An Assessment of the Impact of Liquidity and Capital Regulatory Reforms on Retail Banks in the United Kingdom

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Abstract

This study investigates the impact of regulatory reforms on UK retail banks, specifically examining the effects on stock market value, technical efficiency, and profitability. Using a mixed-methods approach, the study analyses the Banking Reform Act (2013) and the Financial Services and Markets Act (2023), focusing on the top four UK banks (Lloyds Banking Group, Barclays Bank Plc, NATWEST Plc, and HSBC Bank) as at the 1st of June 2023. The study examines the impact of regulatory reforms on bank technical efficiency. A two-stage Data Envelopment Analysis (DEA) is conducted, utilizing both an input-oriented Banker, Charnes, and Cooper (BCC) model under Variable Returns to Scale (VRS) and Malmquist Index estimations to account for changes over time. In the second stage, robust fixed effects panel regression analysis is employed to identify the drivers of efficiency, including total loans, risk-weighted assets, total deposits, and macroeconomic factors. Results reveal that while US banks are slightly more efficient on average, UK banks demonstrate responsiveness to regulatory changes. The findings suggest that less restrictive regulations could enhance efficiency, although a trade-off between bank soundness and efficiency may exist.

The study further assessed the stock market's reaction to these regulatory reforms. An Event Study Methodology (ESM) is employed, using the market model (Single Index Model) to calculate abnormal returns and test their statistical significance. The study analyses cumulative average abnormal returns (CAARs) and unsystematic risk over three event windows (3-day, 5-day, and 10-day) for six key legislative events. Findings reveal mixed reactions, with the Banking Reform Act (2013) generally associated with negative but insignificant effects on individual bank returns, while the Financial Services and Markets Act (2023) is linked to positive and significant effects. These differential reactions underscore the importance of phased implementation and clear communication of regulatory changes. An analysis of the impact of regulatory reforms on bank profitability, using fixed and random effects panel regressions was conducted. Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM) are modelled as dependent variables, with liquidity and capital ratios (proxies for regulatory measures) as independent variables, controlling for macroeconomic factors. The results indicate a positive association between liquidity regulation and all three profitability measures, suggesting that tighter liquidity regulation can enhance profitability. Conversely, the impact of capital regulation is mixed, with total capital positively associated with profitability but Tier 1 capital negatively impacting it.

This study provides comprehensive insights into the multidimensional impact of regulatory reforms on UK retail banks. The findings emphasise the need for a nuanced and balanced regulatory approach, tailored to specific bank characteristics and market conditions. Regulators should consider the potential trade-offs between stability, efficiency, and profitability when designing and implementing regulatory frameworks. Banks, in turn, should adopt proactive strategies for adapting to regulatory changes, focusing on liquidity and capital management, as well as engaging in transparent communication with stakeholders. This research contributes to the existing literature on bank regulation and its economic consequences, offering valuable insights for policymakers, regulators, and industry practitioners. The findings have important implications for the design of future regulatory reforms in the UK and beyond, emphasising the need for evidence-based policymaking that promotes a stable, efficient, and profitable banking sector.

Keywords: Bank Regulation, Retail Banks, Stock Market Value, Technical Efficiency, Profitability, Banking Reform Act (2013), Financial Services and Markets Act (2023), Fixed and Random Effects Panel Regress, Data Envelopment Analysis (DEA), Event Study Methodology (ESM).

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Declaration of Authorship

I, Donald A. Amuah, declare that this thesis titled, `An Assessment of the Impact of Liquidity and Capital Regulatory Reforms on Retail Banks in the United Kingdom' and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
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- Where I have consulted the published work of others, this is always clearly attributed.
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Signed: *Donald A. Amuah*

Date: 30th May 2024

Chapter 1: General Introduction

1.1 Introduction

There have been multiple articles published in the London Financial Times which expose the gaping need for there to be a thorough assessment of the impact of key regulatory reforms on banks. This issue is discussed by Samuels, (2017) where the fundamental question of whether shareholders of banks should celebrate, or fear more lenient regulators remained unanswered. Although required higher levels of capital would probably make banks safer, this will however also make them potentially less profitable in the eyes of the very same shareholders unless a deeper level of assessment is available. Further to this, a publication in the same newspaper by Stafford, (2021), clearly identified the divergence between the UK's regulatory standards and that of the EU. Yet, the EU has only approved two temporary permits in an attempt to give UK banks access to customers across its member countries. To quote Mairead McGuinness, the EU's financial services chief, "You can't have divergence and equivalence". This may imply that UK banks seeking to provide services across the EU will be saddled with serious adverse effects of having to be compliant on both fronts (Stafford, 2021).

