute out of capital market financing and diminish the benefits of information disclosure to maintain access to capital markets.

IV.E. Voluntary Disclosure in 8-K Filings and Managerial Earnings Forecasts

In this subsection, we examine the other two categories of information disclosure indicators. We first 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 number 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 7 and 8.

As shown in Table 7, 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 one standard deviation value would reduce *Voluntary 8-K Frequency* and *Voluntary 8-K Length* by 10% and 13%, respectively, of their corresponding sample mean values. When using the sample of BHCs that excludes large BHCs, the results are similar as reported in columns 3 and 4.

Table 8 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 8, *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 1.5 percentage points when a BHC receives a one standard deviation increase in exposure, which is 24% of the sample mean value of *Voluntary 8K_CAR(-3,3)*.

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 9, *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.F. 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 10, 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 10 as an illustrative example. We find that a one-standard deviation increase in bank exposure raises *Bid-Ask Spread* by 0.08, which is about 5% of the sample mean value of *Bid-Ask Spread*.

IV.G. Instrumental Variable Estimation Results

To further assess the economic impact of deposits on disclosure, we instrument bank deposits with bank exposure to shale development and estimate an instrumental variable (IV) model. With regard to the relevance of the instrument, we note that exposure to shale development is significantly and positively associated with bank deposits, and the instrument passes the weak instrument test, further rejecting the null hypothesis that our instrument is irrelevant to the instrumented variable. We include these analyses as an additional robustness test of the overall results and estimated economic effects.

The second-stage results reported in Table 11 are consistent with the view that shocks to deposits materially affect information disclosure, as measured by managerial discussion and analysis disclosures, voluntary 8-K filings indicators, managerial earnings guidance, and positively and significantly in regressions for bank stock illiquidity. The IV estimates suggest an economically large effect. For example, the estimated coefficients indicate that if bank deposits grow by 10 percentage points, (a) the length of MD&A text-based disclosures would drop by 0.7, equivalent to about 10% of the sample mean value of *MD&A Length*, (b) the frequency of voluntary 8-K filings would drop by about 50% of the mean value of *Voluntary 8-K Frequency*, (c) the frequency of issuing managerial earnings forecasts would decrease by 47% of the sample mean value of *Managerial Earnings Guidance Frequency* and (d) *Bid-Ask Spread* would increase by about 17% of its sample mean value.

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 ways. That is, exploiting bank-specific exposure to the shale development booms, we assess the impact of the fracking shocks 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 drops 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 reduces voluntary information disclosure more (a) among banks in more competitive environments and (b) among banks with greater ex-ante reliance on capital market financing. Thus, our findings indicate that economic shocks that relax external funding constraints tend to reduce voluntary information disclosure.

References

Acharya, V.V., 2014. A transparency standard for derivatives, in *Risk Topography: Systemic Risk and Macro Modeling*, Eds: M. Brunnermeier and A. Krishnamurthy. Chicago, IL: National Bureau of Economic Research, University of Chicago Press, 83–98.

Amihud, Y., 2002. Illiquidity and stock returns: cross-section and time-series effects. *Journal of Financial Markets* 5, 31-56.

Asquith, P., Mikhail, M.B., Au, A.S., 2005. Information content of equity analyst reports. *Journal of Financial Economics* 75, 245-282.

Barth, J.R., Caprio, G., Levine, R., 2006. *Rethinking Bank Regulation: Till Angels Govern*. Cambridge University Press, New York.

Barth, M.E., Konchitchki, Y., Landsman, W.R., 2013. Cost of capital and earnings transparency. *Journal of Accounting and Economics* 55, 206-224.

Beatty, A., Liao, S., 2014. Financial accounting in the banking industry: a review of the empirical literature. *Journal of Accounting and Economics* 58, 339–383.

Beck, T., Levine, R., Levkov, A., 2010. Big bad banks? The winners and losers from bank deregulation in the United States. *Journal of Finance* 65, 1637-1667.

Berger, A.N., Bonime, S.D., Covitz, D.M., Hancock, D., 2000. Why are bank profits so persistent? The roles of product market competition, informational opacity, and regional/macroeconomic shocks. *Journal of Banking and Finance* 24, 1203-1235.

