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Title thesis: The Impact of the EU Audit Reform on Investment Efficiency Across European Industries and Countries

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Abstract: This study investigates the impact of the EU Audit Reform on the investment efficiency of firms across various industries and countries within the European Union. The EU Audit Reform, implemented to improve financial reporting quality and transparency, aims to reduce information asymmetry and create a more reliable financial environment. Using a sample of 17,484 firm-year observations from 2011 to 2022, this research employs a Difference-in-Difference (DiD) regression model to assess the reform's influence on investment efficiency, mainly focusing on financially constrained and unconstrained firms. The analysis further explores how the reform's effects vary across industries and regulatory environments. The findings indicate that the EU Audit Reform positively impacts investment efficiency, with financially constrained firms showing significant improvements, while the impact on financially unconstrained firms was less pronounced. Furthermore, the analysis reveals significant variations in the reform's effects across industries with different levels of innovation and countries with differing regulatory quality. These results provide valuable insights into the broader implications of regulatory changes on corporate investment behaviour and offer essential policy implications for improving financial market efficiency and investor confidence in the EU.

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1. Introduction

Since the implementation of the EU Audit Reform on 17 June 2016, significant changes have been introduced to improve the quality of financial reporting within the European Union. The primary goal of the reform is to reduce information asymmetry and improve transparency, thereby fostering a more reliable financial environment (European Commission, 2022). Higher financial reporting quality is expected to mitigate issues such as overinvestment and underinvestment by financially constrained and unconstrained firms. For instance, prior studies have shown that better accounting standards can reduce investment cash flow sensitivity, improving overall investment efficiency (Biddle & Hilary, 2006; Biddle et al., 2009; Cheng et al., 2013). This study's analysis unit includes firms across various industries and countries within the EU, highlighting the broad applicability and importance of the reform's impact (Christensen et al., 2016).

Moreover, the relevance of this research extends to its potential policy implications. Improved audit standards aim to improve financial statement accuracy and create a more competitive and dynamic audit market. This reform is anticipated to have differential impacts across industries and countries, offering insights into how regulatory changes can drive economic stability and growth (Willekens et al., 2019). Thus, this study contributes to the broader discourse on the role of regulatory frameworks in improving market efficiency and investor confidence.

Previous research indicates that improved quality of financial reporting can improve investment efficiency (Bushman & Smith, 2001; Healy & Palepu, 2001; Lambert et al., 2007). Various empirical studies support this view, demonstrating that high-quality accounting leads to more efficient capital investments (Biddle & Hilary, 2006; Biddle et al., 2009; McNichols & Stubben, 2008). Consistent with this literature, Cheng et al. (2013) provide more direct evidence for this causal relationship than research based on cross-sectional analyses. Their study demonstrated that improved financial reporting quality, initiated by ICW disclosures, can mitigate issues like adverse selection and moral hazard, thereby improving investment efficiency. This research is critical as it highlights the causal link between financial reporting and investment behaviour, providing empirical support for regulatory measures like the Sarbanes-Oxley Act (SOX) to improve internal controls and financial transparency. Following the foundation laid by Cheng et al. (2013), this research aims to extend their work to the European context by focusing on the EU Audit Reform rather than the SOX provision requiring the disclosure of material internal control weaknesses (ICW). The EU Audit Reform represents a regulatory change designed to improve the quality of financial reporting across European firms. By examining the impact of this reform, this study aims to assess whether improved financial reporting quality similarly improves investment efficiency within the EU. Additionally, this study will explore whether the effects of the EU Audit Reform vary across different countries and industries, thereby providing a more comprehensive understanding of the reform's impact in diverse economic environments.

This study buid and extends the methodology of Cheng et al. (2013), who examined the impact of disclosing material weaknesses in internal control over financial reporting on firms' investment efficiency. However, instead of focusing on internal control weaknesses, this study focuses on implementing the EU Audit Reform. The EU Audit Reform, enacted to improve the quality of financial reporting across the European Union, is a regulatory change that potentially influences investment efficiency. By doing so, this study aims to investigate whether this comprehensive regulatory reform, designed to improve audit quality and financial transparency, leads to firms making more efficient investment decisions. Furthermore, this study expands on Cheng et al. (2013) by analysing the differential impacts of the EU Audit Reform across various EU countries and industries. This approach acknowledges that the effect of regulatory changes can vary depending on each country's regulatory environment, economic conditions, and the specific characteristics of different industries. By incorporating these dimensions into the analysis, this study aims to provide a nuanced understanding of how the EU Audit Reform influences investment efficiency in diverse contexts, offering valuable insights for policymakers and stakeholders on the broader implications of such regulatory changes. The research question that this thesis aims to answer is:

"How does the implementation of the EU Audit Reform influence the investment efficiency of firms across different industries and countries within the European Union?"

This study will examine how the EU Audit Reform impacts investment efficiency across different industries and countries within the European Union. The firm serves as the unit of analysis, and the sample encompasses data from various industries across all EU Member States, except Slovenia, due to the delayed implementation of the EU Audit Reform. The primary variables of interest are investment efficiency and the impact of the EU Audit Reform. Control variables include financial constraints and investment determinants. A sample of 17,484 firm-year observations is collected, covering the period from 2011 to 2022. The data sources include Compustat for financial reporting data, Transparency International for the Corruption Perceptions Index, and the World Bank for the Regulatory Quality Index. These secondary data sources are publicly available and widely used in academic research, ensuring reliability and validity. By employing panel regression models with fixed effects, this study controls for variations across firms and over time, providing robust estimates of the reform's impact on investment efficiency.

The hypothesis posits that the EU Audit Reform influences investment efficiency, with variations across different industries and countries. The reform is expected to increase transparency and improve financial reporting quality, improving investment efficiency, particularly in financially constrained firms. These firms often face higher external financing costs due to information asymmetry and risk perceptions. Improved audit quality and financial reporting can reduce these costs by providing more reliable information and facilitating better investment decisions (Cheng et al., 2013).

However, weighing these positive effects against potential negative impacts is crucial. Breuer et al. (2020) highlight that while the EU Audit Reform may improve transparency and market competition, it can also impose proprietary costs discouraging innovation, especially among smaller firms. This suggests that the reform's overall impact is complex, with benefits in terms of investment efficiency potentially offset by drawbacks in innovation capabilities.

Breuer's cross-sectional data from various industries and countries support the hypothesis that the effects of the EU Audit Reform will likely vary across industries and member states (Breuer et al., 2020). By employing a Difference-in-Difference (DiD) regression model, this study aims to capture the nuanced impacts of the reform, accounting for various interactions. The expected findings will contribute valuable insights for policymakers and stakeholders, informing future regulatory decisions and highlighting the broader implications of the EU Audit Reform across diverse economic environments. This analysis demonstrates the reform's effectiveness in encouraging a more transparent and efficient investment landscape while recognising the need to balance these benefits with potential costs to innovation, ultimately leading to more balanced and sustainable economic growth."

The remainder of the paper is organised as follows: Section 2 provides an in-depth examination of the theoretical framework and formulates the hypotheses. Section 3 details the data collection process for various variables and explains the methodology. Section 4 presents the study's results, followed by robustness checks. Section 5 discusses the findings and outlines the study's limitations. Finally, Section 6 summarises the key insights and implications.

2. Theoretical framework

2.1. *Investment efficiency*

Investment efficiency, a critical metric in corporate finance, measures how effectively firms allocate their resources to generate returns. Inefficiencies can arise due to agency problems, information asymmetries, or other market frictions. The foundational works by Jensen (1986) and Richardson (2006) provide the theoretical and empirical bases for understanding investment efficiency, which subsequent research has extensively adopted and expanded upon.

Jensen's seminal work on agency theory laid the groundwork for understanding how agency problems, particularly conflicts between managers and shareholders, can lead to investment inefficiencies. Jensen (1986) argues that managers of firms with free cash flow are more likely to invest in projects that do not necessarily maximise shareholder value, leading to overinvestment. This theoretical perspective highlights the importance of monitoring and controlling managerial discretion to improve investment efficiency. Richardson (2006) builds on this theory by empirically investigating the relationship between free cash flow and investment efficiency. Using a comprehensive dataset, Richardson demonstrates that firms with excess free cash flow tend to overinvest, resulting in lower

returns on investment. This study provides a robust methodological approach to measure investment efficiency as a reference point for numerous subsequent studies.

Biddle et al. (2009) further refine the concept of investment efficiency by defining it as undertaking projects with positive net present value (NPV) under no market frictions such as adverse selection or agency costs. According to Biddle et al. (2009), underinvestment occurs when firms pass up investment opportunities with positive NPV, while overinvestment happens when firms invest in projects with negative NPV. This precise definition aids in clearly measuring and assessing investment efficiency across different contexts.

Gugler et al. (2007) investigate the determinants of investment efficiency within different European corporate governance frameworks. They find that firms with concentrated ownership structures, particularly in Continental Europe, often exhibit underinvestment or overinvestment due to asymmetric information and agency problems. Using investment cash flow sensitivities, their analysis reveals how legal systems and ownership structures systematically affect investment decisions, offering a nuanced understanding of investment inefficiency across various institutional contexts.

Similarly, Liu et al. (2009) examine its impact on firm efficiency in emerging markets, specifically focusing on publicly listed firms in China. Their study underscores the pivotal role of governance mechanisms in mitigating agency problems and improving investment efficiency. The authors find that robust corporate governance practices, such as board independence and ownership concentration, are strongly associated with more efficient investment decisions. This research highlights the importance of institutional frameworks in shaping firm behaviour and optimising resource allocation, emphasising that effective governance is critical for achieving high investment efficiency in emerging market settings.

Hadlock and Pierce (2010) expand the discussion by exploring the impact of financial constraints on investment efficiency. They develop a measure of financial constraints based on firm characteristics and find that constrained firms typically underinvest, while unconstrained firms are prone to overinvest. Their empirical findings highlight the mutual impact of financial constraints on investment efficiency, illustrating how a firm’s financial health critically influences its resource allocation decisions.

Wurgler (2000) adds another dimension by analysing the role of financial market development in improving investment efficiency across countries. His research shows that nations with well-developed financial markets exhibit higher investment efficiency, as firms in these markets can allocate resources more effectively to their most productive uses. This cross-country analysis underscores the importance of financial market infrastructure in facilitating optimal investment decisions.

Shi et al. (2019) examine the influence of managerial learning from analysts on investment efficiency. They discover that firms where managers adhere closely to analysts' recommendations tend to achieve more efficient investment decisions. This research underscores the critical role of external information sources in improving investment outcomes, highlighting the importance of high-quality analyst reports in informing and guiding managerial decisions.

Khurana et al. (2017) examine the implications of actual earnings smoothing on investment efficiency. Their findings indicate that while earnings can occasionally signal stability, excessive smoothing often obscures actual financial performance, leading to inefficient investment decisions. This nuanced view on earnings management highlights its potential to stabilise and distort firm value, depending on the extent of its application and the underlying motives of management.

In conclusion, the extensive body of literature reviewed has examined investment efficiency from multiple perspectives, including agency theory, corporate governance, financial constraints, and market development. These studies provide robust empirical evidence and valuable insights into the determinants and consequences of investment efficiency. This foundational understanding paves the way for further research into the influence of specific regulatory changes, such as the EU Audit Reform, on investment efficiency. Investigating these effects across various industries and countries within the EU could contribute to the field, clarifying how improved financial reporting quality might lead to more efficient resource allocation and overall firm performance.

2.2. EU Audit Reform and financial reporting quality

Disclosure regulation plays a critical role in shaping the quality of financial reporting and the overall economic environment of firms. The EU Audit Reform represents a regulatory shift aimed at financial reporting standards within the European Union. The primary objective of the reform is to reduce information asymmetry and improve transparency, thereby encouraging a more reliable financial environment (European Commission, 2022).

Prior research investigated the general effects of disclosure regulation on corporate behaviour. Leuz et al. (2003) explored the relationship between earnings management and investor protection across 31 countries. They found stronger and better-enforced securities laws associated with fewer earnings management and higher disclosure scores. This indicates that robust disclosure regulations improve the quality of financial reporting by reducing incentives for earnings manipulation. Similarly, Christensen et al. (2016) examine the capital-market effects of securities regulation, specifically the implementation of the Market Abuse and Transparency Directives in the EU. Their study demonstrates that these regulations improved market liquidity and reduced information asymmetry, with effects varying based on prior institutional characteristics. These findings suggest that the success of the EU Audit Reform in improving investment efficiency will depend on existing regulatory frameworks and economic conditions within each EU member state. Overall, both studies underscore the importance of solid disclosure regulations in promoting transparent financial environments, thereby improving the efficiency of capital allocation and investment decisions.

Research on the implementation of the SOX also provides valuable insights. Iliev (2010) investigates the effects of SOX Section 404, focusing on its impact on compliance costs, earnings quality, and stock prices. The study finds that SOX implementation increased audit fees and decreased discretionary accruals among firms, signalling improved financial reporting quality. However, these benefits were

accompanied by costs, particularly for smaller firms, which experienced lower buy-and-hold returns due to the compliance burden. This underscores the trade-offs associated with strict regulatory requirements. In the EU Audit Reform context, Iliev's findings emphasise the need to balance the benefits of improved financial reporting against potential compliance costs, which is crucial for assessing the reform's overall impact on investment efficiency and firm behaviour.

Similarly, Ashbaugh-Skaife et al. (2008) demonstrate that SOXs' improved internal controls led to better financial reporting and lower idiosyncratic risk. Their research shows that strict regulatory measures can improve the quality of financial disclosures by strengthening internal controls. These findings are relevant for evaluating the EU Audit Reform, as similar measures in the EU are expected to improve financial reporting quality and reduce firm risk. By improving the accuracy and reliability of financial statements, the reform can facilitate better investment decisions and overall economic stability.

