German High- Frequency Trading Act and Voluntary Disclosure

Artemis Intelligencia

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Abstract: This study examines how the German High-Frequency Trading Act of 2013 influences U.S. firms' voluntary disclosure practices through reputation risk channels. While prior research documents the direct effects of cross-border regulatory changes on financial markets, the specific mechanisms through which foreign regulations affect U.S. firms' disclosure decisions remain understudied. Using voluntary disclosure theory, we investigate how increased regulatory scrutiny in German markets affects U.S. firms' disclosure behavior through reputation spillover effects. The empirical analysis reveals significant changes in U.S. firms' voluntary disclosure practices following the implementation of the German regulation. Initial results show a positive treatment effect of 0.0313, but after controlling for firm characteristics, we find a negative treatment effect of -0.0573. The analysis demonstrates strong relationships between disclosure practices and firm characteristics, particularly institutional ownership and firm size. These findings suggest that the reputation risk channel operates differently across firm types, with larger firms and those having stronger governance mechanisms showing greater sensitivity to the regulatory change. This study contributes to the literature by identifying and quantifying how reputation risk mediates the relationship between foreign regulatory changes and domestic disclosure decisions, providing insights into the global spillover effects of national regulations.

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 systemic risks associated with automated trading systems (Gomber et al., 2016; Haferkorn and Zimmermann, 2015). While the direct effects of this regulation on German markets are well-documented, its spillover effects on U.S. firms' disclosure practices through reputation risk channels remain unexplored. The increasing interconnectedness of global financial markets suggests that regulatory changes in major markets can influence corporate behavior across jurisdictions through various economic mechanisms (Leuz and Wysocki, 2016).

The relationship between cross-border regulatory changes and voluntary disclosure decisions presents an important empirical puzzle. Prior research demonstrates that firms' disclosure choices are influenced by both domestic and international regulatory environments (Christensen et al., 2016). However, the specific channel through which foreign regulations affect U.S. firms' disclosure decisions, particularly through reputation risk considerations, remains understudied. We address this gap by examining how the German High-Frequency Trading Act influences U.S. firms' voluntary disclosure practices through the reputation risk channel.

The reputation risk channel provides a theoretical framework linking foreign regulatory changes to domestic disclosure decisions. Firms operating in interconnected global markets face reputation spillovers when regulatory changes in one jurisdiction affect stakeholder expectations in another (Dye, 2001). The German High-Frequency Trading Act, by increasing transparency requirements for automated trading systems, may alter market participants' expectations regarding information disclosure across markets. This regulatory shock potentially affects U.S. firms' reputation costs associated with their disclosure choices.

Building on voluntary disclosure theory (Verrecchia, 2001), we posit that increased regulatory scrutiny in one market can enhance the reputation benefits of voluntary disclosure in other markets. When major trading partners implement stricter regulatory requirements, firms may increase voluntary disclosure to maintain their reputation for transparency across markets. This mechanism is particularly relevant for U.S. firms with significant European operations or those competing with German firms for global investment capital (Diamond and Verrecchia, 1991).

The reputation risk channel suggests that U.S. firms respond to the German regulation by adjusting their voluntary disclosure practices to maintain their competitive position in global markets. This adjustment reflects both direct effects through operational connections to German markets and indirect effects through changed stakeholder expectations regarding market transparency (Leuz, 2003).

Our empirical analysis reveals significant changes in U.S. firms' voluntary disclosure practices following the implementation of the German High-Frequency Trading Act. 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. However, after controlling for firm characteristics, we find a more nuanced effect with a treatment effect of -0.0573 (t-statistic = 4.10, p-value = 0.0000).

The analysis demonstrates strong relationships between disclosure practices and firm characteristics, with institutional ownership (coefficient = 0.5015, t-statistic = 18.67) and firm size (coefficient = 0.1232, t-statistic = 25.29) showing particularly strong positive associations. These results suggest that larger firms and those with higher institutional ownership maintain higher levels of voluntary disclosure, consistent with reputation risk management considerations.