In line with this, a more recent article in the London Financial Times newspaper by Morris, Megaw, and Arnold, (2021) raised awareness of the preparations being made by the Bank of England (BoE) to carry out its initial major break from EU regulations. The BoE's proposed regulations would see to it that there are tougher bank capital rules in the UK than that of the EU. A particularly glaring example is with regards to investments in software made by banks. Whereas the European Banking Authority decided to allow these investments count towards core capital levels of banks, the BoE's Prudential Regulation Authority (PRA) on other hand said it found no compelling proof that software assets can effectively absorb financial stress of banks in times of need. Although the PRA's rationale for taking this stand is to prevent the safety and soundness of UK banks from being undermined, it neglects considering its impact from the perspective of the banks. Hence, providing grounds for the relevance of this proposed study.

This study attempts to assess the impact of liquidity and capital regulatory reforms on retail banks in the UK over the period 2000 to 2023. This is done by addressing the following research objectives. The study assessed how cost efficiency of the retail banks is affected by liquidity and capital targeting regulatory reforms. The second is the examination of the effect regulatory reforms have on the market value of retail banks as measured by their Cumulative Average Abnormal Returns (CAAR) over the period considered by the study. The final objective assessed how the profitability of retail banks has been affected by the cost they incurred in complying with regulation.

In order to assess the efficiency of the selected banks in this study, data was sourced from Capital IQ Pro and the annual reports of these banks. A data envelopment analysis was employed in analysing the extracted data. The analysis identified and assessed the relationship between stringent capital requirements, activity restricting regulation, and the efficiency of banks. The study employed an event study methodology using daily stock price data of sampled banks to determine whether the regulatory reforms over the years had an impact on the stock market value of these banks and if so, the nature of said impact. As part of this methodology, the study adopted an appropriate event window relevant to the time period considered. This window was chosen to capture key dates during the enactment of the two main regulatory reforms examined. These reforms are the Banking Reform Act (2013) and Financial Services and Markets Act (2023). In addressing the impact of regulatory reforms on the profitability of retail banks, the study further relied on data from Capital IQ Pro and the annual reports of these banks. The data extracted fed three fixed and random panel regression models.

The remainder of this chapter in presented in the following sections. Section 1.2 presents the background of related research in this field and the traces the evolution of financial services regulation in the UK. Section 1.3 specifically presents an overview of the impact regulatory reforms on banks. Section 1.4 presents the research aim of this thesis. Section 1.5 briefly discusses the research objectives of this thesis. Section 1.6 presents the specific research questions that are addressed by this thesis. Section 1.7 briefly highlights the theoretical background to the research conducted in this thesis. Section 1.8 briefly outlines the methodological approach employed by this thesis. Section 1.9 presents the main contributions this study makes to literature. Section 1.10 presents a high level overview of the structure of the remaining chapters within this thesis.

1.2 Background of the Research and Evolution of Financial Services Regulation in the UK

There are a number of historical financial crisis that have posed significant risk to the health of the global economy. A few of these crises worth mentioning include the Credit Crisis of 1772, which originated from London and rapidly spread to the rest of Europe. This was followed by the Wall Street Crush of 1929 which led to the Great Depression of 1929-1939, which was described by many as the worst financial and economic disaster of the 20th century. The Asian Crisis of 1997, Financial Crisis of 2007-2008 and the 2020 Stock Market Crash are some of the more recent financial crises. Although, many of these crises can be attributed to poor regulation and compliance, it is also important to recognise the impact of sudden global events such as the outbreak of the coronavirus (Britannica, 2021; Hugonnier, and Morellec, 2017).

The financial services industry in the UK has seen several regulatory reforms since the early 1970s, before which a deregulated structure prevailed. This helped financial intermediaries like banks realize the positive impact of globalization due to the transition from a protective interest rate cartel structure to a more dynamically competitive setting with reduced regulatory restrictions (Carlo and Roselli, 2009; Moutsianas and Kosmidou, 2016). The reregulation of the UK financial services industry was prompted by the banking crisis that occurred between 1973 and 1975. These led to the introduction of statutory ratios that were applicable to all banks, which was followed shortly by the Banking Act of 1979 which concentrated regulatory power in the hands of the Bank of England (BoE). The objective of this act was to ensure protection for depositors by giving the central bank regulatory power over all other banking institutions while maintaining a competitive atmosphere in the banking sector (Lee, 1979).

In 1986 when the Financial Services Act 1986 was passed to give the financial service industry in the UK a more formal structure of regulation. This act was designed to offer the industry a mix of government regulation and self-regulation, through the creation of the Securities and Investments Board (SIB) tasked with the mandate of overseeing the various Self-Regulating Organisations (SROs) and the Recognised Professional Bodies (RPBs). In the year 2000, this was repealed and replaced by the Financial Services and Markets Act 2000 which led to the creation of the Financial Services Authority (FSA) through a merger of the various SROs and the SIB. Creating the FSA meant switching from self-regulation to more emphasis on actual regulation (Haines, 1999).

This set the scene for the UK to welcome a more structured form of regulation through the introduction of the Financial Services Act 1986. This was the first of its kind at the time as it offered the industry a mix of government regulation and self-regulation, through the creation of a number of boards and organisations. These included the Securities and Investments Board (SIB) tasked with the mandate of overseeing the various Self-Regulating Organisations (SROs) and the Recognised Professional Bodies (RPBs). This regime was in effect until the addition of the first Basel Accord signed in 1988, which saw banks in many countries including the UK being subject to a common set of regulatory capital requirements. This came with standards that required banks to meet a minimum ratio of regulatory capital to risk-weighted assets of 8%. Shortly after the addition of the first Basel Accord the regime of Self-regulation in the UK came to an end, making way for the Financial Services and Markets Act 2000 which created the Financial Services Authority (FSA) through a merger of the various SROs and the SIB (Haines, 1999).

Banerjee, and Mio, (2018) found that the system of liquidity regulation in the UK as at the time of the 2007 – 2008 financial crisis consisted of three different regimes depending on the type of financial institution. These include the sterling stock liquidity regime; the mismatch liquidity regime; and the building society regime. Further to this, the FSA, (2007) published a consultation paper a year later defining a new liquidity regulation for banks. This was the quantitative Individual Liquidity Guidance (ILG) requirement which requires banks to hold a sufficient stock of high-quality liquid assets capable of meeting hypothetical stress testing scenarios. At the time of its introduction, it was predicted that the ILG would be by far stricter than existing regulations. This implied that banks would be required to hold liquid assets that are both greater in quality and quantity. This further required a majority of these assets to be held in the form of eligible high-quality central bank liabilities or government debt.

Additionally, a subsequent publication by the FSA, (2009) outlined the exemptions the ILG and the conditions for granting them. These were broadly grouped into the following: whole-firm liquidity modifications and the non-UK intragroup liquidity modifications. The Whole-firm Liquidity Modifications was intended to replace the GLCs which were predominantly granted to branches of incoming European Economic Area banks and some select few branches of banks from countries outside the region. Whereas an Intra-Group Liquidity Modification is the process of granting and maintaining modifications of the self-sufficiency requirement of banks, there was the concern that demanding self-sufficiency of liquidity at the legal entity level would result in the creation of multiple pools of trapped liquidity. This would in turn increase barriers to the free flow of international finance with the potential of weakening international firms, thereby adversely affecting international financial stability. The second fear was the likely risk of reciprocal action by other regulatory authorities (Banerjee, and Mio, 2018).

These were being complied with in UK until the 2007–2008 financial crisis prompted international policy makers to respond by proposing significant revisions to the Basel standards with the primary aim of raising both the level and quality of liquidity as well as capital held by the industry. The crisis exposed the regulatory regime at the time to be ineffective in preventing substantial losses and more importantly, in reassuring investors about the solvency of banks. The capital requirements in the UK at the beginning of the crisis entailed bank-specific requirements under Pillar 2 which were found in Basel II. Additionally, the peak of the crisis was met with responses from the UK Financial Services Authority (FSA) which included the introduction of a more stringent minimum capital regime with the aim of promoting market confidence and making banks more capable of absorbing losses that were emerging at the time (De-Ramon, Francis, and Harris, 2021).

Towards the end of the crisis, it became more evident that the previous regimes allowed capital elements that had both equity and debt components. As a result, the Basel III package proposed in response, focused on a central component of tier 1 capital which consisted of equity capital, with much higher minimum requirement at all levels of capital. Additionally, a counter-cyclical capital requirement designed to constrain lending growth and ensure that banks build capital buffers during favourable economic conditions was also introduced by the Basel III suite. Furthermore, a study by Igan, and Mirzaei, (2020) described the Basel III Accord as a comprehensive set of reforms that were introduced as a measure to strengthen international bank regulation, supervision, and risk management. The core of this regulatory reform encompasses both quantity and quality regulatory capital as well as liquidity. The purpose of this reform is to promote a more resilient and flexible international banking sector and by so doing, greatly decrease the risk of spillovers from the financial sector into other sectors of the economy. However, there is still an ongoing debate as to whether such requirements really benefit the broader economy.

Further evidence from the crisis revealed that under the Basel I and II regimes', banks had the tendency to build up excessive leverage and take on additional credit risk within their trading activities over time. Despite the fact that these additional credit risks went unaddressed, the banks were still able to meet risk-based capital rules overall. In a bid to provide a response to this, Basel III included a leverage ratio based on non-risk-weighted assets and higher risk weights in the trading book to account for unexpected credit losses (Francis, and Osborne, 2012).

The global financial crisis that occurred between 2007-2009 exposed flaws in the UK's existing financial services regulatory system and the need for improved regulation. Among the initial responses to the crisis was the enactment of the Banking Reforms Act (2013), which was a major milestone in the regulatory reform process within the UK. This act abolished the UK Financial Services Authority and replaced it with three new financial regulators (Lopez and Saeidinezhad, 2016). These regulators, still in charge of regulating various aspects of the industry are the Financial Conduct Authority (FCA), the Prudential Regulatory Authority (PRA) and the Bank of England (BoE). This was complemented by the adoption of the Basel III framework introduced by the Basel Committee on Banking Supervision (BCBS) which sought to strengthen the Liquidity and Capital positions of banks, as well as other financial institutions.

This imposed a baseline minimum capital requirement of 10.5% which includes capital conservation buffers to help maintain the capital levels of banks (ECB, 2021). Additionally, Basel III also imposed certain minimum liquidity requirements on banks. These were a minimum Net Stable Funding Ratio (NSFR) and Liquidity Coverage Ratio (LCR). The LCR requires banks to hold sufficient high-quality liquid assets that can withstand a 30-day stressed funding scenario, whereas the NSFR was designed to address the liquidity mismatches that may hinder the ability of banks to maintain stable funding above the required amount for a period of one year of extended stress, or as specified by the supervisors. A ratio figure of 100% or more is deemed acceptable for both ratios (Tran, Lin and Nguyen, 2016).

Aside the enactment of the Financial Services and Markets Act (2023), the only other major regulatory reform in the UK's financial services industry was the enactment of the Financial Services Act (2013), which was in response to the 2007-2009 financial crisis. As seen in figure 1, this act abolished the UK Financial Services Authority and replaced it with three new financial regulators (Lopez and Saeidinezhad, 2016; and Milken Institute, 2016). The more recent Financial Services and Markets Act (2023) on the other hand is a ground-breaking piece of UK legislation that introduces significant reforms to the financial services industry, affecting almost all financial services firms including banks as well as their customers. This Act will primarily repeal retained EU law on financial services, giving broader powers to HM Treasury to make regulations and define additional activities for regulation within the UK.

As previously discussed in this section, events such as Credit Crisis of 1772 to the more recent global financial crisis of 2007-2008, these events have underscored the importance of effective regulation in maintaining financial stability. While regulatory reforms have been implemented to address these challenges, a comprehensive understanding of their impact on specific segments of the financial industry, particularly retail banks, remains elusive. These crises highlighted the need for stricter capital and liquidity requirements, improved risk management practices, and enhanced supervisory oversight.

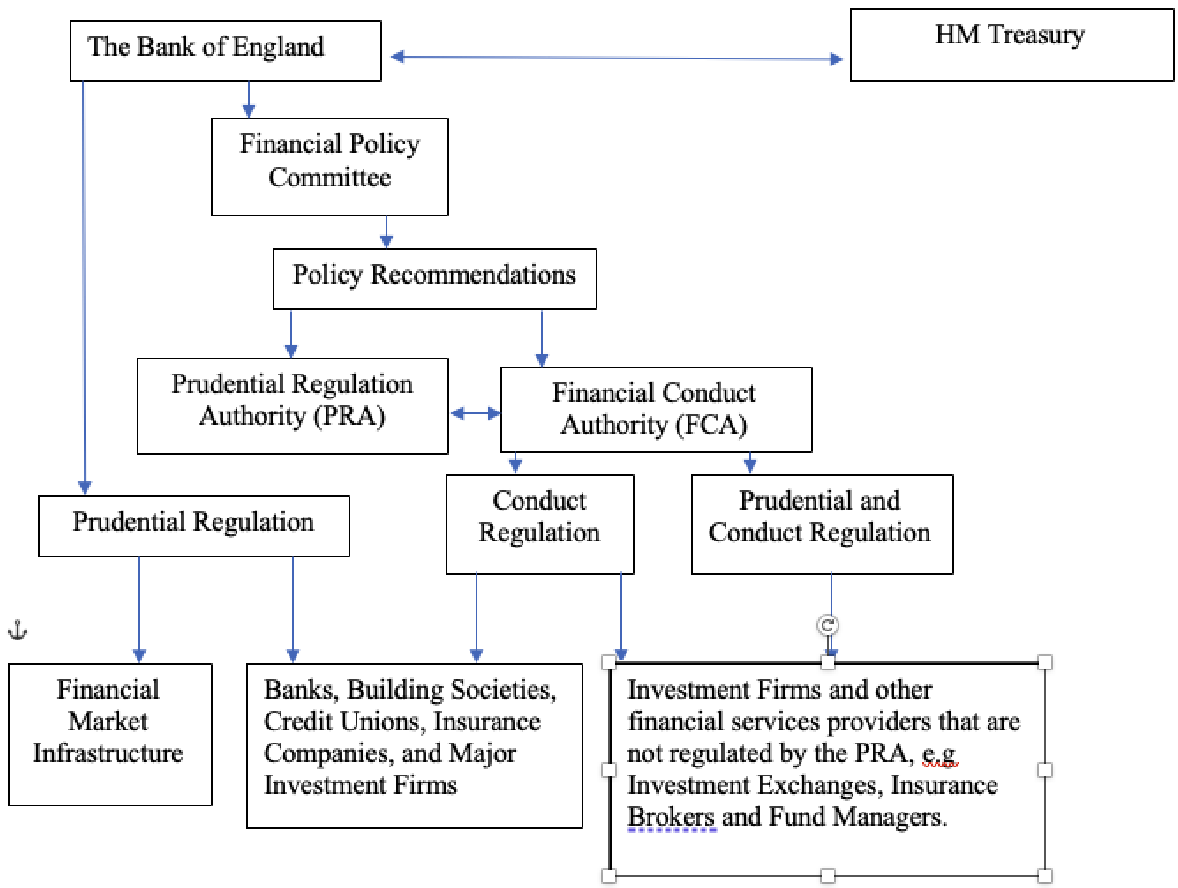
Despite these aforementioned reforms, there remains a knowledge gap regarding the specific impact of regulatory changes on UK retail banks. While numerous studies have examined the broader impact of regulation on the financial industry, relatively few have focused on the unique challenges and opportunities faced by UK retail banks. This study aims to address this gap by investigating the impact of regulatory reforms on the efficiency, profitability, and market valuation of UK retail banks.

By examining the impact of regulatory reforms on UK retail banks, this research contributes to a deeper understanding of the complex relationship between regulation and financial performance. The findings of this study have important implications for policymakers, regulators, and industry practitioners. Policymakers can use the insights gained from this research to develop more effective and targeted regulatory policies that promote financial stability, consumer protection, and economic growth. Regulators can use the findings to refine their supervisory practices and ensure that banks are adequately capitalized and well-managed. Finally, banks can use the research findings to develop strategies to adapt to the changing regulatory environment and improve their operational efficiency and profitability.

The current financial regulatory framework within the UK is presented in Figure 1. The UK's financial services regulatory structure is overseen by two main regulators along with the Bank of England (BoE): the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA). The FCA is tasked with ensuring that financial markets function fairly and that consumers are protected, while the PRA focuses on the financial stability of banks, insurers, and investment firms among other financial institutions. The FCA and PRA have a wide range of powers, including the ability to investigate firms, impose fines, and take action to prevent misconduct. They also set rules and standards for financial institutions and conduct regular supervision to ensure compliance. The types of financial institutions they regulate include banks, insurers, investment firms, pension funds, and mortgage lenders.

The FCA and PRA work closely with other government institutions, such as HM Treasury and the Bank of England. The recent implementation of the Financial Services and Markets Act (2023) further empowers the HM Treasury to set the overall policy framework for financial services, while the Bank of England has a role in maintaining financial stability and overseeing the banking system. This collaborative approach ensures a comprehensive and coordinated regulatory environment for the UK's financial services industry.

Figure 1 The Financial Regulatory Framework Within the UK



Source: Adapted from Milken Institute, (2016); Lopez and Saeidinezhad, (2016)

1.3 The Impact of Regulatory Reforms on Banks

This study is to look at how the banking sectors regulatory reforms after the crisis impacted the transformational efficiency of banks. The global financial crisis was followed shortly by the stricter implementation of the Base II guidelines, which were accompanied by certain liquidity, capital, and bank supervision requirements (Haque, and Brown, 2017).

According to Barth et al., (2013); and Chortareas, Girardone, and Ventouri, (2012), the aspects of regulatory reforms that could potentially affect bank efficiency include activity restricting regulation, capital regulation, and supervisory and market monitoring power. Capital regulation may be described as the required amount of capital that owners of a bank must have at risk. This is intended to control bank risk taking and to some extent promote bank efficiency. Agoraki, Delis, and Pasiouras, (2011), assert that when capital requirements are more stringent, it raise barriers to entry for new banks and impedes competition. This results in banks making lending decisions that are more prudent, hence leading to higher bank efficiency. On the contrary, earlier studies by Pasiouras et al., (2009); and Laeven and Levine, (2009), found that rigorous capital regulation results in the management of banks seeking to atone for the loss of benefits due to capital regulation. This is done by pursuing relatively more expensive and riskier financing sources, which leads to inefficiency of the banks.

Allowing banks engage in broad financial activities beyond their core business may intensify the issue of moral hazard due to the opportunity for banks to increase their risk appetite. The undertaking of broad financial activities by banks if left unchecked may result in the formation of exceedingly large and complex entities which become a challenge to monitor as well as regulate. These entities are sometimes referred to as “too big to fail” and “too big to discipline”. Therefore, the impact of activity restricting regulation on the efficiency of banks needs to be further investigated (Boyd et al., 1998; and Laeven and Levine, 2007). Additionally, activity restricting regulation may hinder a bank’s ability to diversify its sources of income alongside reducing its franchise value, which may collectively disincentivise it to act efficiently in the short term. Activity restricting regulation tends to result in limitations with regards to the variety of services that can be provided to clients as well as the ability to exploit economies of scale in collecting and processing information about clients and other firms (Djankov et al., 2002).

Bank supervisory agency is the institution with the responsibility of overcoming market failures due to imperfect information by using their expertise. These agencies monitor and, in some cases, discipline noncompliant banks which enhances their corporate governance practices. As such, effective supervision tends to lead to better bank efficiency, giving that the supervisory agencies are independent (Barth et al., 2013). Independent supervisory agencies are found to be more effective in monitoring the financial conditions of banks in a truly professional and consistent manner. Some studies, such as Beck et al. (2006), have suggested that overly powerful supervisors may misuse their authority to coerce banks into allocating credit for political or personal gain. This could lead regulators to prioritize private interests over their core mandate of addressing market failures. Consequently, a negative correlation may emerge between bank regulation and efficiency.

Beck et al. (2006) argued that effective regulatory monitoring and governance over banks could be accomplished if bank supervisory policies are geared toward strengthening the ability as well as encouraging private investors overcome market informational barriers. The study further identified that steps were being taken by the bank regulatory authorities in many countries to ensure that accurate information is disclosed periodically. These include compelling banks to make available consolidated information about all their business activities as well as their procedures for managing risk in a manner that is reliable and comprehensive. This is further enforced by holding the management of banks legally accountable for any shortfalls in the information disclosed. This along with greater emphasis on market discipline, were found to be relevant for the proper functioning of banks.

As mentioned by Andriosopoulos et al., (2017) the rationale behind studying the relationship between the stock market and financial regulation emanates from the view that the stock market is believed to be the best judge of the effectiveness of financial reforms. The stock market gives an indication of the impact financial reforms have on the returns of shares of financial institutions such as banks. Additionally, the lack of studies on the impact that the 2013 Banking Reform Act on banks' value as well as the English legal system's lagging response to financial crisis are among the reasons why this relationship should be studied (Putnis 2014; and Casu et al.,2015).

Information asymmetry, a condition where one party possesses more information than another, is a significant contributor to market failures. In the context of banking, this imbalance can lead to adverse selection and moral hazard. Adverse selection occurs when lenders cannot accurately assess the creditworthiness of borrowers, leading to a higher proportion of risky borrowers. Moral hazard arises when borrowers, knowing they are insured, engage in riskier behaviour than they would otherwise. To mitigate these market failures, governments implement various forms of bank regulation. As Parise and Shenai (2018) argue, information asymmetry is a key motivation for such regulation. By imposing rules and standards, regulators aim to reduce information asymmetry and promote transparency. For instance, minimum capital requirements can help ensure that banks have sufficient funds to absorb potential losses, while deposit insurance can protect depositors from bank failures.

However, as Casu et al. (2015) highlight, some regulatory measures can inadvertently exacerbate market failures. For example, deposit insurance, while safeguarding depositors, can also create moral hazard. Banks may take on excessive risks, knowing that their depositors are protected. This can lead to systemic risks and financial instability. Therefore, while bank regulation is essential for addressing market failures, it is crucial to design and implement regulations carefully to avoid unintended consequences. Striking the right balance between promoting financial stability and fostering innovation is a complex challenge for policymakers.

There exists a variety of literature that assess the impact of various aspects of regulatory reforms on the profitability of various types of financial institutions. Literature such as Giordana and Schumacher, (2017); Banerjee and Mio, (2017); and Mashamba, (2018) assess the impacts of Basel accords on the performance of commercial banks. The study conducted by Giordana and Schumacher, (2017) was concentrated on the impact of Basel III standards on the impact of banks' profitability and probability of default. The three standards identified by the study are the Liquidity Coverage Ratio (LCR), the Net Stable Funding Ratio (NSFR) and the leverage ratio which is defined as the Capital-to-Asset Ratio (CAR). The study went further to indicate that since these standards are aimed at very different aspects of banks' risk, and as such complying with them may impact not just the balance sheets but the profits of banks differently. On the other hand, there is no doubt that the COVID-19 pandemic will impact the global economy, while banks as well as regulators are not immune to this impact. It is for this reason that the Basel Committee on Banking Supervision (BCBS) agreed to delay the implementation of the revised Basel III standards by one year, to 1 January 2023. This measure is primarily intended to create operational space within which banks and regulators may rely on while responding to the economic impact of the pandemic (Deloitte, 2020; and bis.org, 2020).

A report by Barclays, (2014) examined the cost of evolving bank regulation focusing on the persistent increase in capital requirements. The analysis revealed that increasing capital requirements either through a defined minimum equity or a minimum wholesale debt as a percentage of a bank's balance sheet, would restrict a bank's ability to serve clients and as a result impair revenue. This was identified as a double-edged sword which would impact both the banks and their corporate as well as individual clients. It would lead to banks missing out on profitable lending opportunities and associated service income, while their clients would be confronted with growing impaired access to credit at an incrementally higher price. The report also acknowledged the relevance of the geographical location of the banks when assessing the impact of the new capital requirement. This will be less expensive for European banks as compared to US banks, since they have typically funded themselves with a higher proportion of wholesale funding. This resultantly could limit the costs of complying with the higher capital requirement by shifting debt balances lower and leaving customer-centric liabilities unchanged (Meli, Monteleone and Pigott, 2014).

This leads to the conclusion that the impact of capital regulation on the profitability of banks to a great degree depends on the measures of profitability employed by the study. Lee and Hsieh (2013) further supported this conclusion by providing empirical evidence to indicate that the effects on bank profits further relied on the income levels of the countries in which the observed banks operated as much as the measure of profitability used. They particularly found that banks operating in upper-middle-income countries displayed the greatest positive capital effect on ROE, whereas banks operating in high-income countries such as the UK where this study was based displayed the lowest positive capital effect on NR.

Tran, Lin and Nguyen (2016), on the other hand, took a much more theoretical approach in examining this relationship. They make reference to the Dupont Analysis, where Return on Equity (ROE), which is a measure of bank profitability, is calculated by taking the product of Return on Assets (ROA) and an equity multiplier (total assets/equity). They argue that a bank forced to keep a higher capital due to regulatory requirements, and as a result, a lower equity multiplier would experience lower profitability as measured by ROE. They further strengthened this argument by highlighting the effect of corporate tax on the equation. An increase in equity including Tier1 equity (a portion of bank capital), leads to a corresponding decrease in debt which in turn reduces tax-shield savings and by extension lowers after-tax earnings of banks. Altogether, this makes a stronger argument that a higher capital ratio as a result of regulatory requirements tends to lower bank profitability.

1.4 Research Aim

This research explores the intricate relationship between liquidity and capital regulatory reforms and their impact on the performance of UK retail banks. By doing so, it aims to address a significant gap in the existing body of knowledge.

1.5 Research Objectives

To achieve its research aims, this study employs a multifaceted methodological approach. Specifically, the research objectives are:

1. To assess the impact of regulatory reforms on bank efficiency.

This objective is addressed using a combination of Data Envelopment Analysis (DEA) and panel regression methods. By analysing the relationship between inputs and outputs, the study aims to determine how well banks are transforming resources into services under different regulatory regimes. DEA, a non-parametric frontier analysis technique, allows for a comprehensive assessment of bank efficiency, while panel regression models enable the identification of the specific impact of regulatory reforms on efficiency over time.

2. To examine the market reaction to regulatory announcements.

The Event Study Methodology (ESM) is employed to analyse the impact of regulatory announcements on the market value of banks. This analysis aims to capture changes in investor sentiment and their subsequent impact on stock prices. By examining the abnormal returns around regulatory announcement dates, the study seeks to understand how the market perceives the implications of these reforms for banks' future cash flows and risk profiles.

3. To investigate the impact of regulatory reforms on bank profitability.

Common ratio measures, such as Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM), are used to assess the impact of regulatory reforms on bank profitability. This analysis is conducted using fixed and random panel regression techniques. By controlling for other relevant factors, such as macroeconomic conditions and bank-specific characteristics, the study aims to isolate the specific impact of regulatory reforms on profitability.

By addressing these objectives, the study intends to provide valuable insights for policymakers and practitioners, contributing to a more stable, efficient, and resilient UK banking sector, where banks can effectively fulfil their intermediation role while adhering to prudential regulations.

1.6 Research Questions

The literature reviewed in the second chapter of this study support the fact that similar research has been conducted on the effects of financial regulatory reforms on banks. Literature was also reviewed on the effects of the financial crisis on the financial services industry and global economy. However, there is no existing literature distinctly assessing the impact that liquidity and capital regulatory reforms have on banks in the UK. This research will attempt to fill this gap. The findings of this proposed study are intended to answer the following research questions.

1. Does liquidity and capital regulatory reforms affect the efficiency (technical) of retail banks?
2. How is the market value of retail banks affected by events associated with regulatory reforms?
3. How does bank regulation affect the profitability of retail banks?

This study attempts to assess how the technical efficiency of banks in the UK is affected due to their compliance with regulatory reforms. Drawing on the theory of financial intermediation the study specifically investigate the impact of liquidity and capital regulatory reforms on the efficiency of banks. Emphasis will be placed on the financial statement items of banks that are most affected by liquidity and capital regulation. To appropriately investigate this phenomenon, the study employed a two-stage data analysis approach using two main methods: The Data Envelopment Analysis (DEA) and panel regression methods. Data Envelopment Analysis is conducted in STATA and the study produce two distinct sets of efficiency scores for each bank. The study estimated the basic Variable Returns to Scales (VRS) DEA scores using the BCC DEA model (see Banker, Charnes and Cooper, (1984)) and the Malmquist Index to account for the effect of time on the efficiency of the banks studied. The panel regression analysis is subsequently used in the second stage to determine the variables (input and output) with the most significant impact on the efficiency of banks. This is done by using the estimated DEA efficiency scores in the first stage as dependent variables. The study estimated both fixed and random effects after which the Hausman Test was used to test for and select the most appropriate effects model. The findings from this research objective may fill a part of the gap identified in literature by providing a clear outline of how the specified regulatory reforms affect the ability of banks to operate and generate revenue efficiently.

A further part of this gap filled as the study attempts to investigate whether the announcement of specific regulatory reforms has an impact on the stock prices of banks. This impact may then be expressed in terms of the overall market value of these banks. The objective will include identifying the direction and magnitude of said impact on the market value of banks. Using the Event Study Methodology (ESM) the study examined the effect of the two major regulatory reforms considered under this study (i.e. Banking Reforms Act (2013) and the Financial Services and Markets Act (2023)) on the sampled UK banks. The study used this method to measure the Cumulative Average Abnormal Return (CAAR) changes in the stock prices of the sampled banks following the occurrence of each identified event. This approach is rationalised by drawing on the semi-strong version of the efficient market hypothesis (see Fama, 1970) and the view that the price of an asset is equal to the present value of all of its future free cash flows (El Ghoul, et. al., 2023). The third research question will contribute to knowledge by answering the question of whether the profitability of banks is affected by liquidity and capital targeting regulatory reforms. The study uses three of the most commonly used ratio measures of bank profitability namely: Return on Assets (ROA), Return on Equity (ROE) and Net Interest Margin (NIM). Lastly, this study aims to offer relevant policy suggestions for consideration by financial regulators as well as banks.

The big four banks in the UK (Lloyds Banking Group, Barclays Bank Plc, NATWEST Plc, and HSBC Bank) are chosen by this study. See Section 3.6 for sample selection criteria. Lloyds Banking Group is one of the UK's largest financial services groups, formed in 2009 through the acquisition of HBOS by Lloyds TSB. The acquisition brought together well-known UK brands like Lloyds Bank, Halifax Bank of Scotland, and Scottish Widows, offering a wide range of personal and business banking services. