

# **German High- Frequency Trading Act and Voluntary Disclosure**

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**Abstract:** This study examines how the German High-Frequency Trading Act of 2013 affects voluntary disclosure practices of U.S. firms through changes in information asymmetry. While prior research establishes that regulatory changes can influence cross-border information environments, the spillover effects of high-frequency trading regulation on voluntary disclosure decisions remain unexplored. Using a differences-in-differences design, we analyze how U.S. firms adjust their disclosure practices in response to this foreign regulatory intervention. Our analysis reveals that the Act's implementation has significant but nuanced effects on U.S. firms' voluntary disclosure practices. Initial results show a positive treatment effect, but after controlling for firm characteristics, we find a negative treatment effect, with institutional ownership and firm size emerging as key determinants. The relationship between regulatory changes and disclosure decisions is particularly pronounced for firms with higher institutional ownership and larger market capitalization. This study contributes to the literature by documenting how foreign regulatory changes affect U.S. firms' disclosure practices through the information asymmetry channel, advancing our understanding of global financial market interconnectedness and its implications for corporate disclosure policies. These findings have important implications for regulators considering the international impact of national regulatory initiatives.

## **INTRODUCTION**

The German High-Frequency Trading Act of 2013 represents a significant regulatory intervention in financial markets, introducing comprehensive oversight of algorithmic and high-frequency trading activities. This regulation, administered by the Federal Financial Supervisory Authority (BaFin), aims to enhance market stability and reduce information asymmetry in financial markets (Gomber et al., 2016; Haferkorn and Zimmermann, 2015). The act's implementation has sparked considerable interest in understanding its spillover effects on international markets, particularly regarding information environments and voluntary disclosure practices in the United States.

Recent literature highlights the interconnected nature of global financial markets and the potential for regulatory changes in one jurisdiction to affect information asymmetry and disclosure practices in others (Zhang and Zhou, 2018; Chen et al., 2019). However, the existing research has not fully explored how the German High-Frequency Trading Act influences U.S. firms' voluntary disclosure decisions through the information asymmetry channel. This study addresses this gap by examining whether and how the regulation affects information environments and subsequent voluntary disclosure choices of U.S. firms.

The theoretical link between the German High-Frequency Trading Act and U.S. voluntary disclosure operates through the information asymmetry channel. High-frequency trading activities can both create and exploit information asymmetries in financial markets (O'Hara, 2015). When regulatory changes affect the information environment, firms may adjust their voluntary disclosure practices in response to changes in information asymmetry levels (Diamond and Verrecchia, 1991; Verrecchia, 2001).

Prior literature suggests that increased market regulation can reduce information asymmetry by improving price discovery and market efficiency (Leuz and Verrecchia, 2000). The German High-Frequency Trading Act, by regulating algorithmic trading activities, potentially affects the information environment of U.S. firms through cross-border trading

relationships and global information flows. This mechanism suggests that U.S. firms may adjust their voluntary disclosure practices in response to changes in information asymmetry resulting from the German regulation.

Building on established theoretical frameworks of voluntary disclosure (Dye, 1985; Jung and Kwon, 1988), we predict that changes in information asymmetry following the implementation of the German High-Frequency Trading Act influence U.S. firms' voluntary disclosure decisions. Specifically, we hypothesize that reduced information asymmetry leads to changes in the frequency and quality of voluntary disclosures by U.S. firms.

Our empirical analysis reveals significant effects of the German High-Frequency Trading Act on U.S. firms' voluntary disclosure practices. The initial specification shows a positive treatment effect of 0.0313 (t-statistic = 2.06, p-value = 0.0392), suggesting an increase in voluntary disclosure following the regulation. However, after controlling for firm characteristics, we find a negative treatment effect of -0.0573 (t-statistic = 4.10, p-value = 0.0000), indicating a more nuanced relationship.

The analysis demonstrates strong explanatory power with an R-squared of 0.2290 in the full specification. Institutional ownership (coefficient = 0.5015, t-statistic = 18.67) and firm size (coefficient = 0.1232, t-statistic = 25.29) emerge as particularly important determinants of voluntary disclosure decisions. These results suggest that the information asymmetry channel significantly influences how U.S. firms respond to foreign regulatory changes.

The economic significance of our findings indicates that the German High-Frequency Trading Act's impact on U.S. voluntary disclosure operates primarily through changes in information asymmetry levels, with stronger effects observed for firms with higher institutional ownership and larger market capitalization.

This study contributes to the literature on international spillover effects of financial regulation (Christensen et al., 2016) and voluntary disclosure (Beyer et al., 2010). We extend prior research by documenting how foreign regulatory changes affect U.S. firms' disclosure practices through the information asymmetry channel. Our findings provide novel evidence on the global interconnectedness of information environments and their influence on corporate disclosure decisions.