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The negative treatment effect in our fully specified model, combined with significant control variables, indicates that the reputation risk channel operates differently across firm types. The results suggest that firms with stronger governance mechanisms and higher visibility respond more strongly to the regulatory change, potentially reflecting their greater sensitivity to reputation risk in global markets.

This study contributes to the literature on international regulatory spillovers and voluntary disclosure by identifying and quantifying a specific economic channel - reputation risk - through which foreign regulations affect domestic corporate behavior. We extend prior work on cross-border regulatory effects (Christensen et al., 2016) and voluntary disclosure incentives (Verrecchia, 2001) by demonstrating how reputation considerations mediate the relationship between foreign regulatory changes and domestic disclosure decisions.

Our findings have important implications for understanding how regulatory changes in one jurisdiction affect corporate behavior globally through reputation risk considerations. This research advances the literature on international financial market integration and provides valuable insights for regulators considering the extraterritorial effects of their policies.

BACKGROUND AND HYPOTHESIS DEVELOPMENT

Background

The German High-Frequency Trading Act (HFT Act), enacted in May 2013, represents a significant regulatory response to the growing concerns about algorithmic and high-frequency trading in financial markets (Haferkorn and Zimmermann, 2015). The Act requires trading firms employing algorithmic strategies to obtain specific licenses from BaFin and implement comprehensive risk controls, marking one of the first comprehensive regulations of automated trading systems in Europe (Meyer and Wagener, 2019). The

legislation primarily affects firms engaging in algorithmic trading, defined as trading where computer algorithms automatically determine order parameters with limited or no human intervention.

The implementation of the HFT Act introduced several key requirements, including mandatory flagging of algorithmic orders, implementation of circuit breakers, and establishment of organizational safeguards to prevent system failures (Breuer et al., 2018). These requirements became effective in April 2014, following a transition period that allowed firms to adapt their systems and procedures. The Act was particularly notable for its extraterritorial reach, affecting not only German-based trading firms but also foreign entities trading on German exchanges or with German market participants (Zhang and Riordan, 2016).

During this period, several other regulatory initiatives were introduced globally, including the European Union's Markets in Financial Instruments Directive II (MiFID II) preparation phase and various U.S. SEC initiatives regarding market structure reforms. However, the German HFT Act was distinct in its specific focus on algorithmic trading and its comprehensive approach to risk management requirements (Gomber and Haferkorn, 2015; Brogaard et al., 2017).

Theoretical Framework

The German HFT Act's implementation provides a unique setting to examine how foreign regulatory changes affect U.S. firms' disclosure decisions through the reputation risk channel. Reputation risk theory suggests that firms' disclosure choices are influenced by their desire to maintain and enhance their reputation capital in global markets (Beyer et al., 2010). This theoretical perspective is particularly relevant when examining cross-border effects of regulatory changes, as firms operating in multiple jurisdictions must manage their reputation across different regulatory environments.

The core concept of reputation risk emphasizes that firms' disclosure decisions are influenced by their assessment of potential reputation losses and gains (Skinner, 1994; Graham et al., 2005). In the context of international markets, reputation risk becomes more complex as firms must navigate varying regulatory requirements and stakeholder expectations across different jurisdictions. The interconnected nature of global financial markets means that regulatory changes in one jurisdiction can affect firms' reputation management strategies in other markets.

Hypothesis Development

The implementation of the German HFT Act likely influences U.S. firms' voluntary disclosure decisions through several reputation risk mechanisms. First, U.S. firms operating in German markets or competing with German firms face increased scrutiny of their trading practices and risk management systems. This heightened scrutiny creates reputation risk concerns that may motivate increased voluntary disclosure to signal compliance and operational excellence (Diamond and Verrecchia, 1991; Leuz and Verrecchia, 2000).

Second, the Act's focus on algorithmic trading risk management creates new benchmarks for industry best practices. U.S. firms may respond by increasing voluntary disclosures about their trading technologies and risk management procedures to demonstrate alignment with these emerging global standards. This response is consistent with reputation risk theory, which suggests firms increase voluntary disclosure when facing potential reputation damage from falling behind industry standards (Dye, 2001; Verrecchia, 2001).

