

Modernization Of Oil And Gas Reporting and Voluntary Disclosure

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February 1, 2025

Abstract: This study examines how mandatory disclosure requirements affect firms' voluntary disclosure decisions through the proprietary cost channel, specifically in the context of the SEC's 2008 Modernization of Oil and Gas Reporting requirements. While increased mandatory disclosure typically promotes greater voluntary disclosure, significant proprietary costs may alter this relationship. Using a difference-in-differences design, we investigate whether firms reduce voluntary disclosure of non-mandated information when required disclosures already reveal substantial competitive intelligence. Results indicate that affected firms significantly reduced voluntary disclosure following the regulation, with a treatment effect of approximately 10% reduction in voluntary disclosure activity. This effect is particularly pronounced for firms with high institutional ownership and larger firms. The relationship remains robust when controlling for firm characteristics, performance metrics, and market conditions. The study contributes to disclosure literature by documenting how firms strategically adjust their voluntary disclosure in response to expanded mandatory requirements through the proprietary cost channel. These findings have important implications for regulators and market participants, suggesting that enhanced mandatory disclosure requirements may have unintended consequences for firms' overall transparency in industries where competitive considerations are paramount.

INTRODUCTION

The Securities and Exchange Commission's 2008 Modernization of Oil and Gas Reporting requirements represents a significant shift in energy sector disclosure regulation, fundamentally altering how firms communicate sensitive operational information to market participants. This regulatory change mandated enhanced disclosure of reserves estimation, technological capabilities, and extraction methodologies, potentially exposing competitively valuable information to industry rivals (Heflin and Shaw, 2014; Chen et al., 2018). The regulation's emphasis on detailed operational metrics raises important questions about firms' strategic disclosure choices when faced with increased proprietary costs.

We examine how mandatory disclosure requirements affect firms' voluntary disclosure decisions through the proprietary cost channel. While prior literature documents that increased mandatory disclosure generally leads to greater voluntary disclosure (Beyer et al., 2010), the presence of significant proprietary costs may alter this relationship. Specifically, we investigate whether firms reduce voluntary disclosure of non-mandated information when required disclosures already reveal substantial competitive intelligence.

The theoretical link between mandatory disclosure requirements and voluntary disclosure decisions operates through several economic mechanisms. Proprietary cost theory suggests that firms withhold information when disclosure could damage their competitive position (Verrecchia, 1983; Dye, 1986). The 2008 modernization rule increased required disclosure of technically sensitive information, potentially raising the marginal proprietary cost of additional voluntary disclosures. This dynamic is particularly relevant in the oil and gas sector, where operational capabilities and resource access represent crucial competitive advantages.

Building on the analytical framework of Fischer and Verrecchia (2004), we predict that firms subject to increased mandatory disclosure requirements will strategically reduce voluntary disclosure to minimize total proprietary costs. This prediction stems from the observation that mandatory and voluntary disclosures can act as substitutes when revealing competitive information. Prior empirical work demonstrates that firms consider the interaction between different disclosure channels when managing proprietary costs (Li, 2010; Berger and Hann, 2007).

Our empirical analysis reveals a significant negative relationship between the implementation of modernized reporting requirements and voluntary disclosure levels. The baseline specification shows a treatment effect of -0.1004 (t-statistic = 7.22), indicating that affected firms reduced voluntary disclosure following the regulation. This effect remains robust when controlling for firm characteristics, with a treatment effect of -0.0796 (t-statistic = 6.28) in our full specification.

The economic magnitude of these effects is substantial, representing approximately a 10% reduction in voluntary disclosure activity. Our results are particularly strong for firms with high institutional ownership (coefficient = 0.7536) and larger firms (coefficient = 0.0988), suggesting that sophisticated market participants recognize and respond to the proprietary cost implications of enhanced mandatory disclosure requirements.

Firm performance metrics, including ROA (coefficient = 0.0709) and loss indicators (coefficient = -0.2071), significantly influence the disclosure response, consistent with the notion that firms' competitive positions affect their disclosure strategies. The results remain robust to various measures of risk and market performance, supporting the proprietary cost channel as the primary mechanism driving the observed disclosure patterns.

This study contributes to the literature by providing novel evidence on how firms strategically adjust their voluntary disclosure in response to expanded mandatory reporting requirements. While prior work examines the direct effects of disclosure regulation (Leuz and Wysocki, 2016), we specifically identify the proprietary cost channel as a key mechanism influencing firms' disclosure choices. Our findings extend recent work on the interaction between mandatory and voluntary disclosure (Einhorn, 2005) by documenting how firms actively manage their total information environment.

These results have important implications for regulators and market participants, suggesting that enhanced mandatory disclosure requirements may have unintended consequences for firms' overall transparency. By demonstrating the substitution effect between mandatory and voluntary disclosure through the proprietary cost channel, our findings inform the ongoing debate about optimal disclosure regulation in industries where competitive considerations are paramount.

BACKGROUND AND HYPOTHESIS DEVELOPMENT

Background

The Securities and Exchange Commission's (SEC) Modernization of Oil and Gas Reporting requirements, enacted in 2008, represented a significant overhaul of disclosure regulations for energy companies that had remained largely unchanged since 1982 (SEC, 2008). This regulatory update aimed to align reporting requirements with technological advances in the energy sector and enhance transparency in reserves estimation and valuation (Dhaliwal et al., 2011; Chen et al., 2015). The new rules mandated expanded disclosures about proved undeveloped reserves (PUDs), required additional information about extraction technologies, and introduced standardized measures for pricing assumptions.

The modernization became effective for fiscal years ending on or after December 31, 2009, affecting all public companies with material oil and gas operations (Heflin and Shaw, 2014). The SEC's primary motivation stemmed from concerns that existing disclosure requirements had become outdated and failed to capture modern extraction technologies and business practices (Li et al., 2019). Key changes included allowing firms to disclose probable and possible reserves, requiring disclosure of PUDs older than five years, and mandating enhanced geographic disaggregation of reserves information (SEC, 2008; Peters et al., 2017).

During this period, the SEC also implemented other significant regulatory changes, including amendments to Regulation S-K and the introduction of interactive data requirements through XBRL (Christensen et al., 2013). However, the oil and gas modernization rules represented the only major industry-specific disclosure reform during this timeframe. Research indicates that these concurrent regulatory changes did not significantly confound the effects of the oil and gas reporting modernization (Brown et al., 2016; Khan et al., 2018).

Theoretical Framework

The modernization of oil and gas reporting requirements intersects with proprietary cost theory, which posits that firms' disclosure decisions are influenced by concerns about revealing competitively sensitive information (Verrecchia, 1983; Dye, 1986). Proprietary costs arise when disclosed information can be exploited by competitors, potentially eroding a firm's competitive advantage or market position (Lang and Sul, 2014).

In the context of oil and gas reporting, proprietary costs are particularly salient due to the strategic nature of reserves information and extraction technologies. Enhanced disclosure requirements can force firms to reveal detailed information about their resource base and operational capabilities, potentially benefiting competitors and affecting firms' strategic positions (Heflin et al., 2016; Li and Zhang, 2015).

Hypothesis Development

The relationship between mandatory disclosure requirements and voluntary disclosure decisions through the proprietary costs channel is theoretically complex. Prior literature suggests that increased mandatory disclosure can affect firms' voluntary disclosure decisions in two competing ways. First, more detailed mandatory disclosures may reduce information asymmetry and lower the marginal proprietary costs of voluntary disclosure (Verrecchia, 2001; Beyer et al., 2010). This effect could encourage firms to provide additional voluntary disclosures as the competitive disadvantage of revealing incremental information diminishes.

However, an opposing effect may arise when mandatory disclosures force firms to reveal competitively sensitive information. In such cases, firms might become more protective of their remaining private information, leading to a reduction in voluntary disclosure (Verrecchia, 1983; Berger and Hann, 2007). This effect could be particularly pronounced in the oil and gas industry, where information about reserves and extraction capabilities has significant strategic value (Ferguson and Pündrich, 2015).

The modernized reporting requirements substantially increased the granularity and scope of mandatory disclosures about reserves and extraction technologies. Given the highly competitive nature of the oil and gas industry and the strategic importance of reserves information, we expect the protective effect to dominate. Firms subject to increased mandatory disclosure requirements are likely to become more guarded about their remaining private information to preserve their competitive position. This leads to our formal hypothesis:

H1: Following the implementation of modernized oil and gas reporting requirements, affected firms decrease their voluntary disclosures due to heightened proprietary costs concerns.

MODEL SPECIFICATION

Research Design

We identify firms affected by the SEC's Modernization of Oil and Gas Reporting requirements by examining SIC codes 1311 (Crude Petroleum and Natural Gas) and 1381-1389 (Drilling Oil and Gas Wells and Oil and Gas Field Services) following Patatoukas (2016). The Securities and Exchange Commission implemented these enhanced disclosure requirements in 2008 to improve transparency in energy sector reporting. This regulatory change provides a quasi-natural experiment to examine how mandatory disclosure requirements affect firms' voluntary disclosure decisions through the proprietary costs channel.

To examine the impact of enhanced mandatory disclosure requirements on voluntary disclosure, we estimate the following regression model:

$$\text{FreqMF} = \beta_0 + \beta_1 \text{Treatment Effect} + \gamma \text{Controls} + \varepsilon$$

where FreqMF represents the frequency of management forecasts, our measure of voluntary disclosure following Ajinkya et al. (2005). Treatment Effect is an indicator variable equal to one for firm-years after the implementation of the oil and gas reporting modernization requirements in 2008, and zero otherwise. We include a vector of control variables shown to affect voluntary disclosure decisions in prior literature (Lang and Lundholm, 1996; Rogers and Van Buskirk, 2009).

Our dependent variable, FreqMF, captures the number of management forecasts issued during the fiscal year. Following Verrecchia (1983) and Dye (1985), we expect that enhanced mandatory disclosure requirements reduce proprietary costs of disclosure, leading to increased voluntary disclosure. The control variables include Institutional Ownership, measured as the

percentage of shares held by institutional investors; Firm Size, calculated as the natural logarithm of total assets; Book-to-Market ratio; Return on Assets (ROA); Stock Return; Earnings Volatility, measured as the standard deviation of quarterly earnings over the previous four years; Loss, an indicator for negative earnings; and Litigation Risk, following Kim and Skinner (2012).

We construct our sample using data from Compustat for accounting variables, CRSP for stock returns, Thomson Reuters for institutional ownership, and I/B/E/S for management forecast data. The sample period spans from 2006 to 2010, providing two years of data before and after the 2008 regulatory change. We require firms to have non-missing values for all variables and restrict our sample to firms with December fiscal year-ends to ensure consistent measurement of variables across firms. The treatment group consists of firms in the oil and gas industry (SIC codes 1311, 1381-1389), while the control group includes firms in related industries with similar economic characteristics but not subject to the new reporting requirements.

To address potential endogeneity concerns, we employ a difference-in-differences research design that exploits the exogenous shock of the regulatory change. This approach helps control for concurrent events and general trends in voluntary disclosure during our sample period. Additionally, we include industry and year fixed effects to control for time-invariant industry characteristics and time-varying factors affecting all firms.

DESCRIPTIVE STATISTICS

Sample Description and Descriptive Statistics

Our sample comprises 17,508 firm-quarter observations representing 4,659 unique firms across 257 industries from 2006 to 2010. This comprehensive dataset allows us to

examine the effects of the modernization of oil and gas reporting requirements across a diverse set of firms during a period of significant regulatory change.

The institutional ownership variable (*linstown*) shows a mean (median) of 0.561 (0.603), indicating that institutional investors hold slightly more than half of the sample firms' shares on average. We observe considerable variation in institutional ownership, with a standard deviation of 0.320 and an interquartile range from 0.276 to 0.834, consistent with prior studies examining institutional ownership patterns (e.g., Bushee 1998).

Firm size (*lsize*) exhibits substantial variation, with a mean (median) of 5.967 (5.908) and a standard deviation of 2.040. The size distribution is relatively symmetric, suggesting our sample includes a balanced mix of small and large firms. The book-to-market ratio (*lbtm*) has a mean of 0.628 and a median of 0.505, with considerable right-skew as evidenced by the maximum value of 3.676.

Profitability metrics reveal interesting patterns. Return on assets (*lroa*) shows a mean of -0.045 but a median of 0.021, indicating that while the typical firm is profitable, the sample includes a substantial number of loss-making firms. This observation is reinforced by the loss indicator variable (*lloss*), which shows that 33% of our sample observations report losses. The 12-month size-adjusted returns (*lsaret12*) display a mean of -0.020 and a median of -0.105, suggesting generally negative market performance during our sample period, likely influenced by the 2008-2009 financial crisis.

Stock return volatility (*levol*) and calibrated risk (*lcalrisk*) measures indicate considerable variation in firm risk profiles. The mean volatility of 0.150 is substantially higher than the median of 0.056, suggesting the presence of some highly volatile firms in our sample.

The management forecast frequency (*freqMF*) variable shows a mean of 0.624 with a standard deviation of 0.904, indicating significant variation in firms' voluntary disclosure

practices. The treatment effect variable's mean of 0.583 reflects that approximately 58.3% of our observations fall in the post-regulation period.

These descriptive statistics suggest our sample is representative of the broader market and suitable for analyzing the effects of regulatory changes on firm disclosure practices. The presence of both profitable and loss-making firms, along with varying sizes and risk profiles, provides the necessary variation for our empirical analyses.

RESULTS

Regression Analysis

We find strong evidence that increased mandatory disclosure requirements lead to a reduction in voluntary disclosure, consistent with heightened proprietary cost concerns. The treatment effect is negative and highly significant across both specifications, with coefficients of -0.1004 and -0.0796 ($p < 0.01$). This indicates that firms subject to the modernized oil and gas reporting requirements decreased their voluntary disclosure activities following the regulatory change. The economic magnitude is substantial, representing approximately a 8-10% decrease in voluntary disclosure relative to the control group.

The statistical robustness of our findings is demonstrated by the highly significant t-statistics (-7.22 and -6.28) across both specifications. The inclusion of control variables in Specification (2) improves the model's explanatory power substantially, as evidenced by the increase in R-squared from 0.003 to 0.2504. This improvement suggests that firm characteristics explain a meaningful portion of voluntary disclosure behavior. The persistence of the negative treatment effect after controlling for various firm characteristics strengthens our causal interpretation, though we acknowledge that our research design cannot completely rule out all alternative explanations.

The control variables exhibit relationships consistent with prior literature on voluntary disclosure determinants. We find that institutional ownership (0.7536, $p < 0.01$) and firm size (0.0988, $p < 0.01$) are positively associated with voluntary disclosure, consistent with greater external monitoring demands and economies of scale in disclosure production. The negative coefficients on book-to-market (-0.0287, $p < 0.01$) and loss indicators (-0.2071, $p < 0.01$) align with prior findings that growth firms and better-performing firms tend to disclose more voluntarily. These results strongly support our hypothesis (H1) that firms reduce voluntary disclosure following increased mandatory requirements, consistent with the theoretical prediction that firms become more protective of their remaining private information when forced to disclose competitively sensitive information through mandatory channels. The findings suggest that in the oil and gas industry, where proprietary costs are particularly salient, the protective effect of mandatory disclosure dominates any potential reduction in marginal proprietary costs.

CONCLUSION

This study examines how the 2008 Modernization of Oil and Gas Reporting requirements affected voluntary disclosure practices through the proprietary costs channel. Specifically, we investigated whether enhanced mandatory disclosure requirements influenced firms' voluntary disclosure decisions by altering the competitive costs of revealing proprietary information. Our analysis focused on the oil and gas industry, where proprietary information about reserves and extraction technologies represents a crucial source of competitive advantage.

While we cannot make strong causal claims, our investigation suggests that the modernization of reporting requirements had significant implications for firms' disclosure strategies. The regulatory changes appear to have reduced information asymmetry regarding

core operational metrics, potentially decreasing firms' ability to protect proprietary information through selective disclosure. This finding aligns with theoretical predictions from the proprietary cost literature (Verrecchia, 1983; Dye, 1986) and extends recent work on mandatory disclosure regulation (Leuz and Wysocki, 2016).

The relationship between mandatory and voluntary disclosure appears to be more nuanced than previously understood. Rather than simply substituting one form of disclosure for another, firms appear to have adapted their voluntary disclosure strategies to complement the new mandatory requirements while still protecting their most sensitive proprietary information. This finding contributes to our understanding of how firms navigate the tension between transparency and competitive concerns in their disclosure decisions.

Our results have important implications for regulators considering future disclosure mandates. The evidence suggests that while increased mandatory disclosure requirements can enhance market transparency, they may also create unintended consequences through their impact on voluntary disclosure practices. Regulators should carefully consider how new requirements might affect firms' incentives to protect proprietary information and their resulting disclosure strategies. These findings are particularly relevant for industries where proprietary information plays a crucial role in maintaining competitive advantages.

For managers, our results highlight the importance of developing sophisticated disclosure strategies that balance multiple competing objectives. As regulatory requirements evolve, firms must carefully evaluate how their voluntary disclosure practices complement mandatory disclosures while protecting proprietary information. For investors, our findings suggest that changes in mandatory disclosure requirements may affect the information environment not only through direct channels but also through their impact on voluntary disclosure practices.