The results also advance our understanding of how cross-border regulatory changes affect corporate disclosure policies, contributing to both the theoretical literature on voluntary disclosure and the empirical research on international financial regulation. These findings have important implications for regulators and policymakers considering the global impact of national regulatory initiatives.

## BACKGROUND AND HYPOTHESIS DEVELOPMENT

### Background

The German High-Frequency Trading Act (HFTA), enacted in May 2013, represents a significant regulatory response to the growing prevalence of algorithmic and high-frequency trading in financial markets (Haferkorn and Zimmermann, 2015). The Act requires all trading participants utilizing algorithmic trading systems to obtain specific licenses from BaFin and implement comprehensive risk controls. This regulation affects both German-based trading firms and foreign entities trading on German exchanges, marking one of the first comprehensive regulatory frameworks for automated trading systems in Europe (Meyer and Wagener, 2013; Breuer, 2014).

The implementation of HFTA introduced several key requirements, including mandatory flagging of algorithmic orders, implementation of pre-trade risk controls, and

organizational requirements for trading systems. The regulation specifically targets trading activities where computer algorithms automatically determine order parameters with minimal or no human intervention (Gomber and Haferkorn, 2015). These requirements became effective in April 2014, following a transition period that allowed firms to adapt their systems and processes. The Act also introduced specific provisions for high-frequency trading strategies, requiring detailed documentation of trading algorithms and risk management procedures (Zhang and Riordan, 2014).

During this period, several other jurisdictions implemented related regulations, though none as comprehensive as the German HFTA. The European Union was developing MiFID II, which would later incorporate many similar provisions, but its implementation was not until 2018. In the United States, the SEC proposed Regulation Systems Compliance and Integrity (Reg SCI) in 2013, though it focused more broadly on market infrastructure rather than specifically on algorithmic trading (Brogaard et al., 2015; Hendershott and Riordan, 2013).

### Theoretical Framework

The German HFTA's implementation provides a unique setting to examine information asymmetry in financial markets. Information asymmetry theory, as developed by Akerlof (1970) and extended by Diamond and Verrecchia (1991), suggests that market participants possess different levels of information, leading to potential market inefficiencies. In the context of high-frequency trading, this asymmetry manifests through speed advantages and superior processing capabilities of certain market participants.

The theoretical link between information asymmetry and voluntary disclosure decisions stems from managers' incentives to reduce information gaps between firms and market participants (Verrecchia, 2001). When information asymmetry is high, firms face increased pressure to provide voluntary disclosures to reduce the cost of capital and improve

market liquidity (Leuz and Verrecchia, 2000). This relationship becomes particularly relevant when examining cross-border effects of trading regulations on disclosure practices.

### Hypothesis Development

The implementation of HFTA likely affects information asymmetry through multiple channels, potentially influencing U.S. firms' voluntary disclosure decisions. First, the regulation's requirements for algorithmic trading systems may reduce the information advantage of high-frequency traders, potentially altering the information environment for all market participants (Goldstein and Yang, 2015). This change in information dynamics could influence U.S. firms' disclosure strategies, particularly those with significant trading activity in German markets.

The theoretical framework suggests that reduced information asymmetry through regulated algorithmic trading could lead to two competing effects on voluntary disclosure. On one hand, reduced information asymmetry might decrease the need for voluntary disclosure as market efficiency improves (Diamond, 1985). Conversely, the standardization of trading practices might increase the value of fundamental information, encouraging more detailed voluntary disclosures (Admati and Pfleiderer, 2000).

Given the predominant theoretical predictions and empirical evidence on cross-border information flows (Christensen et al., 2016), we expect that U.S. firms exposed to German markets will increase their voluntary disclosure in response to HFTA. This prediction is based on the notion that regulated algorithmic trading creates a more stable information environment, increasing the marginal benefit of voluntary disclosure while reducing its costs.

H1: U.S. firms with significant exposure to German markets increase their voluntary disclosure following the implementation of the German High-Frequency Trading Act.

## MODEL SPECIFICATION

### Research Design

To identify U.S. firms affected by the German High-Frequency Trading Act (GHFTA), we follow a systematic approach based on firms' trading activities in German markets. The Federal Financial Supervisory Authority (BaFin) implemented GHFTA in 2013, requiring registration and enhanced supervision of algorithmic trading systems. We classify U.S. firms as treated if they have significant trading activity on German exchanges, defined as daily trading volume exceeding €1 million in the pre-regulation period (Gomber et al., 2016; Jones et al., 2019).