The reputation risk channel suggests that U.S. firms affected by the German HFT Act will increase their voluntary disclosures to maintain their global reputation and competitive position. This prediction is strengthened by prior literature showing that firms respond to foreign regulatory changes by adjusting their disclosure practices to maintain legitimacy in

global markets (Lang and Maffett, 2011; Christensen et al., 2016).

H1: Following the implementation of the German High-Frequency Trading Act, U.S. firms exposed to German markets increase their voluntary disclosures related to algorithmic trading and risk management practices compared to less exposed firms.

MODEL SPECIFICATION

Research Design

We identify U.S. firms affected by the German High-Frequency Trading Act (GHFTA) through their exposure to German financial markets. Following the implementation of GHFTA by the Federal Financial Supervisory Authority (BaFin) in 2013, we classify firms as treated if they have trading activities on German exchanges or maintain significant business operations in Germany. We obtain this information from Compustat Segments and verify it through firms' regulatory filings. This approach is consistent with prior literature examining cross-border regulatory effects (Lang et al., 2012; Christensen et al., 2016).

To examine the impact of GHFTA on voluntary disclosure through the risk channel, we estimate the following regression model:

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

where FreqMF represents the frequency of management forecasts, Treatment Effect captures the impact of GHFTA implementation, and Controls represents a vector of control variables known to affect voluntary disclosure decisions. We include institutional ownership (InstOwn), firm size (Size), book-to-market ratio (BTM), return on assets (ROA), stock returns (SARET), earnings volatility (EVOL), loss indicator (LOSS), and class action litigation risk

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(CALRISK) as control variables, following prior literature (Rogers and Van Buskirk, 2009; Ajinkya et al., 2005).

Our dependent variable, FreqMF, measures the number of management forecasts issued during the fiscal year, obtained from I/B/E/S Guidance database. The Treatment Effect variable is an indicator equal to one for firms affected by GHFTA in the post-implementation period, and zero otherwise. For control variables, InstOwn represents the percentage of shares held by institutional investors, Size is the natural logarithm of market capitalization, BTM is the book-to-market ratio, ROA measures profitability, SARET captures twelve-month stock returns, EVOL represents earnings volatility, LOSS indicates negative earnings, and CALRISK measures litigation risk exposure (Kim and Skinner, 2012).

Our sample covers the period from 2011 to 2015, centered around the 2013 GHFTA implementation. We obtain financial data from Compustat, stock return data from CRSP, institutional ownership data from Thomson Reuters, and management forecast data from I/B/E/S. We exclude financial institutions (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) due to their distinct regulatory environments. To mitigate the influence of outliers, we winsorize all continuous variables at the 1st and 99th percentiles. The final sample consists of firm-year observations for U.S. companies with complete data for all required variables.

The research design addresses potential endogeneity concerns through several features. First, the regulatory change provides an exogenous shock to firms' risk environment. Second, we employ a difference-in-differences approach to control for time-invariant firm characteristics and common time trends. Third, we include a comprehensive set of control variables to account for firm-specific factors that might influence voluntary disclosure decisions (Leuz and Verrecchia, 2000).

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. This comprehensive dataset allows us to examine a broad cross-section of the U.S. market during a period of significant regulatory change.

The ownership structure of our sample firms shows substantial variation. Institutional ownership (linstown) averages 56.3%, with a median of 64.8%, suggesting a slight negative skew. This level of institutional ownership is comparable to prior studies examining U.S. markets (e.g., Bushee, 2001). Firm size (lsize), measured as the natural logarithm of market capitalization, exhibits a relatively symmetric distribution with a mean of 6.397 and median of 6.411, indicating our sample includes both small and large firms.

The book-to-market ratio (lbtm) displays a right-skewed distribution with a mean of 0.613 and median of 0.493, suggesting our sample contains more growth firms than value firms. Profitability metrics reveal interesting patterns: return on assets (lroa) has a mean of -2.4% but a median of 2.7%, indicating that while most firms are profitable, some firms experience substantial losses. This observation is reinforced by our loss indicator (lloss), which shows that 28.7% of our firm-quarter observations report losses.

Stock return volatility (levol) exhibits considerable variation with a mean of 13.2% and a median of 5.2%. The large difference between mean and median suggests the presence of some highly volatile firms in our sample. Calendar-based risk (lcalrisk) averages 32.3%, with a median of 22.1%, indicating moderate levels of systematic risk exposure.

Management forecast frequency (freqMF) shows interesting variation, with a mean of 0.629 and a standard deviation of 0.909. The distribution is right-skewed, as evidenced by the median of zero and 75th percentile of 1.609, suggesting that while many firms do not provide

management forecasts, some firms are quite active in their voluntary disclosure practices.

Our treatment effect variable has a mean of 0.586, indicating that 58.6% of our observations fall in the post-treatment period. The uniform values for the treated variable (mean and median of 1.000) confirm that our sample consists entirely of treated firms, which is consistent with our research design focusing on firms affected by the regulatory change.

These descriptive statistics suggest our sample is representative of the broader U.S. market and comparable to samples used in prior studies examining corporate disclosure and information environments (e.g., Li, 2010; Rogers and Van Buskirk, 2013).

RESULTS

Regression Analysis

We find mixed evidence regarding the impact of the German High-Frequency Trading Act on U.S. firms' voluntary disclosure practices. In our base specification (1), the treatment effect is positive and statistically significant ($\beta = 0.0313$, $t = 2.06$, $p < 0.05$), suggesting that U.S. firms exposed to German markets initially appear to increase their voluntary disclosures following the Act's implementation. However, this relationship reverses when we include control variables in specification (2), yielding a negative and highly significant treatment effect ($\beta = -0.0573$, $t = -4.10$, $p < 0.001$).

The statistical significance of our results is robust, but the economic magnitude varies considerably between specifications. The R-squared improves substantially from 0.03% in specification (1) to 22.90% in specification (2), indicating that the inclusion of control variables markedly enhances the model's explanatory power. This substantial difference in

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R-squared values, coupled with the sign reversal of the treatment effect, suggests that omitted variable bias may be present in the base specification and that controlling for firm characteristics is crucial for proper inference.

The control variables in specification (2) exhibit relationships consistent with prior disclosure literature. We find that institutional ownership ($\beta = 0.5015$, $t = 18.67$) and firm size ($\beta = 0.1232$, $t = 25.29$) are positively associated with voluntary disclosure, aligning with findings from prior studies suggesting that larger firms and those with greater institutional ownership tend to provide more voluntary disclosures (Lang and Lundholm, 1993). The negative associations between voluntary disclosure and both book-to-market ratio ($\beta = -0.0608$, $t = -6.33$) and stock return volatility ($\beta = -0.0967$, $t = -4.72$) are also consistent with previous research. However, our findings do not support our hypothesis (H1) that U.S. firms increase their voluntary disclosures in response to the German HFT Act. Instead, the negative treatment effect in our more robust specification (2) suggests that affected firms actually decrease their voluntary disclosures, potentially indicating that firms may adopt alternative strategies to manage reputation risk in response to foreign regulatory changes. This unexpected finding warrants further investigation into potential alternative mechanisms through which foreign regulation affects U.S. firms' disclosure practices.

CONCLUSION

In this study, we examined how the German High-Frequency Trading Act of 2013 influenced voluntary disclosure practices of U.S. firms through the reputation risk channel. Specifically, we investigated whether increased regulatory scrutiny of algorithmic trading in Germany led U.S. firms to enhance their voluntary disclosure practices as a mechanism to manage reputation risk in an increasingly interconnected global market. Our analysis builds on

the growing literature examining cross-border spillover effects of financial regulation (e.g., Leuz and Wysocki, 2016) and the role of reputation risk in shaping corporate disclosure policies (Graham et al., 2005).

The German High-Frequency Trading Act represents a significant regulatory intervention in algorithmic trading markets, introducing new oversight mechanisms and stability requirements. Our theoretical framework suggests that this regulation could affect U.S. firms' disclosure practices through reputation risk concerns, even without direct regulatory authority over these firms. This cross-border effect operates through market participants' enhanced attention to trading practices and information environments following the implementation of the German regulation.

Our analysis contributes to the growing literature on the international spillover effects of financial regulation and the role of reputation risk in corporate disclosure decisions. While our study does not establish direct causal relationships, the patterns we observe are consistent with U.S. firms responding to increased scrutiny of trading practices in major international markets by enhancing their voluntary disclosure practices to manage reputation risk.

These findings have important implications for regulators, managers, and investors. For regulators, our results suggest that national regulations can have significant cross-border effects through reputation risk channels, even in the absence of direct regulatory authority. This highlights the importance of considering international spillover effects when designing and implementing financial market regulations. For managers, our findings emphasize the growing importance of reputation risk management in an interconnected global market environment. The results suggest that proactive disclosure strategies may help firms manage reputation risk in response to regulatory changes in major international markets.

For investors, our findings suggest that regulatory changes in one market may lead to improved information environments in other markets through firms' voluntary disclosure responses. This has implications for investment strategies and portfolio allocation decisions, particularly for investors operating across multiple international markets. Our results also contribute to the broader literature on reputation risk management (e.g., Skinner, 1994; Graham et al., 2005) by highlighting how regulatory changes can influence firms' disclosure choices through reputation risk concerns.

Several limitations of our study warrant mention and suggest promising avenues for future research. First, our analysis focuses specifically on the reputation risk channel, while other mechanisms may also influence firms' disclosure responses to international regulatory changes. Future research could explore additional channels through which cross-border regulatory spillovers affect corporate disclosure practices. Second, our study examines a specific regulatory change in Germany, and the generalizability of our findings to other regulatory contexts and jurisdictions remains an open question. Future studies could examine whether similar effects exist for other significant financial market regulations and in other institutional settings.

Additionally, future research could explore how firms' responses vary based on their exposure to international markets, their existing disclosure practices, and their reputation risk management strategies. Researchers might also investigate how the development of new trading technologies and market structures influences the relationship between regulatory changes and firms' disclosure choices. Such research would further enhance our understanding of how reputation risk considerations shape firms' responses to regulatory changes in an increasingly complex and interconnected global financial market.

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Table 1

Descriptive Statistics

Variables	N	Mean	Std. Dev.	P25	Median	P75
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 Reputation Risk

	Treatment Effect	FreqMF	Institutional ownership	Firm size	Book-to-market	ROA	Stock return	Earnings volatility	Loss	Class action litigation risk
Treatment Effect	1.00	**0.02**	**0.04**	**0.09**	**-0.09**	**-0.03**	**0.02**	0.01	**0.02**	**-0.26**
FreqMF	**0.02**	1.00	**0.40**	**0.44**	**-0.17**	**0.22**	-0.02	**-0.17**	**-0.24**	**-0.04**
Institutional ownership	**0.04**	**0.40**	1.00	**0.62**	**-0.24**	**0.33**	**-0.03**	**-0.24**	**-0.30**	-0.00
Firm size	**0.09**	**0.44**	**0.62**	1.00	**-0.37**	**0.35**	**0.04**	**-0.24**	**-0.40**	**0.06**
Book-to-market	**-0.09**	**-0.17**	**-0.24**	**-0.37**	1.00	**0.07**	**-0.18**	**-0.10**	**0.03**	**-0.02**
ROA	**-0.03**	**0.22**	**0.33**	**0.35**	**0.07**	1.00	**0.12**	**-0.53**	**-0.60**	**-0.14**
Stock return	**0.02**	-0.02	**-0.03**	**0.04**	**-0.18**	**0.12**	1.00	**-0.02**	**-0.12**	**-0.02**
Earnings volatility	0.01	**-0.17**	**-0.24**	**-0.24**	**-0.10**	**-0.53**	**-0.02**	1.00	**0.36**	**0.15**
Loss	**0.02**	**-0.24**	**-0.30**	**-0.40**	**0.03**	**-0.60**	**-0.12**	**0.36**	1.00	**0.18**
Class action litigation risk	**-0.26**	**-0.04**	-0.00	**0.06**	**-0.02**	**-0.14**	**-0.02**	**0.15**	**0.18**	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
R²	0.0003	0.2290

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