Gao et al. (2009) investigate the unintended consequences of the SOX on smaller firms, explicitly focusing on non-accelerated filers. Their study reveals that these smaller firms showed fewer investments and increased cash payouts post-SOX. This behaviour shift is attributed to the compliance burden imposed by SOX, which disproportionately affects smaller firms due to their limited resources. The study's findings underscore the potential for regulatory exemptions to influence firm behaviour. These insights are crucial in the EU Audit Reform context as they highlight the need to consider how strict disclosure regulations might affect firms differently based on their size and resource availability. The study provides a comparative framework for understanding how improved financial reporting standards under the EU Audit Reform could similarly impact investment decisions and economic strategies.

Breuer et al. (2020) extend this discussion by investigating the impact of financial reporting regulation on corporate innovation. Their study finds that while mandatory reporting improves transparency and market competition, it can impose proprietary costs discouraging innovation, particularly among smaller firms. This suggests that the benefits of the EU Audit Reform in terms of improved financial reporting quality must be weighed against the potential deterrent effects on innovation and firm behaviour. The study underscores the complexity of achieving optimal regulatory outcomes and highlights the need for a balanced approach that considers transparency and the proprietary costs of disclosure.

On 17 June 2016, the EU implemented new rules on statutory audit, marking a milestone in improving the quality of financial reporting across the European Union. This reform aims to address critical deficiencies in the audit market and restore investor confidence by ensuring the accuracy and reliability of financial statements. Statutory audits are crucial as they certify companies' financial statements, providing stakeholders, such as investors and shareholders, with an independent opinion on the accuracy of these accounts. This function is vital for the functioning of markets, contributing to the quality and efficiency of financial reporting.

The EU Audit Reform was initiated to address several critical issues in the audit market. Authorities across Member States observed deficiencies and inaccuracies in audit reports, raising concerns among investors about the reliability of financial statements, particularly those of banks, financial institutions, and publicly traded companies. The financial and economic crisis intensified these issues, further diminishing investor trust in the integrity of statutory auditors' reports. Additional challenges, such as close relationships between company management and audit firms, potential conflicts of interest, and compromised auditor independence, underscored the urgent need for comprehensive regulatory reforms.

The central aim of the EU Audit Reform is to improve the quality of audits and rebuild investor confidence, which is crucial for promoting future investments and economic development. This reform is designed to achieve greater transparency and quality in corporate financial reporting, improve the independence of statutory auditors, and ensure they exercise rigorous professional scepticism. Furthermore, the reform intends to create a more dynamic and competitive audit market within the EU. An additional goal is to improve the oversight and coordination of audit supervision by competent authorities throughout the EU.

The new legal framework comprises an amended Directive and a new Regulation. The Directive revises the 2006 Statutory Audit Directive, which initially set out the duties of statutory auditors and audit firms and established public oversight of the audit profession. The Regulation introduces specific requirements for the statutory audit of public-interest entities (PIEs), which include listed companies, credit institutions, and insurance undertakings.

The reform implements several measures to improve auditor independence and audit report quality. It requires audit reports to offer investors more detailed and relevant information about the audited company, extending beyond an essential opinion on the financial statements. Competent authorities responsible for public audit oversight are granted increased powers and capabilities to ensure adherence to the new regulations. Furthermore, the reform introduces a more robust sanctioning regime to prevent and address breaches of audit standards.

Stricter requirements are imposed on the statutory audits of PIEs to mitigate the higher risks and potential adverse effects of misstatements. These measures include improving audit reports, implementing mandatory rotation for statutory auditors and audit firms to avoid long-term relationships that might jeopardise auditor independence, and prohibiting specific non-audit services to prevent conflicts of interest. Additionally, the reform strengthens the role of audit committees, granting them a more significant role in the selection and oversight of auditors. Furthermore, it establishes a framework for effective communication between statutory auditors and PIE supervisors to improve oversight and promote financial stability (European Commission, 2022).

The EU Audit Reform is anticipated to improve the quality of financial reporting, resulting in more precise and trustworthy financial statements. By decreasing information asymmetry and increasing transparency, the reform seeks to restore investor confidence and facilitate more efficient investment

decisions by firms. However, the implementation of these regulations has encountered several challenges. According to Labbe (2017), the reform has not changed the dominance of the Big Four accounting firms, which continue to audit the most prominent companies. Additionally, Greed and Maginnis (2016) highlight that the new regulations may lead to unintended consequences, such as higher compliance costs and increased complexity for firms operating in multiple jurisdictions.

Furthermore, Willekens et al. (2019) note that while the reform aimed to reduce market concentration and increase competition, the aggregate EU market concentration remained relatively constant after the reform. However, there was evidence of increased rivalry and market share mobility among the most significant audit suppliers. Non-Big 4 audit firms have gained market share and engage more in tender procedures, competing on price, quality, and technology. The impact of the reform varies across different Member States, with stricter implementation leading to more changes in market structure and competition dynamics. Future research should focus on the long-term effects of these regulatory changes on audit quality and market competition across the EU.

Despite these challenges, researchers have documented a positive relationship between the EU Audit Reform (Directive 2014/56/EU and Regulation 537/2014) and improved financial reporting quality. The reform's key measures, such as mandatory audit firm rotation and restrictions on non-audit services, have improved auditor independence and transparency in financial reports. Studies indicate that these changes have resulted in higher audit quality, limiting tax avoidance and improving the overall reliability of financial statements (Lungu et al., 2023). Furthermore, the European Capital Markets Institute (ECMI) found that the reform effectively increased independence levels, indirectly supporting better financial reporting practices (de Groen et al., 2023). ESMA's role in implementing consistent audit standards across the EU has also contributed to higher audit quality and greater investor confidence in financial reports. The European Securities and Markets Authority's oversight ensures adherence to regulatory frameworks, enhancing the reliability and transparency of financial disclosures. This regulatory consistency has played a crucial part in strengthening the overall integrity of financial reporting within the EU (Mack, 2022). The study of Christofidou et al. (2024) on the impact of Directive 2014/56/EU on earnings management in European banks also confirms that the reform reduced discretionary loan loss provisions, indicating a decline in earnings management and an improvement in financial reporting quality (Christofidou et al., 2024). Therefore, it can be concluded that the quality of financial reporting has improved following the EU Audit Reform.

2.3. Empirical evidence on financial reporting quality and investment efficiency

Researchers have documented that improved financial reporting quality, driven by robust disclosure regulations, is positively associated with improved investment efficiency. Biddle and Hilary (2006) found that higher-quality accounting reduces information asymmetry, facilitating better capital investment decisions. Their study demonstrates that transparent accounting practices lower the investment cash flow sensitivity, indicating that firms with high accounting quality rely less on internal

funds and can more effectively secure external financing. This effect is more pronounced in economies where financing is mainly provided through stock markets rather than credit markets. Similarly, Bens and Monahan (2004) showed that superior disclosure quality enables firms to allocate resources more efficiently, thus optimising investment outcomes. Their research indicates that firms with higher disclosure quality better utilise their internal resources and make more informed investment decisions, improving overall firm value and efficiency.

Bushman et al. (2006) prove that improved financial reporting quality strengthens corporate governance mechanisms, leading to more efficient investment. They argue that high-quality financial reporting reduces information asymmetry between managers and investors, improving corporate governance and ensuring investment decisions align with shareholder interests. Biddle et al. (2009) further supported these findings by demonstrating that high financial reporting quality reduces the misallocation of capital, thereby improving investment efficiency. Their study finds that firms with better financial reporting quality exhibit lower investment cash flow sensitivity levels, suggesting they can pursue optimal investment opportunities without being constrained by internal cash flows.

Cheng et al. (2013) extended this line of research by examining the disclosure of internal control weaknesses. Their study provides direct evidence of the causal relationship between financial reporting quality and investment efficiency by examining firms that disclosed internal control weaknesses under the SOX. Before the disclosure, firms with internal control weaknesses exhibited inefficient investment behaviour, with financially constrained firms underinvesting and unconstrained firms overinvesting. After the disclosure, these firms improved investment efficiency, indicating that improved financial reporting quality reduces information asymmetry and improves resource allocation.

Furthermore, Badertscher et al. (2013) examined the implications of financial misreporting on investment decisions. They found that firms engaging in misreporting tend to overinvest, indicating that transparent reporting can mitigate such inefficiencies. Their study highlights how financial misreporting leads to resource misallocation, with firms overstating their earnings and engaging in overinvestment. By improving transparency and accuracy in financial reporting, firms can better align their investment decisions with actual performance, thereby improving investment efficiency. Chen et al. (2013) focused on the externalities of mandatory IFRS adoption, finding that improved disclosure standards under IFRS lead to better investment efficiency, improving financial information's comparability and transparency. Their research shows that adopting IFRS improves the quality of financial reporting, reduces information asymmetry, and enables investors to make more informed decisions. This leads to more efficient capital allocation and better investment outcomes. This suggests that the EU Audit Reform, which aims to improve financial reporting quality, could similarly lead to more efficient investment decisions by firms. The emphasis on solid enforcement regimes and the differential impact on firms with higher initial information asymmetry further underscore the importance of robust implementation for achieving the desired outcomes of the reform. Additionally, the varying impact of regulation across

different countries and industries highlights an exciting area for investigation in this research, as it may reveal how specific contexts influence the effectiveness of the reform.

Goodman et al. (2014) explored the relationship between management forecast quality and capital investment, concluding that higher quality forecasts are associated with more efficient investment decisions. Their study investigates whether the quality of managers' externally reported earnings forecasts could be used to infer the quality of their corporate investment decisions. By examining acquisitions and capital expenditures, they find that firms with high-quality management forecasts make better investment decisions, as evidenced by higher acquisition announcement returns and more efficient capital expenditures. This suggests that management's ability to produce accurate forecasts is critical to successful investment decision-making. Building on this research, Jung et al. (2014) extended the investigation to labour investments, documenting that better financial reporting quality positively affects the efficiency of labour investments. They argue that high-quality financial reporting reduces information asymmetry and provides better information for making labour investment decisions. Their findings indicate that firms with higher financial reporting quality are more likely to invest efficiently in their workforce, improving labour productivity and overall firm performance.

Furthermore, Cho (2015) utilised mandated segment reporting improvements to demonstrate that high-quality disclosures improve firms' internal capital allocation decisions, aligning capital distribution more closely with segment opportunities. His research highlights that the increased transparency from segment reporting helps firms allocate resources more effectively among their various segments, leading to better alignment with segment-specific opportunities and improved investment efficiency. This evidence supports the notion that high-quality financial disclosures are crucial for optimal internal capital allocation.

Leuz and Wysocki (2016) provided a comprehensive literature review, highlighting the real effects of financial reporting quality on investment efficiency. Their work suggests higher reporting quality reduces adverse selection and moral hazard problems, promoting more efficient investment decisions. They argue that high financial reporting quality is crucial for the efficient functioning of capital markets. It ensures that investors receive accurate information, reducing the risks associated with investment decisions. This reduction in information asymmetry helps firms lower their capital cost and allocate resources more efficiently, thus improving overall investment efficiency.

Further support comes from research by Hope et al. (2013), who found that improved financial reporting quality reduces information asymmetry and improves investment efficiency in international markets. Their study, which examines financial reporting quality across various countries, demonstrates that firms with higher-quality financial reports face lower financing constraints and can make more efficient investment decisions. This is particularly evident in countries with robust financial reporting standards, where the improved transparency and comparability of financial information allow for better monitoring by external investors, leading to more optimal capital allocation. These studies are essential for investigating the relationship between the implementation of the EU Audit Reform and investment

efficiency. They collectively illustrate how better financial reporting quality, driven by improved disclosures and transparency, can improve investment efficiency.

Breuer (2020) contributes to this body of evidence by examining the impact of mandatory financial reporting and auditing on industry-wide resource allocation. His findings show that reporting mandates promote competition and ownership dispersion in capital markets by reducing information asymmetry between firms and investors. This increased transparency allows firms to disperse ownership more widely and facilitates a transactional type of resource allocation. However, Breuer also finds that while reporting mandates can improve market competition and entry rates, they do not necessarily improve aggregate productivity or growth. This mixed evidence underscores the complexity of achieving efficient investment through improved disclosure regulations. Incorporating Breuer's findings with existing literature suggests that while robust financial reporting can reduce information asymmetry and improve investment efficiency, compliance costs may offset these benefits, especially for smaller firms. Thus, the overall impact on investment efficiency may vary depending on firm size and industry characteristics.

Moreover, while these findings are significant, Leuz and Wysocki (2016) also point out that there are still many opportunities for future research on the actual effects of financial reporting quality. Specifically, examining the impact of the EU Audit Reform presents a promising area for further study. It could be precious to extend the research to see if there are differences in the effects of the implementation across different industries and various EU countries. Such comparative studies could provide nuanced insights into how industry-specific factors and national regulatory environments influence the relationship between financial reporting quality and investment efficiency, thereby informing targeted policy interventions.

2.4. Hypotheses development

Based on insights from the existing literature, examining the impact of financial constraints on investment behaviour is crucial after implementing regulatory changes. Hadlock and Pierce (2010) develop a measure of financial constraints based on firm characteristics and find that constrained firms typically underinvest, whereas unconstrained firms are prone to overinvestment. Their research illustrates how a firm's financial health critically impacts its investment decisions, with constrained firms prioritising liquidity over growth opportunities. Cheng et al. (2013) provide empirical evidence showing that financially constrained firms are more likely to underinvest due to resource limitations and the high cost of external financing. These studies highlight that constrained firms prioritise liquidity over growth opportunities, leading to inefficiencies.

Biddle et al. (2009) discuss the tendency of financially unconstrained firms to overinvest, driven by managerial over-optimism and agency problems. Having easy access to internal and external funds, these firms often undertake projects with negative net present value, leading to inefficiencies. This

behaviour contrasts sharply with constrained firms, highlighting the differential impact of financial constraints on investment efficiency.