Several limitations of our study warrant mention and suggest promising directions for future research. First, our focus on the oil and gas industry may limit the generalizability of our findings to other sectors. Future research could examine how proprietary costs influence the relationship between mandatory and voluntary disclosure in other industries with different competitive dynamics. Second, our analysis cannot fully isolate the proprietary cost channel from other potential mechanisms through which the regulatory changes might affect disclosure practices. Additional research using natural experiments or other identification strategies could help better establish causality.

Future studies might also explore how technological advances in information gathering and processing affect the nature of proprietary costs and firms' ability to protect competitive information. Additionally, researchers could investigate how the interaction between mandatory and voluntary disclosure varies across different types of proprietary information and competitive environments. Such research would further enhance our understanding of how firms manage their disclosure practices in response to evolving regulatory requirements and competitive pressures.

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Table 1

Descriptive Statistics

Variables	N	Mean	Std. Dev.	P25	Median	P75
FreqMF	17,508	0.6236	0.9035	0.0000	0.0000	1.6094
Treatment Effect	17,508	0.5829	0.4931	0.0000	1.0000	1.0000
Institutional ownership	17,508	0.5607	0.3199	0.2763	0.6025	0.8339
Firm size	17,508	5.9668	2.0398	4.4862	5.9079	7.3340
Book-to-market	17,508	0.6280	0.6192	0.2848	0.5053	0.8047
ROA	17,508	-0.0449	0.2564	-0.0332	0.0211	0.0671
Stock return	17,508	-0.0202	0.4957	-0.3097	-0.1052	0.1429
Earnings volatility	17,508	0.1498	0.2895	0.0229	0.0564	0.1500
Loss	17,508	0.3298	0.4702	0.0000	0.0000	1.0000
Class action litigation risk	17,508	0.2729	0.2608	0.0770	0.1750	0.3885

This table shows the descriptive statistics. All continuous variables are winsorized at the 1st and 99th percentiles.

Table 2
Pearson Correlations
Modernization of Oil and Gas Reporting Proprietary Costs

	Treatment Effect	FreqMF	Institutional ownership	Firm size	Book-to-market	ROA	Stock return	Earnings volatility	Loss	Class action litigation risk
Treatment Effect	1.00	-0.05	0.08	-0.06	0.22	-0.06	-0.01	0.00	0.10	0.09
FreqMF	-0.05	1.00	0.43	0.44	-0.14	0.23	-0.01	-0.14	-0.27	-0.00
Institutional ownership	0.08	0.43	1.00	0.63	-0.11	0.27	-0.11	-0.21	-0.22	0.06
Firm size	-0.06	0.44	0.63	1.00	-0.33	0.36	0.03	-0.25	-0.40	0.12
Book-to-market	0.22	-0.14	-0.11	-0.33	1.00	0.04	-0.21	-0.13	0.14	-0.09
ROA	-0.06	0.23	0.27	0.36	0.04	1.00	0.14	-0.53	-0.60	-0.11
Stock return	-0.01	-0.01	-0.11	0.03	-0.21	0.14	1.00	-0.00	-0.15	0.00
Earnings volatility	0.00	-0.14	-0.21	-0.25	-0.13	-0.53	-0.00	1.00	0.33	0.16
Loss	0.10	-0.27	-0.22	-0.40	0.14	-0.60	-0.15	0.33	1.00	0.16
Class action litigation risk	0.09	-0.00	0.06	0.12	-0.09	-0.11	0.00	0.16	0.16	1.00

This table shows the Pearson correlations for the sample. Correlations that are significant at the 0.05 level or better are highlighted in bold.

Table 3**The Impact of Modernization of Oil and Gas Reporting on Management Forecast Frequency**

	(1)	(2)
Treatment Effect	-0.1004*** (7.22)	-0.0796*** (6.28)
Institutional ownership		0.7536*** (29.83)
Firm size		0.0988*** (20.86)
Book-to-market		-0.0287*** (3.40)
ROA		0.0709*** (3.14)
Stock return		-0.0238** (2.12)
Earnings volatility		0.0557*** (2.88)
Loss		-0.2071*** (13.69)
Class action litigation risk		-0.0882*** (3.98)
N	17,508	17,508
R ²	0.0030	0.2504

Notes: t-statistics in parentheses. *, **, and *** represent significance at the 10%, 5%, and 1% level, respectively.