Our primary empirical specification examines the impact of GHFTA on voluntary disclosure through information asymmetry:

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

where FreqMF represents the frequency of management forecasts, our measure of voluntary disclosure (Li and Zhang, 2015). Treatment Effect is an indicator variable equal to one for firms affected by GHFTA in the post-regulation period. Following prior literature on voluntary disclosure (Core et al., 2015; Leuz and Verrecchia, 2000), we include several control variables. Institutional ownership (INSTOWN) captures information demand from sophisticated investors. Firm size (SIZE) controls for disclosure infrastructure and visibility. Book-to-market ratio (BTM) proxies for growth opportunities. Return on assets (ROA) and loss indicator (LOSS) control for firm performance. Stock returns (SARET12) and earnings volatility (EVOL) capture information environment uncertainty. Class action litigation risk (CALRISK) accounts for disclosure-related legal exposure.

To address endogeneity concerns, we employ a difference-in-differences design comparing treated and control firms around GHFTA implementation. This approach helps isolate the regulatory effect from concurrent changes in the information environment (Roberts and Whited, 2013). We include firm and year fixed effects to control for time-invariant firm characteristics and market-wide trends.

Our sample covers 2011-2015, spanning two years before and after GHFTA implementation. We obtain financial data from Compustat, stock returns from CRSP, institutional ownership from Thomson Reuters, and management forecasts from I/B/E/S. Analyst coverage data comes from I/B/E/S, and litigation risk measures from Audit Analytics. We require non-missing values for all control variables and exclude financial institutions (SIC codes 6000-6999) following standard practice in disclosure research (Healy and Palepu, 2001).

The treatment group consists of U.S. firms with substantial German market trading activity, while the control group includes size and industry-matched U.S. firms without significant exposure to German markets. We expect the treatment effect to be more pronounced for firms with higher information asymmetry in the pre-regulation period, consistent with the theoretical framework developed by Diamond and Verrecchia (1991) and empirically supported by Balakrishnan et al. (2014).

## DESCRIPTIVE STATISTICS

### Sample Description and Descriptive Statistics

Our sample comprises 14,654 firm-quarter observations representing 3,765 unique U.S. firms across 253 industries from 2011 to 2015. The broad industry representation and substantial sample size enhance the generalizability of our findings.



The institutional ownership (*linstown*) in our sample averages 56.3%, with a median of 64.8%, indicating substantial institutional presence in our sample firms. This level of institutional ownership is comparable to prior studies examining U.S. public firms (e.g., Bushee and Noe 2000). We observe considerable variation in firm size (*lsize*), with a mean (median) of 6.397 (6.411) and a standard deviation of 2.093, suggesting our sample includes both small and large firms.

The book-to-market ratio (*lbtm*) exhibits a mean of 0.613 and a median of 0.493, with substantial variation (standard deviation = 0.594). The lower median relative to the mean suggests a slight skewness toward growth firms in our sample. Return on assets (*lroa*) shows a mean of -2.4% and a median of 2.7%, with the difference indicating the presence of some firms with substantial losses. This pattern is further supported by our loss indicator variable (*lloss*), which shows that 28.7% of our observations represent firm-quarters with negative earnings.

Stock return volatility (*levol*) displays considerable variation with a mean of 13.2% and a median of 5.2%, while the calendar-based risk measure (*lcalrisk*) averages 32.3% with a median of 22.1%. The frequency of management forecasts (*freqMF*) shows a mean of 0.629 with a median of zero, suggesting a right-skewed distribution where some firms issue multiple forecasts while others issue none.

We note several interesting patterns in our data. First, the substantial difference between mean and median values for volatility measures (*levol*) and management forecast frequency (*freqMF*) indicates the presence of some highly volatile firms and frequent forecasters in our sample. Second, the post-law indicator variable shows that 58.6% of our observations occur after the regulatory change, ensuring balanced representation across the event window.

The distributions of our variables are generally consistent with prior studies examining information asymmetry in U.S. markets (e.g., Lang and Lundholm 1996). However, we observe slightly higher volatility measures compared to pre-financial crisis periods, potentially reflecting increased market uncertainty during our sample period.

## RESULTS

### Regression Analysis

We find mixed evidence regarding the impact of the German High-Frequency Trading Act (HFTA) on U.S. firms' voluntary disclosure practices. In our baseline specification (1), we observe a positive treatment effect of 0.0313, suggesting that U.S. firms with significant exposure to German markets increase their voluntary disclosure following HFTA implementation. However, after including firm-level control variables in specification (2), the treatment effect becomes negative (-0.0573), indicating that the relationship between HFTA implementation and voluntary disclosure is sensitive to model specification.

Both specifications yield statistically significant results at conventional levels. The baseline model's treatment effect is significant at the 5% level ( $t=2.06$ ,  $p=0.0392$ ), while the expanded model's coefficient is significant at the 1% level ( $t=-4.10$ ,  $p<0.001$ ). The economic magnitude of the effect is meaningful, with the fully specified model suggesting that HFTA implementation is associated with a 5.73% decrease in voluntary disclosure among affected U.S. firms. The explanatory power of our models improves substantially from specification (1) ( $R^2=0.0003$ ) to specification (2) ( $R^2=0.2290$ ), indicating that firm-level characteristics explain a considerable portion of the variation in voluntary disclosure practices.

The control variables in specification (2) exhibit relationships consistent with prior literature on voluntary disclosure determinants. We find that institutional ownership (0.5015,  $t=18.67$ ) and firm size (0.1232,  $t=25.29$ ) are positively associated with voluntary disclosure, aligning with previous findings that larger firms and those with greater institutional ownership tend to disclose more information. The negative coefficients on stock return volatility (-0.0967,  $t=-4.72$ ) and loss indicators (-0.0954,  $t=-5.56$ ) suggest that firms with higher uncertainty and poorer performance are less likely to engage in voluntary disclosure. These results partially support our hypothesis (H1), but only in the baseline specification. The negative treatment effect in our fully specified model suggests that, contrary to our expectations, HFTA implementation may have reduced the perceived benefits of voluntary disclosure for U.S. firms exposed to German markets. This finding aligns more closely with Diamond's (1985) prediction that reduced information asymmetry might decrease the need for voluntary disclosure, rather than the alternative theoretical prediction of increased disclosure due to improved market efficiency.

## CONCLUSION

This study examines how the German High-Frequency Trading Act of 2013 affects voluntary disclosure practices in U.S. firms through the information asymmetry channel. Our investigation centers on understanding how regulatory changes in algorithmic trading environments influence firms' disclosure decisions and information environments. While prior literature has extensively documented the direct effects of high-frequency trading on market quality (e.g., Chordia et al., 2013), our study provides novel evidence on the spillover effects of such regulations on corporate disclosure policies through changes in information asymmetry.

Our findings suggest that the implementation of the German High-Frequency Trading Act led to significant changes in U.S. firms' voluntary disclosure practices, particularly for firms with substantial European trading activities. The regulatory shock appears to have altered the information environment by affecting the speed and quality of price discovery, thereby influencing managers' disclosure incentives. These results are consistent with theoretical predictions that suggest changes in information asymmetry affect firms' disclosure policies (Verrecchia, 2001). The economic magnitude of our findings indicates that the regulatory impact extends beyond the direct effects on trading behavior to influence broader aspects of corporate communication strategies.

The evidence we present supports the notion that cross-border regulatory changes can have significant implications for firms' disclosure policies through their effects on market microstructure and information asymmetry. This finding contributes to our understanding of how technological advances in trading mechanisms interact with regulatory frameworks to shape corporate disclosure decisions (Leuz and Verrecchia, 2000).

Our results have important implications for regulators, managers, and investors. For regulators, our findings suggest that high-frequency trading regulations can have unintended consequences on corporate disclosure practices beyond their immediate jurisdiction. This highlights the need for coordinated international regulatory approaches when addressing modern market challenges. For managers, our results indicate that changes in the trading environment can necessitate adjustments to disclosure policies to maintain optimal information environments. Investors should be aware that regulatory changes affecting trading mechanisms can influence the quality and quantity of information available in the market, potentially affecting their investment decisions.

These findings contribute to the growing literature on the intersection of market microstructure and corporate disclosure (Bushee et al., 2010) and extend our understanding of

how technological advances in trading affect information asymmetry in capital markets. Our results also complement recent work on the economic consequences of high-frequency trading regulations (Goldstein et al., 2014) by highlighting the indirect effects on corporate disclosure policies.

Several limitations of our study warrant mention and suggest avenues for future research. First, while we document associations between the regulatory change and disclosure practices, establishing definitive causal relationships remains challenging due to the concurrent nature of other market changes. Future research could exploit additional regulatory changes or natural experiments to further isolate the causal effects. Second, our focus on U.S. firms may limit the generalizability of our findings to other markets with different institutional features. Future studies could examine these relationships in other jurisdictions or investigate how different regulatory approaches to high-frequency trading affect corporate disclosure practices. Additionally, researchers might explore how artificial intelligence and machine learning developments in trading technology interact with disclosure policies and information asymmetry. Finally, future work could investigate how changes in high-frequency trading regulations affect other aspects of corporate behavior beyond disclosure policies, such as real investment decisions or capital structure choices.

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**Table 1**

## Descriptive Statistics

<b>Variables</b>	<b>N</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>P25</b>	<b>Median</b>	<b>P75</b>
FreqMF	14,654	0.6291	0.9090	0.0000	0.0000	1.6094
Treatment Effect	14,654	0.5861	0.4926	0.0000	1.0000	1.0000
Institutional ownership	14,654	0.5634	0.3400	0.2434	0.6479	0.8602
Firm size	14,654	6.3971	2.0935	4.8936	6.4110	7.8682
Book-to-market	14,654	0.6131	0.5937	0.2629	0.4926	0.8222
ROA	14,654	-0.0244	0.2283	-0.0123	0.0275	0.0688
Stock return	14,654	0.0165	0.4273	-0.2142	-0.0385	0.1616
Earnings volatility	14,654	0.1322	0.2666	0.0228	0.0519	0.1323
Loss	14,654	0.2867	0.4522	0.0000	0.0000	1.0000
Class action litigation risk	14,654	0.3225	0.2826	0.1014	0.2213	0.4711

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

**Table 2**  
**Pearson Correlations**  
**GermanHigh-FrequencyTradingAct Information Asymmetry**

	Treatment Effect	FreqMF	Institutional ownership	Firm size	Book-to-market	ROA	Stock return	Earnings volatility	Loss	Class action litigation risk
Treatment Effect	1.00	<b>0.02</b>	<b>0.04</b>	<b>0.09</b>	<b>-0.09</b>	<b>-0.03</b>	<b>0.02</b>	0.01	<b>0.02</b>	<b>-0.26</b>
FreqMF	<b>0.02</b>	1.00	<b>0.40</b>	<b>0.44</b>	<b>-0.17</b>	<b>0.22</b>	-0.02	<b>-0.17</b>	<b>-0.24</b>	<b>-0.04</b>
Institutional ownership	<b>0.04</b>	<b>0.40</b>	1.00	<b>0.62</b>	<b>-0.24</b>	<b>0.33</b>	<b>-0.03</b>	<b>-0.24</b>	<b>-0.30</b>	-0.00
Firm size	<b>0.09</b>	<b>0.44</b>	<b>0.62</b>	1.00	<b>-0.37</b>	<b>0.35</b>	<b>0.04</b>	<b>-0.24</b>	<b>-0.40</b>	<b>0.06</b>
Book-to-market	<b>-0.09</b>	<b>-0.17</b>	<b>-0.24</b>	<b>-0.37</b>	1.00	<b>0.07</b>	<b>-0.18</b>	<b>-0.10</b>	<b>0.03</b>	<b>-0.02</b>
ROA	<b>-0.03</b>	<b>0.22</b>	<b>0.33</b>	<b>0.35</b>	<b>0.07</b>	1.00	<b>0.12</b>	<b>-0.53</b>	<b>-0.60</b>	<b>-0.14</b>
Stock return	<b>0.02</b>	-0.02	<b>-0.03</b>	<b>0.04</b>	<b>-0.18</b>	<b>0.12</b>	1.00	<b>-0.02</b>	<b>-0.12</b>	<b>-0.02</b>
Earnings volatility	0.01	<b>-0.17</b>	<b>-0.24</b>	<b>-0.24</b>	<b>-0.10</b>	<b>-0.53</b>	<b>-0.02</b>	1.00	<b>0.36</b>	<b>0.15</b>
Loss	<b>0.02</b>	<b>-0.24</b>	<b>-0.30</b>	<b>-0.40</b>	<b>0.03</b>	<b>-0.60</b>	<b>-0.12</b>	<b>0.36</b>	1.00	<b>0.18</b>
Class action litigation risk	<b>-0.26</b>	<b>-0.04</b>	-0.00	<b>0.06</b>	<b>-0.02</b>	<b>-0.14</b>	<b>-0.02</b>	<b>0.15</b>	<b>0.18</b>	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 German High-Frequency Trading Act on Management Forecast Frequency**

	(1)	(2)
Treatment Effect	0.0313** (2.06)	-0.0573*** (4.10)
Institutional ownership		0.5015*** (18.67)
Firm size		0.1232*** (25.29)
Book-to-market		-0.0608*** (6.33)
ROA		0.0697*** (2.67)
Stock return		-0.0786*** (5.78)
Earnings volatility		-0.0967*** (4.72)
Loss		-0.0954*** (5.56)
Class action litigation risk		-0.1731*** (7.40)
N	14,654	14,654
R <sup>2</sup>	0.0003	0.2290

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