Biddle and Hilary (2006) demonstrate that higher-quality accounting reduces information asymmetry, facilitating better capital investment decisions. Their study shows that transparent accounting practices lead to more efficient investment by lowering the sensitivity of investment to cash flow, which means firms with high accounting quality rely less on internal funds and can secure external financing more effectively. Gao et al. (2009) add to this by examining the impact of stringent regulatory measures on investment efficiency. They find that improved financial reporting quality, driven by regulatory changes, improves investment efficiency by reducing underinvestment and overinvestment. Their findings suggest that regulations to improve financial reporting standards lead to more optimal resource allocation within firms.

Cheng et al. (2013) provide direct evidence on how financial reporting quality influences investment efficiency. Their study shows that firms exhibit improvements in investment efficiency after disclosing internal control weaknesses. This implies that improved financial reporting quality can mitigate investment inefficiencies resulting from regulatory reforms. The evidence from Breuer's paper (2020) suggests that while reporting mandates may lead to better investment decisions by reducing information asymmetry, the effect on aggregate productivity is mixed. This supports the need to investigate the reform's impact on underinvestment and overinvestment. Considering these insights, the following hypothesis is developed:

H_1: *Implementing the EU Audit Reform influences the investment efficiency of firms in the EU, with financially constrained firms underinvesting less and financially unconstrained firms overinvesting less after the reform.*

Building on the existing literature, this study aims to provide direct evidence on the relationship between regulatory changes and investment efficiency, similar to Cheng et al. (2013). However, it extends this research by examining the variability in investment efficiency improvements across different industries and countries. Christensen et al. (2016) investigate the capital-market effects of securities regulation and highlight that the impact of regulatory changes can vary across different industries and countries. Their findings suggest that the effectiveness of financial reporting improvements depends heavily on the existing regulatory and economic environment. This variability is crucial for understanding how the EU Audit Reform might influence investment efficiency differently across industries and member states. Breuer's use of cross-sectional data from various industries and countries to measure the impact of financial reporting mandates provides a methodological basis for hypothesising that the effects of the EU Audit Reform will most likely vary across different industries and member states (Breuer, 2020). To ensure clarity, *Hypotheses 2* and *3* split the impact on industries and countries. Considering these insights, the following hypotheses are developed:

H_2: *The improvement in investment efficiency varies across industries due to the EU Audit Reform.*

H_3: *The improvement in investment efficiency varies across countries due to the EU Audit Reform.*

Given these insights, examining how the EU Audit Reform affects investment efficiency at the firm level and in different industries and countries is essential. The existing literature underscores the importance of context-specific factors in determining the impact of regulatory changes. For instance, industries with higher levels of innovation may respond differently to the reform than less innovative industries. Similarly, countries with varying degrees of regulatory stringency and economic development may exhibit different patterns in investment efficiency improvements. By analysing these dimensions, this study aims to uncover the broader implications of the EU Audit Reform and contribute to a deeper understanding of its differential effects.

Finally, an answer to the research question is formulated by testing the two hypotheses.

3. Data and methodology

3.1. Data

The primary sample consists of 17,484 firm-year observations from 2011 to 2022. This research takes 2011 as a starting point because it captures a comprehensive view of investment efficiency before the reform, considering a range of at least 3 to 5 years. This period aims to establish a clear baseline of investment activities before any influence from the reform. Suppose the reform was effectively implemented by mid-2016. In that case, data from at least 2011 to 2015 is considered the pre-reform period; similarly, data from several years after the reform is included to analyse its impact over time. Since regulatory changes take time to influence corporate behaviour, including data up to the most recent full year available is advantageous. Data is unavailable for all companies up to 2023, so a range of 2011 to 2022 is used. Financial reporting data is collected from Compustat, the Corruption Perceptions Index from Transparency International, and the Regulatory Quality Index from World Development Indicators (WDI). In line with established norms in the literature, financial firms (i.e., those with SIC codes ranging from 6000 to 6999) are excluded due to their unique investment characteristics.

Winsorisation is a statistical technique used to reduce the impact of extreme outliers on data analysis. Outliers can skew statistical measures like the mean and standard deviation, leading to misleading results, especially in regression analysis. Winsorisation caps extreme values at specified percentiles, limiting their impact while maintaining the data's overall structure.

For this study, winsorising at the 2.5th and 97.5th percentiles was chosen because this level of winsorisation balances the need to reduce the influence of extreme outliers while keeping the data's

variability. Winsorising at these percentiles reduces skewness and kurtosis, bringing the distribution closer to normality, which is advantageous for regression analysis. This method retains more of the original data's variability compared to more aggressive winsorisation (e.g., 5th and 95th percentiles), thus balancing the influence of extreme outliers and preserving the data's natural spread. Consequently, this approach leads to more robust and reliable regression results, ensuring that a few extreme values stay within the findings.

In conclusion, winsorisation at the 2.5th and 97.5th percentiles effectively mitigated the impact of extreme outliers, resulting in a distribution more suitable for robust statistical analyses. To ensure the reliability of this analysis, all continuous variables were winsorised at the 2.5th and 97.5th percentiles due to extreme outliers. This approach aligns with standard empirical practices, ensuring that extreme values do not overly influence the results and that the findings are robust and reliable. Sharma and Chatterjee (2021) discuss this application, which demonstrates its flexibility and effectiveness in enhancing the robustness of statistical models across various contexts, including econometric analyses.

3.2. Main variables

Appendix A summarises each hypothesis's independent, dependent, and control variables before discussing the dependent and independent variables utilised in the analyses.

Consistent with Cheng et al. (2013), the dependent variable, *Investment Efficiency*, represents the total investment activities adjusted for scale. This metric integrates the sum of expenditures on research and development, capital investments, and acquisitions, less the proceeds from selling property, plant and equipment multiplied by 100 and scaled by the lagged total assets.

$$Investment\ Efficiency = \frac{(R\&D + CAPEX + Acquisitions - Proceeds\ Sale\ PPE) \times 100}{Lagged\ Total\ Assets} \quad (1)$$

The introduction of the EU Audit Reform is captured through the *PostReform* variable, which is used as the independent variable. The *PostReform* dummy assumes a value of one in the periods after the reform's enforcement in each specific country and zero otherwise, reflecting the staggered implementation dates across different countries. To handle edge cases where the fiscal year matches the reform year, the *PostReform* variable is set to 1 if the fiscal year is the same as the reform year and the month is the same or later than the reform month. This adjustment is necessary because firms must comply with the EU Audit Reform for that year, as they share their financial reporting at the end of each year. *Investment Efficiency* and *PostReform* are measured at the end of Year t, while *Constrained, IndustryInnovation and RegulatoryQuality* and control variables are measured at the end of Year $t-1$. Adopting this approach is beneficial for ensuring temporal separation between independent and dependent variables, which helps in establishing causality. It aligns with standard practices in empirical

research and ensures comparability with previous studies, such as Biddle et al. (2009) and Cheng et al. (2013).

The staggered implementation dates of the EU Audit Reform across different countries were referenced from the paper by Willekens et al. (2019), which details the implementation status from June 2016 to November 2018 for various member states, highlighting the differences in enforcement dates across the EU. The table with the Member State implementation status is included in *Appendix B*. Slovenia is excluded from this study because it did not implement the EU Audit Reform before November 2018.

The variable *Constrained*, critical for identifying firms' investment behaviour, is derived from the OverFirm rankings of firms' cash positions and leverage levels at year-end $t - 1$. By classifying firms based on financial flexibility, those with a propensity towards investment extremes, over- or underinvesting, are identified. This classification is achieved by converting cash and leverage indicators into decile ranks. Lower values of *Constrained* indicate financially constrained firms, while higher values indicate financially unconstrained firms. Using *Constrained* ensures that the financial constraint status of firms is measured before the investment decisions are made in Year t. This temporal ordering supports the causal interpretation of the results and aligns with standard empirical practices in financial and economic research.

The variable *IndustryInnovation* is based on the nature of the innovation process and uses key intermediate metrics. According to Hagedoorn and Coodt (2003), research and development (R&D) activities, often measured by R&D intensity, lead to patents and new product introductions. As the market learns about a firm's R&D activities, patents, and new product introductions, it responds by valuing the firm's assets higher. For this study, *IndustryInnovation* is calculated from the ratio of industry-level R&D expenditure to sales at year-end $t - 1$. This measure captures the intensity of innovation within each industry. Data on R&D expenditures and sales for firms within each industry are gathered to compute the industry-level innovation metric for each industry and year. This study uses this measurement of R&D intensity because it reflects the firm's efforts in innovation, and it is the most feasible metric to use, given the available data. Other measures, such as patent counts and Tobin's q, were not used due to a lack of comprehensive data.

The variable *RegulatoryQuality*, crucial for assessing a firm's investment behaviour, measures the government's ability to develop and enforce adequate policies and regulations that support and encourage private sector growth. This measure reflects the quality of regulatory frameworks in each EU country, providing insight into how regulatory environments influence firm behaviour (Shleifer & Vishny, 1997; Jensen & Meckling, 1976).

Due to collinearity issues, this study did not control for industry- and country-specific externalities using fixed effects based on the established SIC industry classification and country-specific indicators. This approach aligns with standard empirical practices, such as those of Cheng et al. (2013). However, the interaction terms for *PostReform* with *IndustryInnovation* and *RegulatoryQuality* were retained.

Including these interaction terms ensures that the model can provide valuable insights into how the reform's impact varies by industry and country. This is crucial for understanding the broader implications of the reform. This methodological choice aligns with previous studies, such as Cheng et al. (2013), where interaction terms are employed to isolate and understand the specific impacts within subgroups.

3.3. Control variables

To examine the impact of the EU Audit Reform on investment efficiency, it is essential to incorporate control variables that account for various determinants influencing financial reporting quality and investment levels. Based on Cheng et al. (2013), the regression model includes controls grouped into two key areas: (1) determinants of financial weakness (*FinancialWeak*) and (2) determinants of investment level (*INVDeterminant*)

The first group, *FinancialWeak*, focuses on control variables that could indicate poorer financial reporting, particularly relevant to the EU Audit Reform, as it aims to improve such quality. These variables include smaller firm size (*Log Asset*), as smaller firms are more likely to face internal control weaknesses due to limited resources and less established processes, leading to generally weaker financial reporting quality. Financially weaker firms (*Loss*) are included because such firms are more likely to experience internal control issues and consequently have poorer financial reporting quality. Additionally, firms growing more rapidly (*Extreme Growth)* are considered because rapid growth can challenge existing control systems, leading to poorer financial reporting quality. The variable *Cross-Border Listed* was intended to control for the complexity associated with firms listed across borders, as such complexity necessitates maintaining adequate internal controls, impacting financial reporting quality. However, collinearity issues omitted this variable from the analysis (Doyle et al., 2007).

The second group, *INVDetereminant*, includes investment determinants based on Biddle et al. (2009). These variables encompass cash flow (*CFO Sales*), as cash flow from operations divided by sales is essential to control the firm's liquidity, which can impact investment decisions and financial stability. The standard deviation of cash flow (*σ (CFO)*) and sales (*σ (Sales)*) are controlled because cash flow and sales volatility can influence investment risk and decision-making. The standard deviation of investments (*σ (Investment)*) is included to account for fluctuations in investment levels that might impact overall investment efficiency. Tangibility (*Tangibility*) is essential to control as firms with higher tangibility may have different investment opportunities and risks. Market leverage (*Leverage*) is controlled because high leverage can constrain a firm's investment capacity and affect financial stability. Dividends (*Dividends*) is an essential control variable as they reflect the firm's profit distribution policies, which can influence available funds for investment. The operating cycle (*Operating Cycle*) is controlled as it affects the firm's liquidity and operational efficiency, impacting investment decisions. Firm size (*Log Asset*) and a loss indicator (*Loss*) are also included to control for the firm's scale and financial health, respectively. Cash (*Cash*) and Slack (*Slack*) are also included as

control variables for the firm's liquid assets and excess resources, which can also influence investment efficiency. (Biddle et al., 2009).

Table 1

Summary statistics

	Mean	SD	Min	Median	Max	Kurtosis	Skewness
Investment Efficiency	12.173	13.184	0.356	7.537	61.554	7.527	2.133
CAPEX Efficiency	50.011	98.276	0.467	19.627	5548.786	18.489	3.896
Non-CAPEX Efficiency	8.136	12.222	0.011	3.200	57.473	8.967	2.445
PostReform	0.615	0.487	0.000	1.000	1.000	1.223	-0.472
Constrained	2842.364	2105.026	0.000	2680.222	7462.889	2.098	0.512
Constrained_dummy	0.601	0.490	0.000	1.000	1.000	-0.411	1.169
Constrained - WW Index	-0.251	0.164	-0.694	-0.228	0.011	3.242	-0.732
IndustryInnovation	0.050	0.045	0.000	0.040	0.200	2.398	0.623
IndustryInnovation_dummy	0.499	0.500	0.000	0.000	1.000	1.000	0.006
RegulatoryQuality	1.371	0.434	0.135	1.529	0.2040	2.203	-0.584
RegulatoryQuality_dummy	0.494	0.500	0.000	0.000	1.000	1.001	0.022
RegulatoryQuality – CPI	73.158	13.401	33.000	78.000	94.000	2.738	-0.777
Log(Asset)	5.944	2.408	0.496	5.653	11.320	2.512	0.382
Loss	0.286	0.452	0.000	0.000	1.000	1.898	0.948

Extreme Growth	0.199	0.400	0.000	0.000	1.000	3.263	1.504
Cross-Border Listed	0.222	0.416	0.000	0.000	1.000	2.786	1.336
CFO Sales	-0.203	1.204	-6.455	0.077	0.533	21.696	-4.357
σ(CFO)	0.261	0.326	0.009	0.096	6.125	3.096	1.327
σ(Sales)	0.156	0.183	0.000	0.096	0.929	8.941	2.413
σ(Investment)	0.075	0.087	0.001	0.031	0.857	2.570	1.122
Tangibility	0.192	0.176	0.000	0.140	0.810	3.786	1.130
Leverage	0.677	1.090	-1.276	0.402	6.125	13.418	2.759
Dividends	1.000	0.020	0.000	1.000	1.000	2495.715	-49.947
Operating Cycle	-236.412	294.105	-936.332	-258.548	569.576	4.235	0.681
Cash	379.463	935.589	0.000	33.889	4289.100	13.199	3.307
Slack	7.100	21.349	0.003	0.765	141.621	28.341	4.887
Observations	17,484						
Number of firms	2,865						

Notes: Table 1 provides summary statistics for the variables used in the analysis, including the mean, standard deviation (SD), minimum (Min), median, maximum (Max), kurtosis, and skewness. Kurtosis measures the "tailedness" of the data distribution, where high kurtosis indicates more outliers. Skewness measures the asymmetry of the data distribution, with positive skewness indicating a longer tail on the right side and negative skewness indicating a longer tail on the left side. These statistics offer a comprehensive overview of the variables' distribution and characteristics, aiding in understanding their behaviour and informing subsequent analysis.