Berger, A.N., Davies, S.M., Flannery, M.J., 2000. Comparing market and supervisory assessments of bank performance: who knows what when? *Journal of Money, Credit and Banking* 32, 641-667.

Boone, A.L., White, J.T., 2015. The effect of institutional ownership on firm transparency and information production. *Journal of Financial Economics 117*, 508-533.

Brown, S.V., Tucker, J.W., 2011. Large‐sample evidence on firms' year‐over‐year MD&A modifications. *Journal of Accounting Research* 49, 309-346.

Bushman, R.M., Hendricks, B.E., Williams, C.D., 2016. Bank competition: measurement, decision-making, and risk-taking. *Journal of Accounting Research* 54, 777-826.

Bushman, R.M., Williams, C.D., 2015. Delayed expected loss recognition and the risk profile of banks. *Journal of Accounting Research* 53, 511-553.

Carter, M.E., Soo, B.S., 1999. The relevance of form 8-K reports. *Journal of Accounting Research* 37, 119-132.

Calomiris, C.W., Kahn, C.M., 1991. The role of demandable debt in structuring optimal banking arrangements. *American Economic Review* 81, 497-513.

Caprio, G., Laeven, L., Levine, R., 2007. Governance and bank valuation. *Journal of Financial Intermediation* 16, 584-617.

Dang, T.V., Gorton, G., Holmström, B., Ordoñez, G., 2017. Banks as secret keepers. *American Economic Review* 107, 1005-29.

Darrough, M.N., Stoughton, N.M., 1990. Financial disclosure policy in an entry game. *Journal of Accounting and Economics* 12, 219-243.

Diamond, D.W., Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. *Journal of Political Economy* 91, 401-419.

Diamond, D.W., Rajan, R.G., 2001. Liquidity risk, liquidity creation, and financial fragility: a theory of banking. *Journal of Political Economy* 109, 287-327.

Diamond, D.W., Verrecchia, R.E., 1991. Disclosure, liquidity, and the cost of capital. *Journal of Finance* 46, 1325-1359.

Easley, D., O'Hara, M., 2004. Information and the cost of capital. *Journal of Finance* 59, 1553-1583.

Fahlenbrach, R., Stulz, R.M., 2011. Bank CEO incentives and the credit crisis. *Journal of Financial Economics* 99, 11-26.

Flannery, M.J., Kwan, S.H., Nimalendran, M., 2004. Market evidence on the opaqueness of banking firms' assets. *Journal of Financial Economics* 71, 419-460.

Flannery, M.J., Kwan, S., Nimalendran, M., 2013. The 2007-09 financial crisis and bank opaqueness, *Journal of Financial Intermediation* 22, 55-84.

Frankel, R., McNichols, M., Wilson, G.P., 1995. Discretionary disclosure and external financing. *The Accounting Review* 70, 135-150.

Gilje, E.P., Loutskina, E., Strahan, P.E., 2016. Exporting liquidity: branch banking and financial integration. *Journal of Finance* 71, 1159-1184.

Graham, J.R., Harvey, C.R., Rajgopal, S., 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40, 3-73.

Green, T.C., Jame, R., Markov, S., Subasi, M., 2014. Access to management and the informativeness of analyst research. *Journal of Financial Economics* 114, 239-255.

Hanson, S.G., Shleifer, A., Stein, J.C., Vishny, R.W., 2015. Banks as patient fixed-income investors. *Journal of Financial Economics* 117, 449-469.

Healy, P.M., Palepu, K.G., 2001. Information asymmetry, corporate disclosure, and the capital markets: a review of the empirical disclosure literature. *Journal of Accounting and Economics* 31, 405-440.

Huizinga, H., Laeven, L., 2012. Bank valuation and accounting discretion during a financial crisis. *Journal of Financial Economics* 106, 614-634.

Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3, 305-360.

Konchitchki, Y., Patatoukas, P.N., 2014. Accounting earnings and gross domestic product. *Journal of Accounting and Economics* 57, 76-88.

Kothari, S.P., Li, X., Short, J.E., 2009. The effect of disclosures by management, analysts, and business press on cost of capital, return volatility, and analyst forecasts: a study using content analysis. *The Accounting Review* 84, 1639-1670.