3.4. Methodology

The DiD regression model was chosen for this study due to its robustness in evaluating the impact of policy changes, such as the EU Audit Reform. The DiD approach allows for a clear comparison of investment efficiency before and after the reform, distinguishing between financially constrained and unconstrained firms. This model effectively captures the reform's differential effects across various industries and countries by including a dummy variable for the post-reform period and interaction terms.

This study defines the treatment groups based on the specific characteristics being investigated. For *Hypothesis 1*, the treatment group consists of financially constrained firms, which are more likely to be affected by the EU Audit Reform. In contrast, the control group consists of financially unconstrained firms.

For *Hypothesis 2*, the treatment and control groups are defined based on the continuous variable *IndustryInnovation*. This variable allows for assessing how innovation intensity at the industry level impacts the effect of the EU Audit Reform on investment efficiency.

For *Hypothesis 3*, the treatment and control groups are defined based on the continuous variable *RegulatoryQuality.* This variable enables the examination of how differences in regulatory quality influence the impact of the EU Audit Reform on investment efficiency.

The DiD regression model is a statistical technique used to estimate causal relationships by comparing the changes in outcomes over time between a treatment group (exposed to the reform) and a control group (not exposed to the reform) (Angrist & Pischke, 2009). This method mitigates potential biases from time-invariant unobserved heterogeneity by differencing out these fixed effects, thereby isolating the impact of the policy change.

An advantage of the DiD model is its ability to integrate interaction terms, allowing it to capture the effects of the reform across different levels of financial constraints, industries, and countries. This capability facilitates a thorough analysis of the reform's broader implications and aids in comprehending its diverse impacts across various contexts.

Moreover, the DiD model excels in policy evaluation, offering insights for policymakers and stakeholders. Measuring the reform's impact helps assess the effectiveness of the regulatory changes and guides future policy decisions.

A distinct post-reform period separates the independent and dependent variables. This approach strengthens the causal relationship between the EU Audit Reform and investment efficiency, reducing the likelihood of reverse causality.

In conclusion, the DiD regression model is chosen for its ability to deliver reliable estimates of the impact of the EU Audit Reform. By accounting for interactions between firm-level characteristics and regulatory changes, this approach thoroughly evaluates the reform's effects on corporate investment decisions across different economic environments.

3.4.1.Main assumptions

The validity of this study's DiD analyses relies on satisfying two fundamental assumptions: the *Parallel Trends Assumption* (PTA) and the *Stable Unit Treatment Value Assumption* (SUTVA). These assumptions ensure that the control group is a valid counterfactual for the treatment group in the absence of the treatment (Angrist & Pischke, 2009).

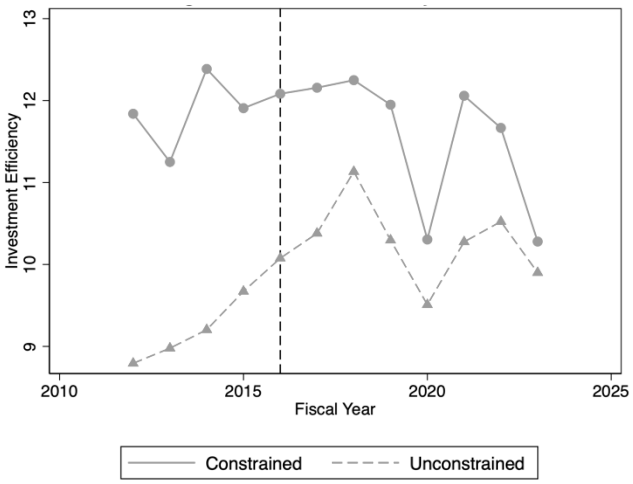
3.4.1.1. Parallel Trends Assumption

PTA requires that the outcome trend of the control group equals the outcome trend of the treated group in the absence of treatment. Although the counterfactual trend (the trend the treated group would have followed without the intervention) is not directly observable, the credibility of this assumption can be tested by comparing the pre-intervention trends of both groups.

The analysis was refined by classifying firms based on whether their *Constrained* value was above or below the median for each year. A dummy variable named *Constrained_dummy* was created, where firms with a *Constrained* value above the median were assigned a value of 1, and those below the median were assigned a value of 0. This categorisation allowed for a detailed examination of the investment efficiency trends for firms with high and low financial flexibility. This study visually inspected the pre-intervention trends of investment efficiency for constrained and unconstrained firms by generating a line graph. Figure 1 illustrates the average investment efficiency over time for constrained (straight line) and unconstrained (dashed line) firms. The vertical line in the graph marks the year of the policy intervention. As seen in the figure, the pre-intervention trends (prior to 2016) for both groups appear to run roughly parallel, suggesting that the trends in investment efficiency for constrained and unconstrained firms were similar before the reform.

Figure 1

Average Investment Efficiency over time Constrained_dummy

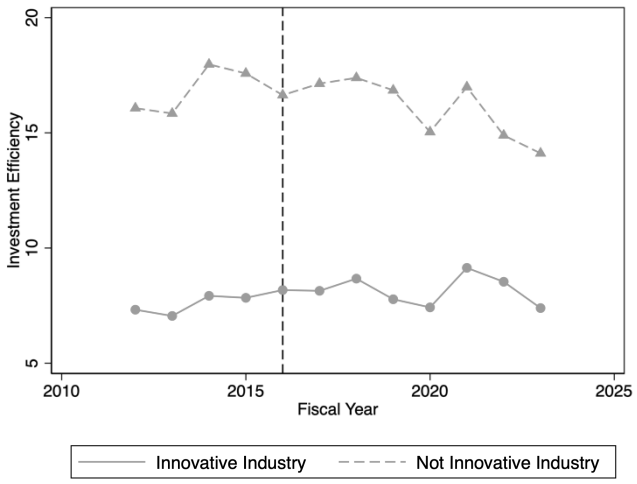


Notes: Comparison of outcome trends reflecting *Investment Efficiency* of the control and treated group based on *the Constrained_dummy.* The years are presented on the x-axis, whereas the mean *Investment Efficiency* is on the y-axis. The vertical line indicates the year of the reform implementation.

Furthermore, for *Hypothesis 2*, firms were classified based on whether their IndustryInnovation value was above or below the median for each year. A dummy variable named *IndustryInnovation_dummy* was created, where firms with an IndustryInnovation value above the median were assigned a value of 1, and those below the median were assigned a value of 0. This categorisation allowed for a detailed examination of the investment efficiency trends for firms in highly innovative industries versus less innovative industries. Figure 2 illustrates these trends.

Figure 2

Average Investment Efficiency over time IndustryInnovation_dummy

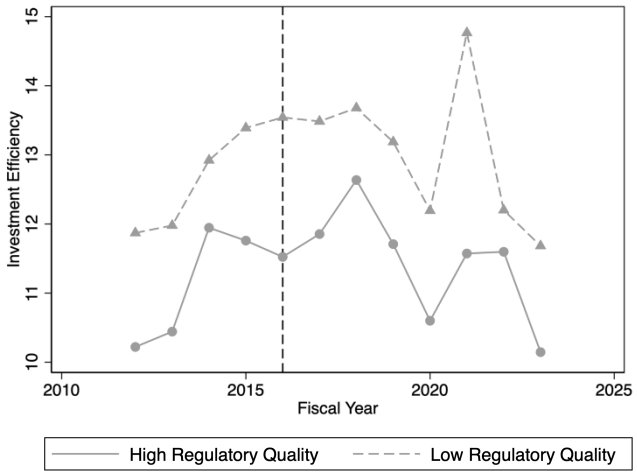


Notes: Comparison of outcome trends reflecting *Investment Efficiency* of the control and treated group based on the *IndustryInnovation_dummy*. The years are presented on the x-axis, whereas the mean *Investment Efficiency* is on the y-axis. The vertical line indicates the year of the reform implementation.

Similarly, for *Hypothesis 3*, firms were classified based on whether their *Regulatory Quality* value was above or below the median for each year. A dummy variable named *RegulatoryQuality_dummy* was created, where firms with a *Regulatory Quality* value above the median were assigned a value of 1, and those below the median were assigned a value of 0. This categorisation allowed for a detailed examination of the investment efficiency trends for firms in countries with high versus low regulatory quality. Figure 3 illustrates these trends.

Figure 3

Average Investment Efficiency over time RegulatoryQuality_dummy



Notes: Comparison of outcome trends reflecting *Investment Efficiency* of the control and treated group based on the *RegulatoryQuality_dummy*. The years are presented on the x-axis, whereas the mean *Investment Efficiency* is on the y-axis. The vertical line indicates the year of the reform implementation.

To further validate the assumption of parallel trends, this study conducts a regression analysis, interacting fiscal year indicators with the constrained status for the pre-intervention period. This regression analysis is also conducted for the *IndustryInnovation_dummy* and *RegulatoryQuality_dummy*. The regression results are shown in *Appendix C*. It is important to note that by 2018, all countries had implemented the EU Audit Reform. The regression results indicated that all interaction terms between fiscal year indicators and the constrained status were not statistically significant. This means that the trends in investment efficiency for constrained and unconstrained firms were similar before the reform, supporting the assumption of parallel trends.

For the *IndustryInnovation_dummy*, the regression results also indicated that the interaction terms between fiscal year indicators and *IndustryInnovation_dummy* were not statistically significant. This suggests that, overall, the trends in investment efficiency for industries with high and low innovation intensity were similar before the reform, further supporting the parallel trends assumption for *Hypothesis 2*.

Similarly, for the *RegulatoryQuality_dummy*, the regression results showed that the interaction terms between fiscal year indicators and *RegulatoryQuality_dummy* were not statistically significant. This indicates that the trends in investment efficiency for firms in high and low-regulatory-quality environments were similar before the reform, validating the parallel trends assumption for *Hypothesis 3*.

3.4.1.2. Stable Unit Treatment Value Assumption

SUTVA ensures the validity of drawing causal conclusions in DiD analyses. This assumption includes two main components: no interference and consistency. These components are essential for accurately linking changes in the outcome variable to the treatment effect.

The no-interference component of SUTVA implies that the outcome of any given unit (firm) should remain unaffected by the treatment status of other units. In practical terms, for this study, the investment decisions and outcomes of firms in the treatment group should be independent of those in the control group. Specifically, for *Hypothesis 1*, firms classified as financially constrained should have independent outcomes from those classified as financially unconstrained. For *Hypothesis 2*, firms with high innovation intensity should have independent outcomes from those with low innovation intensity. For *Hypothesis 3*, firms operating in high regulatory quality environments should have independent outcomes from those in low regulatory quality environments. This separation is crucial because any spillover effects between these groups could distort the results, making it difficult to isolate the impact of the treatment.

The consistency component requires that the potential outcome under the treatment received matches the observed outcome. For instance, the observed investment efficiency of a financially constrained firm under treatment should be the same as the potential investment efficiency if the same firm had not been treated. This consistency ensures that the observed changes in the outcome variable can be attributed directly to the treatment and not to other external factors.

Despite its critical nature, SUTVA's satisfaction cannot be directly tested because it involves unobservable counterfactuals. Formal testing would require knowing how untreated firms would behave if treated and vice versa, which is impossible. This limitation necessitates a reliance on theoretical and contextual justifications to argue that SUTVA holds in a given study.

Although SUTVA cannot be formally tested in this study, it can be reasonably argued that firms in the control group are unlikely to react to the treatment affecting the treated group. Firms classified differently based on financial constraints, industry innovation intensity, and regulatory quality do not operate in sufficiently distinct contexts, which raises the possibility of some interaction that could influence each other's investment decisions.

The operational contexts of the firms involved are carefully considered to support this assumption further. Instead of using control variables that capture sector, geographic, and market differences, this study captures the differences in financial constraints for *Hypothesis 1*, the differences in industry innovation intensity for *Hypothesis 2*, and the differences in regulatory quality for *Hypothesis 3*. This approach helps to isolate the treatment effect on the respective groups accurately.

In conclusion, the assumption of parallel trends and stable unit treatment value have been thoroughly evaluated. The visual and statistical analyses support the assumption of parallel trends, and the contextual reasoning supports the SUTVA. Together, these validations ensure the robustness and reliability of the DiD analysis conducted in this study.

3.4.2. Hausman Test

This study performs a specification test proposed by Hausman (1978) based on the difference between the fixed and random effects estimators. The Hausman Test was conducted to determine the appropriate model for this panel data analysis: fixed effects (FE) or random effects (RE). The test compared the coefficients of the FE and RE models for the critical variables in each hypothesis: *PostReform*, *Constrained*, *IndustryInnovation*, and *RegulatoryQuality*, as well as their interaction terms with *PostReform*. The results showed significant differences between all hypotheses' coefficients obtained from the FE and RE models. The detailed regression results for the Hausman Test for all hypotheses are presented in *Appendix D*.

For *Hypothesis 1*, the chi-squared statistic was 59.73 with a p-value of 0.0000, indicating significant differences between the FE and RE models. Specifically, the coefficients for *PostReform*, *Constrained*, and the interaction term *(PostReform × Constrained)* differed significantly. This led to rejecting the null hypothesis that the coefficient differences are not systematic, indicating that the RE model is inconsistent and that the FE model is preferred.

For *Hypothesis 2*, the chi-squared statistic was 115.23 with a p-value of 0.0000, again showing significant differences between the FE and RE models. The coefficients for *PostReform*, *IndustryInnovation*, and the interaction term *(PostReform × IndustryInnovation)* showed systematic differences, leading to the rejection of the RE model.

For *Hypothesis 3*, the chi-squared statistic was 73.28 with a p-value of 0.0000, confirming significant differences between the FE and RE models. The coefficients for *PostReform*, *RegulatoryQuality*, and the interaction term *(PostReform × RegulatoryQuality)* were notably different, supporting the rejection of the RE model.

Consequently, rejecting the null hypothesis in all cases indicates that the coefficient differences are systematic, implying that the RE model is inconsistent. Thus, the FE model is preferred to provide consistent and reliable estimates. The fixed effects model is chosen because it effectively controls for unobserved heterogeneity by accounting for time-invariant characteristics within the entities, ensuring that omitted variables do not bias the observed effect of the explanatory variables on the dependent variable. Given the systematic differences highlighted by the Hausman Test Field, the FE model is a robust choice for the analysis.

3.4.3. Hypothesis 1

Hypothesis 1 is tested by focusing on the interaction between *PostReform* and *Constrained* to examine how financial constraints influence investment behaviour after the EU Audit Reform implementation. The regression equation for this hypothesis is:

$$InvestmentEfficiency_{it} = \beta_0 + \beta_1 PostReform_t + \beta_2 Constrained_{t-1} + \beta_3 (Constrained_{t-1} \times PostReform_t) + \beta_4 FinancialWeak_{i,t-1} + \beta_5 INVDeterminant_{i,t-1} + \epsilon_{i,t} \quad (2)$$

The null hypothesis (H_0) and the alternative hypothesis (H_A) for *Hypothesis 1* are as follows:

H_0: The interaction term ($\beta 3$) does not affect investment efficiency, implying that financial constraints do not influence investment efficiency differently in the post-reform period.

H_A: The interaction term ($\beta 3$) affects investment efficiency, indicating that financial constraints influence investment efficiency differently in the post-reform period.

The coefficient $\beta 1$ associated with the variable *PostReform* measures the effect of being in the post-reform period on investment efficiency. The coefficient $\beta 2$ measures the direct impact of financial constraints on investment efficiency, regardless of the reform period. The interaction term *(PostReform × Constrained)* captures how the relationship between financial status and investment efficiency changes in the post-reform period. The coefficient $\beta 3$ associated with this term is central to the hypothesis, allowing us to identify the differential effects of financial constraints on investment efficiency following the reform.

If the coefficient $\beta 3$ is negative and statistically significant, it indicates that financially constrained firms underinvest less following the EU Audit Reform. This suggests that the reform helped ease some financial constraints, allowing these firms to increase their investment activities. Conversely, if the coefficient $\beta 3$ is positive and statistically significant, it suggests that financially unconstrained firms overinvest less following the reform. This indicates that the reform may have curbed excessive investment behaviours among financially flexible firms by imposing stricter audit requirements and compliance costs.

Through the interaction term *(PostReform × Constrained)*, this comprehensive model effectively captures how financial constraints influenced investment efficiency following the EU Audit Reform. By examining the sign and significance of $\beta 3$, this study can determine whether financially constrained firms increased their investment or financially unconstrained firms reduced their overinvestment after the reform. This analysis provides valuable insights into how the EU Audit Reform impacted firms' investment behaviours based on their financial conditions, contributing to the understanding of the broader implications of the reform.

3.4.4.Hypothesis 2

To test *Hypothesis 2*, this study first examines how the relationship between investment efficiency and the EU Audit Reform varies across different industries. The regression equation employed for *Hypothesis 2* is:

$$InvestmentEfficiency_{it} = \beta_0 + \beta_1 PostReform_t + \beta_2 IndustryInnovation_{i,t-1} + \beta_3 \left(PostReform_t \times IndustryInnovation_{i,t-1}\right) + \beta_4 FinancialWeak_{i,t-1} + \beta_5 INVDeterminant_{i,t-1} + \epsilon_{it} \quad (3)$$

The interaction term *(PostReform × IndustryInnovation)* is used to assess the differential effects of the reform across various industries. A significant coefficient on this interaction term would indicate that the improvement in investment efficiency due to the reform varies across industries with different levels of innovation. The coefficient *β1* associated with *PostReform* measures the effect of being in the post-reform period on investment efficiency. *Hypothesis 3*'s critical focus is on the interaction term *(PostReform × Industries),* which captures how the relationship between investment efficiency and reform varies across different industries. The coefficients *β3* associated with these terms are crucial for *Hypothesis 3.*

The null hypothesis (H_0) and the alternative hypothesis (H_A) for *Hypothesis 2* are as follows:

(H_0): There is no difference in the improvement in investment efficiency across industries due to the EU Audit Reform.

(H_A): There is a difference in the improvement in investment efficiency across industries due to the EU Audit Reform.

3.4.5.Hypothesis 3

Hypothesis 3 explicitly investigates the interaction between *PostReform* and *RegulatoryQuality* variables to determine whether the impact of the EU Audit Reform on investment efficiency varies across different countries. The regression equation *for Hypothesis 3* is:

$$InvestmentEfficiency_{it} = \beta_0 + \beta_1 PostReform_t + \beta_2 RegulatoryQuality_{i,t-1} + \beta_3 \left(PostReform_t \times RegulatoryQuality_{i,t-1}\right) + \beta_4 FinancialWeak_{i,t-1} + \beta_5 INVDeterminant_{i,t-1} + \epsilon_{it} \quad (4)$$

The critical focus of *Hypothesis 3* is on the interaction term *(PostReform × RegulatoryQuality),* which captures how the relationship between investment efficiency and reform varies across different countries. The term *(PostReform × RegulatoryQuality)* evaluates the differential impact across countries. A significant coefficient on these interaction terms would support the alternative hypothesis,

suggesting that the reform's impact is not uniform but influenced by specific industry and country contexts.

The coefficient *β1* associated with *PostReform* measures the effect of being in the post-reform period on investment efficiency. *Hypothesis 3*'s critical focus is on the interaction term *(PostReform × RegulatoryQuality),* which captures how the relationship between investment efficiency and reform varies across different countries. The coefficients *β3* associated with these terms are crucial for *Hypothesis 3.*

The null hypothesis (H_0) and the alternative hypothesis (H_A) for *Hypothesis 3* are as follows:

(H_0) : There is no difference in the improvement in investment efficiency across countries due to the EU Audit Reform.

(H_A): There is a difference in the improvement in investment efficiency across countries due to the EU Audit Reform.

The term *(PostReform × RegulatoryQuality)* evaluates the differential impact across countries. A significant coefficient on these interaction terms would support the alternative hypothesis, suggesting that the reform's impact is not uniform but influenced by specific industry and country contexts.

This comprehensive model *(PostReform × RegulatoryQuality)* effectively captures how the impact of the EU Audit Reform on investment efficiency varies across different countries. By examining the sign and statistical significance of *β3*, this study can determine whether there is a difference in the improvement in investment efficiency across industries and countries due to the reform. This improved model allows a nuanced exploration of how external regulatory changes interact with internal firm characteristics and external industry or country-specific factors to influence corporate investment decisions. By incorporating these layers of interaction, this approach not only tests the direct effects of regulatory changes but also uncovers the broader implications of such reforms in diverse economic environments.

4. Results

The results in this section should indicate improvements in investment efficiency following the implementation of the EU Audit Reform. Prior research suggests that regulatory changes to improve financial reporting quality can impact investment efficiency (Biddle & Hilary, 2006; Cheng et al., 2013). Accurate financial reporting is crucial for various firms, and strict audit controls are expected to show noticeable improvements in investment efficiency.

For *Hypothesis 1*, which focuses on financial constraints, positive and statistically significant interaction terms between the *PostReform* and *Constrained* variables are expected. This would suggest that the reform helped reduce financial constraints, leading to better investment decisions. This aligns

with Biddle et al. (2009) and Bushman et al. (2006), who observed similar effects of improved financial reporting on reducing information problems.

Hypothesis 2 examines industry innovation. Industries with high innovation intensity are expected to improve investment efficiency after the reform. Positive and statistically significant interaction terms between the *PostReform* variable and the *IndustryInnovation* variable indicate that the reform helped reduce inefficiencies, especially in innovative industries that rely heavily on accurate and reliable financial information.

For *Hypothesis 3*, which focuses on regulatory quality, countries with existing robust regulatory systems are expected to see a more noticeable positive impact from the reform. This is consistent with Christensen et al. (2016), who found that regulatory improvements are more effective in countries with a history of higher regulatory quality. Significant interaction terms between the *PostReform* variable and the *RegulatoryQuality* variable should reflect these expected findings, showing that the reform's impact on investment efficiency depends on the regulatory context of each country.

These results would support the hypothesis that the EU Audit Reform's impact on investment efficiency varies across different levels of financial constraints, industries, and countries. This highlights the importance of contextual factors in evaluating the effectiveness of regulatory changes. This comprehensive analysis aims to provide valuable insights into the reform's influence on investment efficiency, offering essential implications for policymakers and stakeholders regarding the broader economic benefits of better financial reporting standards (Hope et al., 2013).

The expected results will contribute to the existing literature by showing how regulatory changes can improve investment decisions and economic stability across different contexts, providing a clearer understanding of the broader implications of the EU Audit Reform.

4.1. Hypothesis 1

Table 2 presents the results of the DiD regression analysis, assessing the impact of the EU Audit Reform on investment efficiency while differentiating between financially constrained and unconstrained firms.

The primary variable of interest, *PostReform*, captures the effect of the post-reform period on investment efficiency. In both models, the coefficient for *PostReform* is positive and statistically significant, indicating an increase in investment efficiency during the post-reform period. Specifically, the coefficient for *PostReform* in Model (2) is 2.055, which is significant at the 0.1% level. This finding suggests that the EU Audit Reform introduced improvements positively influencing firms' investment decisions. This result aligns with previous studies that found improvements in financial reporting quality are associated with improved investment efficiency.

The variable *Constrained*, which identifies financially constrained firms, shows a consistently negative and significant coefficient across both models. In Model (2), the coefficient is -0.000, which is significant at the 0.1% level. This indicates that constrained firms have lower investment efficiency,

consistent with existing literature suggesting that constrained firms are more cautious and efficient in their investment decisions due to limited resources.

The interaction term *(PostReform × Constrained)* is not statistically significant in Model (1) but is significant in Model (2) with a coefficient of -0.000 at the 0.1% significance level. This suggests that the differential effect of the EU Audit Reform on investment efficiency between financially constrained and unconstrained firms is not strongly evident when control variables are excluded but become noticeable when they are included. Therefore, the null hypothesis (*H0*) for *Hypothesis 1*, which states that the interaction term (*β3*) does not affect investment efficiency, cannot be rejected based on Model (1) but is rejected in Model (2).

Several control variables also significantly correlate with Model (2) investment efficiency. *Log(Asset)* is negatively and significantly related to investment efficiency, with a -6.185 coefficient indicating that larger firms tend to have lower investment efficiency. *Loss* is negatively significant with a coefficient of -1.904, suggesting that firms reporting losses tend to have lower investment efficiency. The variable *σ (CFO)* is significant and negative, with a coefficient of -1.577, implying that firms with more volatile cash flows have lower investment efficiency. Additionally, *σ (Investment)* is significant and negative with a coefficient of -8.294, indicating that firms with more variability in their investment levels tend to have lower investment efficiency. The variable *Cash* is significant and positive with a coefficient of 0.002, suggesting that firms with higher cash reserves have higher investment efficiency. Other control variables, such as *Extreme Growth*, *Leverage*, *Sales*, *Tangibility*, *CFO Sales*, *Slack*, *Dividend*, and *Operating Cycle*, are included in the model but do not show significant relationships in this context, highlighting the complex nature of the factors influencing investment efficiency.

Regarding the R-squared (R^2) value, Model (1) reports an R^2 of 0.0011, indicating that the model explains approximately 0.11% of the variance in investment efficiency. Model (2) has an R^2 of 0.0799, explaining approximately 7.99% of the variance. While these R^2 values may seem low, they are not unusual in social sciences or economics, where numerous factors influence behaviour and decision-making. In DiD regressions, which deal with complex real-world data, a modest R^2 can still provide valuable insights. The primary objective of a DiD regression is to estimate an intervention's causal impact rather than maximise the explained variance. Thus, the statistical significance and magnitude of the coefficients are more crucial than the R^2 value alone.

Given Model (2)'s higher R^2 value, it better fits the data, suggesting it captures more of the variance in investment efficiency. Moreover, Model (2) includes a comprehensive set of control variables, offering a detailed understanding of the factors influencing investment efficiency. Therefore, Model (2) should be valued for its explanatory power, while Model (1) provides additional context.

The comparison of results between Table 2, which uses a continuous variable for financial constraints, and Table A5.1 in *Appendix E*, which uses a binary variable, reveals notable differences in the impact of the EU Audit Reform on investment efficiency. These differences highlight that using a continuous variable for financial constraints captures more nuanced variations, revealing a differential

impact of the reform. In contrast, a binary variable may oversimplify the classification, potentially obscuring some effects and leading to divergent interpretations of the reform's impact on investment efficiency.