Kothari, S.P., Shu, S., Wysocki, P.D., 2009. Do managers withhold bad news? *Journal of Accounting Research* 47, 241-276.

Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. *Journal of Financial Economics* 93, 259-275.

Lake, L.W., Martin, J., Ramsey, J.D., Titman, S., 2013. A primer on the economics of shale gas production just how cheap is shale gas? *Journal of Applied Corporate Finance* 25, 87-96.

Lang, M.H., Lundholm, R.J., 2000. Voluntary disclosure and equity offerings: reducing information asymmetry or hyping the stock?. *Contemporary Accounting Research* 17, 623-662.

Lesmond, D.A., Ogden, J.P., Trzcinka, C.A., 1999. A new estimate of transaction costs. *Review of Financial Studies* 12, 1113-1141.

Leuz, C., Verrecchia, R.E., 2000. The economic consequences of increased disclosure. *Journal of Accounting Research* 38, 91-124.

Leuz, C., Wysocki, P.D., 2016. The economics of disclosure and financial reporting regulation: evidence and suggestions for future research. *Journal of Accounting Research* 54, 525-622.

Levine, R., 1997. Financial development and economic growth: views and agenda. *Journal of Economic Literature* 35, 688-726.

Levine, R., 2005. Finance and growth: theory and evidence, in *Handbook of Economic Growth*, Eds: Philippe Aghion and Steven Durlauf, Netherlands: Elsevier Science.

Li, F., 2008. Annual report readability, current earnings, and earnings persistence. *Journal of Accounting and Economics* 45, 221-247.

Li, F., Hundholm, R., Minnis, M., 2013. A measure of competition based on 10-K filings. *Journal of Accounting Research* 51, 399-436.

Loh, R.K., Stulz, R.M., 2011. When are analyst recommendation changes influential? *Review of Financial Studies* 24, 593-627.

Morgan, D.P., 2002. Rating banks: risk and uncertainty in an opaque industry. *American Economic Review* 92, 874-888.

Morris, S., Shin, H.S., 2002. Social value of public information. *American Economic Review* 92, 1521-1534.

Myers, S.C., Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 13, 187-221.

Peria, M.S.M., Schmukler, S.L., 2001. Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises. *Journal of Finance* 56, 1029-1051.

Plosser, M.C., 2014. Bank heterogeneity and capital allocation: evidence from “fracking” shocks. Working paper.

Popov, A., 2018. Evidence on finance and economic growth. In *Handbook of Finance and Development*, Eds: Thorsten Beck and Ross Levine, Cheltenham, UK, Edward Edgar Publishing, 63-104.

Stoll, H.R., 1989. Inferring the components of the bid-ask spread: theory and empirical tests. *Journal of Finance* 44, 115-134.

Times-Picayune, 2008. Drilling rush in North Louisiana creates new millionaires. September 16. http://www.nola.com/news/index.ssf/2008/09/northwest_la_oil_rush_creating.html.

U.S. Securities and Exchange Commission (SEC). 1980. Securities Act Release No. 6231 (September 2).

Verrecchia, R., 1983. Discretionary disclosure. *Journal of Accounting and Economics* 5, 179-194.

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	0.12	3017	0.01	0.13
MD&A Length	3554	7.46	3.47	3017	7.23	3.56
MD&A Modification	3554	1.02	0.69	3017	1	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
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	0.43	0.45	3017	0.42	0.45
Loss	3554	0.03	0.16	3017	0.03	0.17
Cap	3554	8.87	2.22	3017	8.87	2.27
Deposit Growth	3301	11.73	14.31	2768	11.98	14.30
Cost of Deposits	3301	2.59	0.97	2768	0.97	1.87
Competition	3554	-1.12	3.10	3017	-1.14	3.13
Access to Capital Markets	3554	0.82	2.93	3017	0.56	2.36

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. BHC controls include book value of total assets (*Size*), capital-asset ratio (*Cap*), loan loss provisions (*LLP*) and an indicator of whether net income is negative or not (*Loss*), all lagged one year. 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	5.6106**	-0.1495***	4.6661***	-0.1654***
	(2.1962)	(0.0212)	(1.7099)	(0.0155)
Size	-18.6691***	0.5043***	-18.3643***	0.5553***
	(1.2414)	(0.0560)	(1.3549)	(0.0564)
LLP	-1.7029**	0.0477	-2.0937**	-0.0004
	(0.7529)	(0.0314)	(0.8652)	(0.0261)
Loss	-4.9793***	0.0853	-3.8836**	0.1040**
	(1.8249)	(0.0534)	(1.8740)	(0.0529)
Cap	0.8050***	-0.0182*	0.7527***	-0.0263***
	(0.2229)	(0.0098)	(0.2377)	(0.0099)
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3301	3301	2768	2768
R-sq	0.3982	0.8620	0.4115	0.8971

Table 3. Shale Exposure and Pre-Trends in Bank Deposits, Branches, and Information Disclosure

This table presents regression results of (a) banks deposit growth, (b) the growth of bank branches, and (c) information disclosure over the pre-shale discovery period, 2000-2002, on bank exposure to shale development over the 2003-2007 period. The sample in columns 1-4 consists of all U.S. public BHCs, and the sample in columns 5-8 excludes the largest BHCs that account for 80% of total banking assets. The dependent variables, *Deposit Growth*, *#Branch Growth*, *MD&A Length*, and *MD&A Modification*, measure the growth rate of deposits, the growth rate of the number of branches, or information disclosure in managerial discussion and analysis, averaged over the pre-shale discovery period from 2000-2002. The key explanatory variable, *Bank Exposure*, *2003-2007*, is the average bank-specific exposure to shale discoveries in the post-2002 period. BHC controls include book value of total assets (*Size*), capital-asset ratio (*Cap*), loan loss provisions (*LLP*) and an indicator of whether net income is negative or not (*Loss*), averaged over the 2000-2002 period. 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	Deposit Growth, 2000-2002	#Branch Growth, 2000-2002	MD&A Length, 2000-2002	MD&A Modification, 2000-2002	Deposit Growth, 2000-2002	#Branch Growth, 2000-2002	MD&A Length, 2000-2002	MD&A Modification, 2000-2002
Shale Exposure 2003-2007	-6.0398	-4.5078	1.2995	-0.0434	-5.2843	-1.6676	0.8278	-0.1154
	(4.3482)	(6.2839)	(1.0473)	(0.1753)	(4.2606)	(6.2483)	(0.9632)	(0.1799)
Size	-1.2878***	-1.8720*	0.8743***	0.1311***	-1.7769***	-3.3423**	1.2090***	0.1938***
	(0.3234)	(1.0811)	(0.1156)	(0.0196)	(0.4511)	(1.5574)	(0.1788)	(0.0297)
LLP	2.7132*	0.2898	-0.1221	0.0451	3.4785**	0.0070	0.2282	0.0986
	(1.3966)	(4.8180)	(0.4190)	(0.0748)	(1.5794)	(5.0196)	(0.4189)	(0.0786)
Loss	-8.6444	65.4658	-2.8261**	-0.2516	-8.4019	66.4618	-3.2416***	-0.3400
	(5.6055)	(44.2941)	(1.2211)	(0.2355)	(5.7310)	(44.5979)	(1.1895)	(0.2291)
Cap	-0.5289**	0.1332	0.1207*	0.0257**	-0.4796*	-0.2349	0.1229	0.0240
	(0.2390)	(0.7228)	(0.0723)	(0.0131)	(0.2474)	(0.6965)	(0.0822)	(0.0147)
N	518	518	518	518	450	450	450	450
R-sq	0.0502	0.0721	0.1606	0.1106	0.0612	0.0833	0.1835	0.1403

Table 4. Bank Exposure and Disclosure via Management Discussion &Analysis

This table presents regression results of banks MD&A disclosure 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 *MD&A Length* (columns 1 and 3), and *MD&A Modification* (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 book value of total assets (*Size*), capital-asset ratio (*Cap*), loan loss provisions (*LLP*) and an indicator of whether net income is negative or not (*Loss*), all lagged one year. 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	MD&A Length	MD&A Modification	MD&A Length	MD&A Modification
Bank Exposure	-0.4416***	-0.2272***	-0.4932***	-0.2312***
	(0.0774)	(0.0320)	(0.0773)	(0.0360)
Size	2.4045***	0.3389***	2.7388***	0.4052***
	(0.2976)	(0.0709)	(0.3289)	(0.0796)
LLP	0.1121	0.0167	0.1353	0.0056
	(0.1086)	(0.0339)	(0.1273)	(0.0375)
Loss	-0.5187	0.1207	-0.3809	0.1596*
	(0.3558)	(0.0834)	(0.3639)	(0.0866)
Cap	0.0179	0.0087	0.0196	0.0127
	(0.0518)	(0.0102)	(0.0569)	(0.0113)
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3554	3554	3017	3017
R-sq	0.7571	0.5244	0.7440	0.5304

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. The sample in columns 1 and 2 consists of all U.S. public BHCs from 2000 through 2007, and columns 3 and 4 excludes the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Length* (columns 1 and 3), and *MD&A Modification* (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. *Competition* is a bank-specific measure of competition. We measure how managers perceive their banks' competition environment using textual analysis of each bank's 10-K filings. BHC controls include book value of total assets (*Size*), capital-asset ratio (*Cap*), loan loss provisions (*LLP*) and an indicator of whether net income is negative or not (*Loss*), all lagged one year. 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	MD&A Length	MD&A Modification	MD&A Length	MD&A Modification
Bank Exposure × Competition	-0.7344**	-0.1943*	-0.5981**	-0.1797*
	(0.2915)	(0.0994)	(0.2489)	(0.1069)
Bank Exposure	-0.0285	-0.1179*	-0.1550	-0.1296*
	(0.2061)	(0.0661)	(0.1888)	(0.0718)
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	0.7571	0.5245	0.7440	0.5305

Table 6. Bank Exposure, MD&A Disclosure and Access to Capital Markets

This table presents regression results of banks MD&A disclosure on bank exposure to shale development and its interaction with external financing needs. Columns 1 and 2 use the sample of all U.S. public BHCs from 2000 through 2007, while columns 3 and 4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Length* (columns 1 and 3), and *MD&A Modification* (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. *Access to Capital Markets* equals the number of public bond and equity issuance of each BHC over the five-year window prior to the shock. 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	MD&A Length	MD&A Modification	MD&A Length	MD&A Modification
Bank Exposure × Access to Capital Markets	-0.4305**	-0.3426***	-3.6865**	-2.2133***
	(0.2072)	(0.1150)	(1.8116)	(0.1959)
Bank Exposure	-0.4362***	-0.2229***	-0.4873***	-0.2277***
	(0.0745)	(0.0330)	(0.0741)	(0.0374)
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	0.7571	0.5250	0.7442	0.5318

Table 7. 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	-0.2312**	-1.4499**	-0.2091*	-1.4053**
	(0.1173)	(0.6548)	(0.1119)	(0.6392)
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	0.6833	0.5084	0.6725	0.5040

Table 8. 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	-0.0184***	-0.0270***	-0.0168***	-0.0245***
	(0.0022)	(0.0016)	(0.0032)	(0.0027)
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	0.5929	0.5619	0.5982

Table 9. 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	-0.0856***	-0.1536***	-0.0212***	-0.0215***	-0.1048***	-0.1626***	-0.0209***	-0.0216***
	(0.0207)	(0.0196)	(0.0016)	(0.0020)	(0.0199)	(0.0179)	(0.0014)	(0.0017)
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	1107	1107	1107	1107	741	741	741	741
R-sq	0.4976	0.3600	0.4766	0.4659	0.4876	0.4128	0.5014	0.4873

Table 10. 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	0.1481***	0.5979***	0.7609***	0.1607***	0.6529***	0.8570***
	(0.0320)	(0.1207)	(0.1263)	(0.0225)	(0.1069)	(0.1206)
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	0.8074	0.7016	0.7546	0.8101	0.6987	0.7541

Table 11. Deposit Growth and Bank Voluntary Disclosure – IV Estimation

This table presents the 2SLS regression results of bank voluntary disclosure (i.e., MD&A dislcosure, voluntary 8K filings, managerial earnings guidance, and stock market illiquidity) on bank deposit growth. The sample includes all U.S. public BHCs from 2000 through 2007. The dependent variables in the second-stage results are *MD&A Length* (column 1), *MD&A Modification* (column 2), *Voluntary 8K Frequency* (column 3), *Voluntary 8K Length* (column 4), *Managerial Earnings Guidance Frequency* (column 5), *Precision* (column 6), *Bid-Ask Spread* (column 7), *Amihud Illiquidty* (column 8), and *Proportion Zero-Return Days* (column 9). The key explanatory variable in the second-stage regression is the instrumented *Deposit Growth*. The instrumental 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)	(9)
	Management Discussion &Analysis		Voluntary 8K Filings		Managerial Earnings Guidance		Stock Market Illiquidity		
Dep Var	MD&A Length	MD&A Modification	Frequency	Length	Frequency	Precision	Bid-Ask Spread	Amihud Illiquidity	Proportion Zero-Return Days
Deposit Growth	-0.0707***	-0.0463*	-0.0589***	-0.3149***	-0.0235***	-0.0414***	0.0252**	0.1076***	0.1327***
	(0.0259)	(0.0258)	(0.0158)	(0.1043)	(0.0084)	(0.0140)	(0.0103)	(0.0359)	(0.0473)
BHC controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Weak Instrument Test *F*-statistic	17.27	20.02	11.17	10.08	11.98	37.15	10.46	18.51	16.42
N	3301	3301	3301	3301	1045	1045	2969	2970	2970

Appendix

Table A1. Variable Definition

Variable Name	Definition
Bank Exposure	For each bank *b* in year *t*, we compute the following: $Bank\ Exposure_{b,t} = \ln[1 + \sum_j(\Delta Wells_{j,t} * Mktshr_{b,j,t} * 1(Boom_{j,t}))/Branches_{b,t}]$, 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* in 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*. $Branches_{b,t}$ equals the total number of branches owned by BHC *b* in year *t* across the U.S. 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
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 (in percentage). 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 (in percentage). Source: FRY-9C
Deposit Growth	The growth rate of bank deposits (in percentage). Source: FRY-9C
Cost of Deposits	Interest expense on domestic deposits divided by interest-bearing domestic deposits (in percentage). Source: FRY-9C
Competition	The natural logarithm of competition words per thousand words in a BHC's 10-K filing before the shale-boom shock. 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
Access to Capital Markets	The number of public bond or equity issuance of each BHC over the past five years prior to the shale-boom shock. Source: Global New Issues Databases in SDC Platinum

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

This table presents robustness results of banks MD&A disclosure on bank exposure to shale development using alternative MD&A disclosure measures. Columns 1-2 use the sample of all U.S. public BHCs from 2000 through 2007, and columns 3-4 exclude the largest BHCs that account for 80% of total banking assets. The dependent variables are *MD&A Exhibits* (columns 1 and 3), and *MD&A Numbers* (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	MD&A Exhibits	MD&A Numbers	MD&A Exhibits	MD& Numbers
Bank Exposure	-0.1286***	-0.3374***	-0.1389***	-0.3784***
	(0.0450)	(0.0551)	(0.0425)	(0.0559)
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	0.7788	0.7580	0.7632	0.7435

Table A3. 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. The sample include all U.S. public BHCs from 2000 through 2007. The dependent variables are *MD&A Length* (column 1), *MD&A Modification* (column 2), *MD&A Exhibits* (column 3), and *MD&A Numbers* (column 4). 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, where the number of shale wells is weighted by one-year-lagged market share of BHC *b* in county *j* in year *t*. 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)
	MD&A Length	MD&A Modification	MD&A Exhibits	MD&A Numbers
Bank Exposure Alternative	-0.4248***	-0.1442***	-0.1409**	-0.3227***
	(0.0960)	(0.0257)	(0.0588)	(0.0658)
BHC controls	yes	yes	yes	yes
BHC fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
N	3554	3554	3554	3554
R-sq	0.7570	0.5237	0.7788	0.7579

Table A4. 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	-0.4434***	-0.2265***	-0.1283***	-0.3391***
	(0.0760)	(0.0324)	(0.0429)	(0.0543)
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	0.7528	0.5225	0.7746	0.7537