In conclusion, the regression results indicate that the EU Audit Reform impacts overall investment efficiency. However, there is no differential effect between financially constrained and unconstrained firms based on Model (1). Including control variables in Model (2) provides a more nuanced understanding of the factors influencing investment efficiency, underscoring the importance of variables that could indicate poorer financial reporting and investment determinants. These findings support the hypothesis that the EU Audit Reform influences firms' investment efficiency in the EU, even though the anticipated differential impact based on financial constraints is observed in Model (2) but not in Model (1). Future research should examine additional variables that influence the relationship between financial constraints and the effectiveness of regulatory reforms. While this study has incorporated several control variables to account for factors affecting financial reporting quality and investment efficiency, other relevant factors still need to be explored. Investigating these additional dimensions could provide a more nuanced understanding of how financial constraints interact with regulatory reforms and contribute to a deeper insight into their overall effectiveness.

Table 2

Investment Efficiency and PostReform relationship

Dependent variable: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	-0.526	2.055***
	(0.328)	(0.323)
Constrained$_{t-1}$	-0.000***	-0.000***
	(0.000)	(0.000)
*PostReform$_t$ * Constrained$_{t-1}$*	-0.000	-0.000***
	(0.000)	(0.000)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0011	0.0799

Notes: Difference-in-Difference regression results with Investment Efficiency as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

4.2. Hypothesis 2

Table 3 presents the results of the DiD regression analysis, evaluating the impact of the EU Audit Reform on investment efficiency across different industries.

The primary variable of interest, *PostReform*, captures the overall effect of the reform period. In Model (2), the coefficient for *PostReform* is 0.602 and is statistically significant at the 5% level, suggesting that investment efficiency increases in the post-reform period. This finding implies that the EU Audit Reform introduced improvements that positively influenced firms' investment decisions.

The variable *IndustryInnovation*, which measures the intensity of innovation within each industry, shows a positive and significant coefficient in Models (1) and (2). Specifically, the coefficient is 24.555 in Model (1) and 22.989 in Model (2), both significant at the 5% level. This indicates that industries with higher innovation intensity tend to have higher investment efficiency. The interaction term *(PostReform × IndustryInnovation)* is -13.833 and statistically significant at the 1% level in Model (1), while it is 9.425 and significant at the 5% level in Model (2). This suggests that the improvement in investment efficiency due to the reform varies across industries with different levels of innovation intensity. The negative coefficient in Model (1) may imply that the reform had a less positive impact on highly innovative industries than on less innovative ones. Conversely, the positive coefficient in Model (2) suggests that the reform's positive impact is more pronounced when additional control variables are considered.

The variation in the significance of the interaction term between the models can be attributed to the influence of control variables. In Model (1), without control variables, the negative interaction term may reflect underlying challenges that highly innovative industries face, such as higher compliance costs or disruptions during the reform implementation. Conversely, in Model (2), the positive interaction term indicates that once firm-specific factors, such as size and financial health, are accounted for, the reform's benefits for highly innovative industries become more evident. This suggests that the reform's positive effects are better captured when considering these additional factors, highlighting the importance of a comprehensive model.

The comparison between Table 3 and Table A5.2 in *Appendix E* underscores differences in the impact of the EU Audit Reform on investment efficiency when using continuous versus binary variables for *IndustryInnovation*. These differences indicate that using a binary variable oversimplifies the classification, potentially obscuring the reform's nuanced effects. In contrast, employing a continuous variable for *IndustryInnovation*, as discussed in Table 3, captures more detailed variations, revealing a more nuanced differential impact of the EU Audit Reform.

In conclusion, the regression results indicate that the EU Audit Reform impacts overall investment efficiency. The significant interaction terms suggest that the reform's impact varies across industries with different innovation intensities. Including control variables in Model (2) highlights the importance of firm-specific factors in determining investment efficiency. These findings support the hypothesis that

the EU Audit Reform influences firms' investment efficiency in the EU, with a differential impact based on industry innovation intensity observed. Future research could explore whether other industry characteristics, such as industry size or market structure, might also affect the reform's effectiveness. Understanding these characteristics could reveal how various industry dynamics influence the reform's impact on investment efficiency, offering a more comprehensive view of the reform's overall effectiveness.

Table 3

Investment efficiency and post-reform relationship

Dependent: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	-0.171	0.602*
	(0.233)	(0.235)
IndustryInnovation$_{t-1}$	24.555*	22.989*
	(12.015)	(11.313)
*PostReform * IndustryInnovation$_{t-1}$*	-13.833**	9.425*
	(5.119)	(4.770)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0888	0.0890

Notes: Difference-in-Difference regression results with Investment Efficiency as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

4.3. Hypothesis 3

Table 4 presents the results of the DiD regression analysis, which evaluates the impact of the EU Audit Reform on investment efficiency across countries with different regulatory environments. The analysis examines whether the reform's effects vary based on each country's regulatory quality.

The primary variable of interest, *PostReform*, captures the overall effect of the reform period. In Model (2), the coefficient for *PostReform* is 1.190 and statistically significant at the 5% level, indicating that investment efficiency increases in the post-reform period. This result suggests that the EU Audit Reform introduced improvements positively influencing firms' investment decisions.

The variable *RegulatoryQuality*, which measures the regulatory environment within each country, shows a coefficient of -3.102 in Model (2) and is statistically significant at the 0.1% level. This indicates

that countries with higher regulatory quality tend to have lower investment efficiency. The interaction term *(PostReform × RegulatoryQuality)* is -0.873 and statistically significant at the 5% level in Model (1). This suggests that the reform may have had a less positive impact on countries with higher regulatory quality. Conversely, in Model (2), the interaction term is 0.045 and not statistically significant, indicating that once control variables are included, the differential impact of the reform across countries with varying regulatory quality diminishes.

Regarding the R^2 values, Model (1) reports an R^2 of 0.0056, indicating that the model explains approximately 0.56% of the variance in investment efficiency. Model (2) has an R^2 of 0.0664, explaining approximately 6.64% of the variance.

The comparison between Table 4, which uses a continuous variable for *RegulatoryQuality*, and Table A5.3 in *Appendix E*, which employs a binary variable for regulatory quality, does not highlight notable differences in the EU Audit Reform's impact on investment efficiency.

In conclusion, the regression results indicate that the EU Audit Reform impacts overall investment efficiency. The significant interaction terms suggest that the reform's impact varies across countries with different regulatory environments. Including control variables in Model (2) highlights the importance of firm-specific factors in determining investment efficiency. These findings support the hypothesis that the EU Audit Reform influences firms' investment efficiency in the EU, with a differential impact based on regulatory quality observed. Future research could explore the long-term sustainability of the effects of the EU Audit Reform on investment efficiency. Specifically, it would be beneficial to explore how the reform interacts with other macroeconomic factors and regulatory changes over time. This comprehensive approach would offer more profound insights into how evolving regulatory environments and broader economic conditions impact investment efficiency over extended periods.

Table 4

Investment efficiency and post-reform relationship

Dependent: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	0.440	1.190*
	(0.589)	(0.596)
RegulatoryQuality$_{t-1}$	-0.185	-3.102***
	(0.898)	(0.888)
*PostReform$_t$ * RegulatoryQuality$_{t-1}$*	-0.873*	0.045
	(0.437)	(0.433)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0056	0.0664

Notes: Difference-in-Difference regression results with Investment Efficiency as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

4.4. Robustness checks

Various robustness checks were conducted to ensure the reliability and validity of the primary DiD analysis. These checks involved modifying the sample or the model specifications to see if the results hold under different conditions. Robustness checks are essential as they help confirm that the findings are not sensitive to specific model assumptions or sample selections. In this study, three distinct robustness checks were carried out for all three hypotheses, and additional checks were explicitly conducted for *Hypothesis 1* and *Hypothesis 3*.

For all hypotheses, the first robustness check focuses on investment efficiency based solely on capital expenditures (*CAPEX*). By concentrating exclusively on CAPEX, this check aims to determine whether capital expenditures primarily drive the overall investment efficiency results. This approach helps to understand the specific contribution of CAPEX to the observed effects of the reform. Ensuring that the results are robust when isolating CAPEX investments enhances the validity of the findings related to the reform's impact on investment efficiency.

The second robustness check evaluates investment efficiency using only research and development expenses plus acquisition costs (*Non-CAPEX*). By examining these specific types of investments separately, this check verifies if the results remain consistent when different categories of investments are considered independently. This approach is crucial as it allows for determining whether the findings

are robust across various investments, providing a more comprehensive understanding of the reform's impact on investment efficiency.

Finally, a sensitivity analysis is performed by excluding the first and last years of the sample. This approach aims to ensure that the results are not unduly influenced by observations at the temporal boundaries of the dataset, which might be affected by unique events or anomalies specific to the initial or final years of the study period. Focusing on the central years allows testing whether the core findings hold steady when potentially atypical boundary data points are removed. This is important as it helps confirm that the observed effects are consistent and not artefacts of specific outlier years, thereby strengthening the robustness and generalizability of the results.

To further examine the robustness of the results of *Hypothesis 1*, the Whited-Wu (*WW*) Index is employed as an alternative measure to classify constrained firms. The WW Index is a well-established measure of financial constraints, enabling the assessment of the findings' consistency with a different classification approach. Using the WW Index helps verify if the reform's effects on investment efficiency hold across various financial constraint measures. This ensures that the results are not dependent on a single classification method, thereby enhancing the robustness and validity of the conclusions. The WW Index is calculated using the formula provided by Hennessy and Whited (2007):

$$\begin{aligned} WW\ Index = & -0.091 \times \frac{Cash\ Flow}{Total\ Assets} + 0.072 \times Dividends - 0.045 \times Log(Assets) \\ & - 0.062 \times Leverage + 0.020 \times Industry\ Sales\ Growth \\ & - 0.044 \times Sales\ Growth \end{aligned} \tag{5}$$

The ratio of cash flow to total assets measures the firm's ability to generate cash relative to its total assets. This ratio indicates how efficiently a company uses its assets to produce cash flow. Dividends is a binary variable that equals 1 if the firm pays dividends and 0 otherwise. Paying dividends is often a sign of financial health and stability, suggesting the firm has sufficient profits and cash flow to distribute to shareholders. The log of total assets accounts for size effects, as larger firms typically have better access to capital markets and are thus less financially constrained. Leverage is calculated as the ratio of total debt to total assets. High leverage indicates higher financial risk and potential financial constraints, as the firm may face more difficulty raising additional debt. Industry sales growth measures the average sales growth in the firm's industry. Industry growth can impact a firm's financial constraints, as firms in growing industries may find it easier to access external financing. Sales growth measures the firm's own sales growth. High sales growth indicates better performance and can reduce financial constraints by improving access to capital markets.

For *Hypothesis 2*, an alternative measure for *IndustryInnovation* was not employed, as other potential indicators, such as patent counts and Tobin's q, could not be assessed due to the unavailability of comprehensive data.

For *Hypothesis 3*, the Corruption Perceptions Index is employed as an alternative measure of regulatory quality (*CPI*). The Corruption Perceptions Index measures the perceived level of public sector corruption in different countries. This index is a proxy for the strictness and quality of a country's corporate governance and financial reporting regulations. Employing the Corruption Perceptions Index allows for assessing whether the effects of the reform on investment efficiency are consistent when using different measures of regulatory quality. This ensures that the results are not dependent on a single measure of regulatory quality, thereby enhancing the robustness and validity of the conclusions. Indices could be based on worldwide governance indicators, ease of doing business rankings, or specific scores related to financial reporting standards (Davis et al., 2012).

The robustness checks for *Hypothesis 1*, summarised in Table 5, illustrate the consistency and variability in the findings under various conditions.

First, the robustness check isolates *Investment Efficiency* based solely on capital expenditures (*CAPEX*). The *PostReform* coefficient in this model is 4.331 and is statistically significant at the 5% level. The interaction term between *PostReform* and *Constrained* is -0.000, which is not statistically significant. The lack of statistical significance in the interaction term suggests that when focusing exclusively on CAPEX, the differential impact on constrained firms' investment efficiency needs to be more evident. This could be due to CAPEX-related investments being more stable and less sensitive to changes in financial reporting requirements, leading to less observable impact from the reform.

Second, the robustness check evaluates *Investment Efficiency* using only research and development expenses plus acquisition costs (*Non-CAPEX*). The *PostReform* coefficient here is 1.760, which is significant at the 0.1% level, while the interaction term is -0.000, which is also significant at the 0.1% level. This suggests a positive differential impact on constrained firms when focusing on non-capital expenditure investments. These statistically significant coefficients indicate that the EU Audit Reform has a notable impact on *Non-CAPEX* investments, potentially due to these types of investments being more discretionary and thus more influenced by changes in financial reporting and audit requirements.

Third, a sensitivity analysis is conducted by excluding the first and last years of the sample. The PostReform coefficient in this model is 2.128 and significant at the 0.1% level, while the interaction term remains insignificant. This check aims to ensure that the results are independent of observations at the temporal boundaries of the dataset. The consistent findings when excluding boundary years suggest that the observed effects are stable and not artefacts of specific outlier years.

Finally, using the *WW* Index to classify constrained firms shows a PostReform coefficient of 1.738, which is significant at the 0.1% level. The interaction term in this model is 2.074, but it is not statistically significant. This indicates no differential impact on constrained firms identified by this alternative measure, suggesting that the method of classifying constrained firms can affect the observed effects of the reform.

The robustness checks indicate that the primary findings are generally stable across different specifications, although some variability is observed. The positive interaction term in the *Non-CAPEX*

model suggests that constrained firms experience a slight improvement in investment efficiency post-reform when focusing on research and development and acquisition costs. This variability underscores the importance of considering different dimensions of investment efficiency to understand the reform's impact. These checks provide a nuanced view of the robustness and reliability of the findings, demonstrating that while the primary conclusions are generally upheld, the specifics can vary depending on the model and sample adjustments.

Table 5

Robustness Test Hypothesis 1

	Baseline	CAPEX	Non-CAPEX	Sensitivity	WW
Investment Efficiency$_t$	(1)	(2)	(3)	(4)	(5)
PostReform$_t$	2.055***	4.331*	1.760***	2.128***	1.738***
	(0.323)	(2.212)	(0.290)	(0.328)	(0.411)
Constrained$_{t-1}$	-0.000***	0.002*	-0.000**	-0.000***	1.269
	(0.000)	(0.001)	(0.000)	(0.000)	(2.647)
PostReform$_t$ * *Constrained*$_{t-1}$	-0.000***	-0.000	-0.000***	-0.000***	2.074
	(0.000)	(0.001)	(0.000)	(0.000)	(1.324)
Control Variables$_{t-1}$	Included	Included	Included	Included	Included
Observations	17,484	17,484	17,484	15,071	17,484
R^2	0.0799	0.2068	0.0644	0.0774	0.0734

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) is the DiD model used in the primary regression, which includes control variables. Model (2) uses the dependent variable, *Investment Efficiency*, based only on the firm's capital expenditures. Model (3) uses the dependent variable, *Investment Efficiency*, based on only the firm's research and development expenses plus acquisition costs. Model (4) excludes this study's sample's first and last year. Model (5) uses a continuous variable based on the Whited Wu Index for the *Constrained* variable. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

The robustness checks for *Hypothesis 2*, summarised in Table 6, evaluate the sensitivity of the results under different model specifications and classifications, focusing mainly on the interaction terms with industry innovation intensity.

When using the *CAPEX* model (Model 2), the coefficient for *PostReform* is 2.911 but not statistically significant. The coefficient for *IndustryInnovation* is -107.582 and is also not statistically significant. The interaction term *(PostReform × IndustryInnovation)* is 16.297 and not statistically significant. This indicates that the differential impact of the reform on investment efficiency based on industry innovation is not evident when focusing solely on capital expenditures. The results suggest that capital expenditures may not be as responsive to the reform, potentially due to the stable and long-term nature of such investments, which might not immediately reflect changes in financial reporting and audit requirements.

Conversely, in the *Non-CAPEX* model (Model 3), the coefficient for *PostReform* is 0.584 and statistically significant at the 1% level, while the coefficient for *IndustryInnovation* is 30.194 and also statistically significant at the 1% level. The interaction term *(PostReform × IndustryInnovation)* is 6.291 but not statistically significant. These results suggest that the positive impact of the reform on investment efficiency is more pronounced for non-capital expenditures, such as research and development and acquisitions. These types of investments are typically more discretionary and sensitive to changes in regulatory environments, thus showing a response to the reform.

The sensitivity analysis, which excludes the first and last years of the sample (Model 4), shows a *PostReform* coefficient of 0.534 and is statistically significant at the 5% level. The coefficient for *IndustryInnovation* is 24.097 but not statistically significant, and the interaction term *(PostReform × IndustryInnovation)* is 8.582 and not statistically significant at the 5% level. These results indicate that while the core effect of the reform remains significant, the lack of statistical significance for *IndustryInnovation* and the interaction term in the sensitivity analysis suggests that the findings may not be robust when excluding boundary years.

Overall, the robustness checks for *Hypothesis 2* indicate that the primary findings are generally stable across different specifications and classifications. The positive impact of the EU Audit Reform on investment efficiency is more pronounced for non-capital expenditures, highlighting the responsiveness of investments such as research and development to regulatory changes. The results underscore the importance of considering different dimensions of investment efficiency to fully understand the reform's impact, providing a nuanced view of its differential effects across industries with varying innovation intensities.

Table 6

Robustness Test Hypothesis 2

	Baseline	CAPEX	Non-CAPEX	Sensitivity
Investment Efficiency$_t$	(1)	(2)	(3)	(4)
PostReform$_t$	0.602*	2.911	0.584**	0.534*
	(0.235)	(1.648)	(0.194)	(0.248)
IndustryInnovation$_{t-1}$	22.989*	-107.582	30.194**	24.097
	(11.313)	(75.909)	(9.942)	(12.374)
*PostReform * IndustryInnovation*$_{t-1}$	9.425*	16.297	6.291	8.582
	(4.770)	(32.301)	(4.132)	(4.905)
Control variables$_{t-1}$	*Included*	*Included*	*Included*	*Included*
Observations	17,484	17,484	17,484	15,071
R^2	0.0890	0.2077	0.0863	0.0863

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) is the DiD model used in the primary regression, which includes control variables. Model (2) uses the dependent variable, *Investment Efficiency*, based only on the firm's capital expenditures. Model (3) uses the dependent variable, *Investment Efficiency*, based on only the firm's research and development expenses plus acquisition costs. Model (4) excludes this study's sample's first and last year. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

Table 7 summarises the results of the robustness checks for *Hypothesis 3*, focusing on the coefficients and significance levels under various conditions. These checks assess the sensitivity of the results to different model specifications and classifications, with a particular emphasis on the terms of interaction with countries.

In the *CAPEX* model, the coefficient for *PostReform* is 3.793 but not statistically significant, and the interaction term for *RegulatoryQuality* is -0.300 and not statistically significant. This indicates that when focusing solely on capital expenditures, the differential impact of the reform across countries with varying regulatory quality needs to be evident.

Conversely, in the *Non-CAPEX* model, the coefficient for *PostReform* is 1.126 and statistically significant at the 5% level. The coefficient for *RegulatoryQuality* is -2.224 and statistically significant at the 1% level, while the interaction term for *RegulatoryQuality* is -0.022 and not statistically

significant. This suggests that the positive impact of the reform on investment efficiency is more pronounced for non-capital expenditures. The difference in results between *CAPEX* and *Non-CAPEX* regressions could be attributed to the nature of the investments. Non-capital expenditures, such as research and development (R&D) and acquisitions, are often more discretionary and sensitive to changes in financial reporting and audit requirements. These investments may benefit more from improved transparency and accountability introduced by the reform, thus positively impacting investment efficiency.

The sensitivity analysis, which excludes the sample's first and last years, reveals a *PostReform* coefficient of 1.111, though not statistically significant, a *RegulatoryQuality* coefficient of -3.247 statistically significant at a 0.1% level, and a *RegulatoryQuality* interaction term of 0.026, also not statistically significant. These findings suggest that the core results are stable even when excluding boundary years, underscoring the robustness of the observed effects.

When using the Corruption Perceptions Index (*CPI*) as an alternative measure of regulatory quality, the *PostReform* coefficient is 0.751 but not statistically significant. Similarly, the coefficient for *RegulatoryQuality* is 0.007 and is not statistically significant, and the interaction term for *RegulatoryQuality* is 0.006, also lacking statistical significance. The lack of statistical significance for these coefficients suggests that the robustness of the primary findings may be limited, indicating that the observed effects are not consistently robust across different measures of regulatory quality.

In conclusion, the robustness checks for *Hypothesis 3* indicate that the primary findings are generally stable across different specifications and classifications. While the core results suggest that the EU Audit Reform positively impacts overall investment efficiency, the differential impact based on regulatory quality is only sometimes significant across all models. The differences in results between *CAPEX* and *Non-CAPEX* models highlight the varying effects of the reform on different types of investments, suggesting that non-capital expenditures are more responsive to regulatory changes. These findings underscore the importance of considering various regulatory quality and investment efficiency dimensions to fully understand the reform's impact, providing a nuanced view of its differential effects across countries.

Table 7

Robustness Test Hypothesis 3

	Baseline	CAPEX	Non-CAPEX	Sensitivity	CPI
Investment Efficiency$_t$	(1)	(2)	(3)	(4)	(5)
PostReform$_t$	1.190*	3.793	1.126*	1.111	0.751
	(0.596)	(4.369)	(0.501)	(0.613)	(1.090)
RegulatoryQuality$_t$	-3.102***	-9.409	-2.224**	-3.247***	0.007
	(0.888)	(5.900)	(0.774)	(0.937)	(0.032)
PostReform$_t$ * *RegulatoryQuality*$_{t-1}$	0.045	-0.300	-0.022	0.026	0.006
	(0.433)	(3.064)	(0.375)	(0.445)	(0.015)
Control variables$_{t-1}$	*Included*	*Included*	*Included*	*Included*	*Included*
Observations	17,484	17,484	17,484	15,071	17,484
R^2	0.0664	0.2066	0.0526	0.0638	0.0761

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) is the DiD model used in the primary regression, which includes control variables. Model (2) uses the dependent variable, *Investment Efficiency*, based only on the firm's capital expenditures. Model (3) uses the dependent variable, *Investment Efficiency*, based on only the firm's research and development expenses plus acquisition costs. Model (4) excludes this study's sample's first and last year. Model (5) uses a continuous variable based on the Corruption Perceptions Index for the *RegulatoryQuality* variable. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

5. Discussion

The EU Audit Reform aimed to improve the quality of financial reporting across EU member states, expecting to improve investment efficiency by reducing information asymmetry and increasing transparency. This discussion section will reflect on whether the results align or differ from previous studies, discuss the broader implications of the findings, address the study's limitations, and suggest directions for future research.

The findings of this study align with existing literature, suggesting that robust financial reporting and regulatory reforms can significantly improve investment efficiency. Prior studies by Biddle and Hilary (2006) and Cheng et al. (2013) demonstrated that higher financial reporting quality reduces information asymmetry and investment cash flow sensitivity, facilitating better investment decisions.

The positive impact observed in this study confirms these findings, indicating that the EU Audit Reform has indeed contributed to improving investment efficiency across various industries and countries within the EU. This is particularly evident in the post-reform period, where significant improvements in investment efficiency were noted, consistent with theoretical expectations and prior empirical evidence.

When analysing financially constrained firms, the results indicate these firms experience a more significant improvement in investment efficiency post-reform, consistent with Bushman et al. (2006). Constrained firms, often characterised by limited access to external capital, benefit more from increased transparency and reduced information asymmetry, which lowers the cost of capital and improves investment decisions. This finding aligns with the study by Biddle et al. (2009), which suggests that such firms benefit most from improved financial reporting as it reduces some of their financing constraints.

In high-innovation industries, the reform's impact on investment efficiency was more pronounced, reflecting the complex nature of these industries where improved transparency can lead to better investment allocation and innovation outcomes. This finding is consistent with prior research indicating that innovative industries benefit significantly from improved regulatory environments due to their reliance on external capital and the high stakes of their investment projects. This result aligns with the observations of Biddle et al. (2009), who noted that improved financial reporting can reduce information asymmetry, thereby improving investment efficiency in dynamic and innovation-driven industries.

Regarding countries with higher regulatory quality, the results differ from the expectations of Christensen et al. (2016). While Christensen et al. (2016) found that regulatory improvements are more effective in countries with a history of higher regulatory quality, the findings in this study suggest otherwise. The results show that countries with higher regulatory quality tend to have lower investment efficiency, and the reform negatively impacted these countries. This indicates that the additional benefit of the EU Audit Reform could have been more pronounced in environments with already high regulatory standards, possibly due to diminishing returns on regulatory improvements in well-regulated markets. This finding is consistent with the study by Leuz et al. (2003), who highlighted the differential impact of regulatory quality across varying institutional contexts.

The results of this study have several important implications. Firstly, the positive effect of the EU Audit Reform on investment efficiency underscores the importance of regulatory frameworks in promoting transparent and reliable financial environments. Improved audit quality and financial reporting standards improve investor confidence and facilitate more efficient capital allocation, contributing to economic stability and growth. These findings are crucial for policymakers, suggesting that continued emphasis on improving financial reporting standards can yield significant economic benefits.

Furthermore, the differential impacts observed across various industries and countries highlight the role of contextual factors in determining the effectiveness of regulatory changes. Industries with higher

innovation intensity exhibited more pronounced improvements in investment efficiency. In contrast, countries with robust regulatory environments did not see significant improvement, indicating that the additional benefit of the EU Audit Reform was less in these environments. This suggests that the regulatory reforms yield more benefits in environments with weaker baseline governance and transparency, with more room for improvement.

Despite the robust findings, this study has several limitations. Firstly, the reliance on secondary data sources ensures reliability but may need to fully capture the nuances of firm-level investment behaviours and regulatory impacts. This dependency on secondary data could overlook specific contextual factors influencing investment efficiency. Kaplan and Zingales (1997) discuss the limitations of secondary data in capturing the intricate dynamics of firm behaviour and financial constraints, emphasising the potential for overlooked contextual variables in such analyses.

Secondly, the DiD methodology, while rigorous, depends heavily on the assumptions of parallel trends and the stable unit treatment value. The assumption of parallel trends implies that the treatment and control groups would follow the same trend over time without treatment. Although efforts were made to validate this assumption through visual and statistical analyses, it cannot be tested directly. Similarly, SUTVA, which assumes no interference between units and consistency in treatment effects, remains untestable, potentially affecting the causal interpretations (Lechner, 2011; Angrist & Pischke, 2009).

Furthermore, the study's primary focus on observable firm characteristics might not account for unobserved heterogeneity that could influence investment efficiency. Unobserved variables such as managerial quality, firm culture, or specific market conditions could play significant roles and are not included in the analysis (Wooldridge, 2010).

Finally, the study covers a specific timeframe and geographical region, which may limit the generalisability of the findings. While the EU Audit Reform applies explicitly to EU member states, its impact might offer insights into how similar reforms could influence other regions with different economic conditions or regulatory environments. Future research should also explore the long-term sustainability of the reform's impact on investment efficiency and its interaction with macroeconomic factors or other regulatory changes over time. Investigating these aspects could offer a more comprehensive understanding of the reform's effectiveness and relevance across different contexts.

6. Conclusion

This study investigated the impact of the EU Audit Reform on investment efficiency across various industries and countries within the European Union. The primary aim was to assess whether improved financial reporting quality resulting from the reform could improve investment efficiency, particularly in financially constrained firms. This research provides valuable insights into the effectiveness of regulatory changes in improving market efficiency and investor confidence.

The study aimed to understand the effects of the EU Audit Reform on investment efficiency. Addressing this research problem is crucial as it sheds light on how regulatory changes can influence financial reporting quality and investment decisions. The research question focused on whether the EU Audit Reform improved investment efficiency, especially for financially constrained firms.

This study utilised a Difference-in-Difference (DiD) regression model to address the research question, analysing a comprehensive dataset of 17,484 firm-year observations from 2011 to 2022. The analysis included various control variables for firm-specific factors affecting investment decisions. The findings indicate that the EU Audit Reform positively influenced overall investment efficiency. Specifically, financially constrained firms showed a statistically significant improvement in investment efficiency post-reform. Conversely, financially unconstrained firms experienced a reduction in overinvestment, indicating that the reform helped curb excessive investment behaviours.

Additionally, the reform's impact varied across industries and countries. Industries with high innovation intensity benefited more from the reform, reflecting the critical role of transparency in dynamic and innovation-driven industries. On the other hand, the reform’s impact was less pronounced in countries with higher regulatory quality, suggesting diminishing returns from regulatory improvements in already well-regulated markets.

The findings of this study contribute to the broader discourse on the role of regulatory frameworks in improving investment efficiency. The EU Audit Reform has effectively improved financial reporting quality, leading to more efficient investment decisions. These results underscore the importance of robust disclosure regulations in promoting transparency and reducing information asymmetry. The differential impact across industries and countries provides valuable insights. High-innovation industries, which rely heavily on external capital, saw more pronounced improvements in investment efficiency, aligning with the need for accurate financial information to support complex investment decisions. Conversely, countries with existing high regulatory standards experienced lesser gains, indicating that the baseline level of regulatory quality moderates the effectiveness of new reforms.

For policymakers, the study highlights several critical implications. First, there is a need for targeted regulatory improvements, especially in industries and countries with lower baseline regulatory quality. High-innovation industries benefit significantly from improved financial transparency, suggesting that support for these industries should be prioritised. Policymakers should also address the compliance burden on smaller firms through resources, training, or subsidies to help them meet new regulations without hindering their growth. Continuous monitoring and adaptation of policies are essential as market conditions evolve, necessitating regular assessment and readiness to adjust regulations. Finally, enhancing coordination and harmonisation of regulatory standards across member states can promote uniform improvements in financial reporting quality and investment efficiency, ensuring a stable and efficient investment environment.

In conclusion, the EU Audit Reform has positively impacted investment efficiency, with varying effects across different financial constraints, industries, and countries. These findings offer critical

insights for future regulatory policies to improve financial transparency and investment efficiency across diverse economic landscapes.

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APPENDIX A - Variable Definitions

Dependent Variables

Investment Efficiency = Calculated as the total of research and development expenditure, capital expenditure, and acquisition costs minus cash proceeds from the sale of property, plant, and equipment. This total is multiplied by 100 and scaled by the total assets from the previous year.

CAPEX Efficiency = Defined as capital expenditure multiplied by 100 and adjusted by the previous year's property, plant, and equipment.

Non-CAPEX Efficiency = Comprised of research and development expenses plus acquisition costs, multiplied by 100 and scaled by the prior year's total assets.

Financial Reporting Quality Variables

PostReform = A dummy variable set to 0 for periods before the EU Audit Reform and 1 for periods after its implementation, reflecting the staggered implementation dates across different countries.

Overinvestment Variables

Constrained = A ranked variable based on the average OverFirm ranking (in deciles) of cash holdings and leverage. Leverage is multiplied by -1 before ranking to ensure both variables increase with the likelihood of overinvestment.

Constrained_dummy = a binary variable set to 1 if a firm's Constrained value is above the median for that year and 0 otherwise.

Constrained - WW Index = A measure of financial constraint based on Whited and Wu's methodology, which considers factors such as cash flow, dividends, leverage, and firm size to assess a firm's level of financial constraint.

Industry Variables

IndustryInnovation = This variable measures the intensity of innovation within each industry. It is calculated as the ratio of industry-level R&D expenditure to total sales within the industry for a given year. Higher values indicate greater emphasis on R&D and innovation activities.

IndustryInnovation_dummy = A binary variable set to 1 if a firm's IndustryInnovation value is above the median for that year and 0 otherwise.

Country Variables

RegulatoryQuality = This variable measures the government's ability to formulate and implement sound policies and regulations that promote private sector development, retrieved from the World Bank's Worldwide Governance Indicators (WGI).

RegulatoryQuality_dummy = A binary variable set to 1 if a firm's Regulatory Quality value is above the median for that year and 0 otherwise.

RegulatoryQuality - CPI = These indices measure the strictness and quality of a country's corporate governance and financial reporting regulations.

Financial Reporting Weakness Control Variables

Log Asset = The natural logarithm of total assets.

Loss = A dummy variable set to 1 if net income before extraordinary items is negative and 0 otherwise.

Extreme Growth = A dummy variable set to 1 if year-over-year industry-adjusted sales growth is in the top quintile and 0 otherwise.

Cross-border Listed = A dummy variable indicating if a company is listed outside its home EU country. This variable takes 1 if the company is not listed outside its home country and 0 if it is.

Investment Determinants Variables

CFO Sales = The ratio of cash flow from operations to sales.

σ (CFO) = The standard deviation of cash flow from operations, adjusted by average total assets from the previous five years.

σ (Sales) = The standard deviation of sales, adjusted by average total assets from the previous five years.

σ (Investment) = The standard deviation of investment (Investment, CAPEX, and Non-CAPEX) over the previous five years.

Tangibility = The property, plant, and equipment ratio to total assets.

Leverage = The ratio of long-term debt to the sum of long-term debt and the market value of equity.

Dividends = A dummy variable set to 1 if the firm paid dividends and 0 otherwise.

Operating Cycle = The logarithm of the receivables ratio to sales plus inventory to COGS, multiplied by 360.

Log Asset = The natural logarithm of total assets.

Loss = A dummy variable set to 1 if net income before extraordinary items is negative and 0 otherwise.

Cash = The ratio of cash to total assets.

Slack = The ratio of cash to property, plant, and equipment.

APPENDIX B - Member state implementation status of EU Audit Reform

Table A2.1

Member state implementation status from June 2016 to November 2018

Country	June 2016	Sep 2016	Jan 2017	March 2017	June 2017	Dec 2017	April 2018	Oct 2018	Nov 2018
Austria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Belgium	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bulgaria	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Croatia	No	No	No	No	No	No	Yes	Yes	Yes
Cyprus	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Czech Republic	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Denmark	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estonia	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Finland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
France	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Greece	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Hungary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ireland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Italy	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Latvia	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lithuania	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Luxembourg	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Malta	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Netherlands	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poland	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Portugal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Romania	No	No	No	No	No	Yes	Yes	Yes	Yes
Slovakia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slovenia	No	No	No	No	No	No	No	No	No
Spain	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sweden	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TOTAL:	11	15	20	22	24	25	26	26	26

APPENDIX C - Regression results for pre-reform Parallel Trends Assumption

Table A3.1

Regression analysis of Investment Efficiency trends for Constrained-dummy before reform

	Investment Efficiency$_t$
	(1)
Constrained_dummy$_{t-1}$ * *Year*	
2013	-0.805
	(0.822)
2014	-0.444
	(0.864)
2015	-1.268
	(0.958)
2016	-0.181
	(0.965)
2017	-0.924
	(1.898)
Observations	6,734
R^2	0.0109

Notes: Regression results show the interaction between *Constrained_dummy* and year indicators before the reform, with *Investment Efficiency* as the dependent variable. Standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

Table A3.2

Regression analysis of Investment Efficiency trends for IndustryInnovation_dummy before reform

	Investment Efficiency$_t$
	(1)
IndustryInnovation_dummy$_{t-1}$ * *Year*	
2013	-0.051
	(0.640)
2014	-1.357
	(0.753)
2015	-1.009
	(0.803)
2016	0.332
	(0.821)
2017	0.366
	(2.163)
Observations	6,734
R^2	0.1288

Notes: Regression results show the interaction between *IndustryInnovation_dummy* and year indicators before the reform with *Investment Efficiency* as the dependent variable. Standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

Table A3.3

Regression analysis of Investment Efficiency trends for RegulatoryQuality_dummy before reform

	Investment Efficiency$_t$
	(1)
RegulatoryQuality_dummy$_{t-1}$ * *Year*	
2013	0.114
	(0.610)
2014	0.673*
	(0.723)
2015	0.019
	(0.779)
2016	-0.369
	(0.812)
2017	1.136
	(2.615)
Observations	6,734
R^2	0.0086

Notes: Regression results show the interaction between *RegulatoryQuality_dummy* and year indicators before the reform with *Investment Efficiency* as the dependent variable. Standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

APPENDIX D - Hausman Test results for model selection

Table A4.1

Fixed Effects vs. Random Effects Hypothesis 1

	Fixed Effects Model	*Random Effects Model*	*Difference*	*Std. err.*
Dependent: Investment Efficiency$_t$	(b)	(B)	(b-B)	(4)
PostReform$_t$	-0.526	-0.410	-0.115	0.057
Constrained$_{t-1}$	-0.000	-0.000	0.000	0.000
*PostReform$_t$ * Constrained$_{t-1}$*	-0.000	-0.000	-0.000	0.000
Chi^2	59.73			
Prob > Chi^2	0.0000			

Notes: Results of the Hausman Test, which compares the Fixed Effects and Random Effects models. The columns display the coefficients (b) for the Fixed Effects Model, (B) for the Random Effects Model, the difference between the coefficients (b-B), and the standard error of the difference. The Chi-squared statistic (*Chi^2*) and the associated probability (*Prob>Chi^2*) are provided to test the null hypothesis that the Random Effects model is appropriate. A probability value greater than 0.05 indicates no significant difference between the models, suggesting that the Random Effects model is preferred.

Table A4.2

Fixed Effects vs. Random Effects Hypothesis 2

	Fixed Effects Model	*Random Effects Model*	*Difference*	*Std. err.*
Dependent: Investment Efficiency$_t$	(b)	(B)	(b-B)	(4)
PostReform$_t$	-0.171	-0.186	0.016	0.071
IndustryInnovation$_{t-1}$	24.555	88.393	-63.839	7.090
*PostReform$_t$ * IndustryInnovation$_{t-1}$*	-13.833	-15.583	1.750	0.839
Chi^2	115.23			
Prob > Chi^2	0.0000			

Notes: Results of the Hausman Test, which compares the Fixed Effects and Random Effects models. The columns display the coefficients (b) for the Fixed Effects Model, (B) for the Random Effects Model, the difference between the coefficients (b-B), and the standard error of the difference. The Chi-squared statistic (*Chi^2*) and the associated probability (*Prob>Chi^2*) are provided to test the null hypothesis that the Random Effects model is appropriate. A

probability value greater than 0.05 indicates no significant difference between the models, suggesting that the Random Effects model is preferred.

Table A4.3

Fixed Effects vs. Random Effects Hypothesis 3

	Fixed Effects Model	*Random Effects Model*	*Difference*	*Std. err.*
Dependent: Investment Efficiency$_t$	(b)	(B)	(b-B)	(4)
PostReform$_t$	0.440	0.853	-0.413	0.140
RegulatoryQuality$_{t-1}$	-0.185	3.352	-3.537	0.649
PostReform$_t$ * *RegulatoryQuality*$_{t-1}$	-0.873	-1.010	0.138	0.097
Chi^2	73.28			
Prob > Chi^2	0.0000			

Notes: Results of the Hausman Test, which compares the Fixed Effects and Random Effects models. The columns display the coefficients (b) for the Fixed Effects Model, (B) for the Random Effects Model, the difference between the coefficients (b-B), and the standard error of the difference. The Chi-squared statistic (Chi^2) and the associated probability (*Prob*>Chi^2) are provided to test the null hypothesis that the Random Effects model is appropriate. A probability value greater than 0.05 indicates no significant difference between the models, suggesting that the Random Effects model is preferred.

APPENDIX E - Difference-in-Difference regression analysis using binary variables

Table A5.1

Investment Efficiency and PostReform relationship

Dependent variable: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	-0.827**	0.770**
	(0.292)	(0.284)
Constrained_dummy$_{t-1}$	0.843*	0.851*
	(0.355)	(0.348)
*PostReform$_t$ * Constrained_dummy$_{t-1}$*	0.054	0.651
	(0.361)	(0.348)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0008	0.0773

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

Table A5.2

Investment Efficiency and PostReform relationship

Dependent variable: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	-1.233***	1.771***
	(0.345)	(0.335)
IndustryInnovation_dummy$_{t-1}$	-1.249	0.214
	(0.704)	(0.617)
*PostReform * IndustryInnovation_dummy$_{t-1}$*	0.890*	-1.119**
	(0.396)	(0.384)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0401	0.0890

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.

Table A5.3

Investment Efficiency and PostReform relationship

Dependent variable: Investment Efficiency$_t$		
Fixed Effects Regression	(1)	(2)
PostReform$_t$	-0.824**	1.349***
	(0.293)	(0.284)
RegulatoryEstimate_dummy$_{t-1}$	-0.644	1.021
	(0.642)	(0.612)
*PostReform$_t$ * RegulatoryEstimate_dummy$_{t-1}$*	0.149*	-0.339
	(0.394)	(0.380)
Control variables$_{t-1}$	-	*Included*
Observations	17,484	17,484
R^2	0.0005	0.0733

Notes: Difference-in-Difference regression results with *Investment Efficiency* as the dependent variable. Model (1) excludes control variables. Model (2) includes all control variables. Robust standard errors clustered at the firm level are in parentheses. Significance levels are indicated as follows: * denotes significance at the 5% level, ** denotes significance at the 1% level, and *** denotes significance at the 0.1% level.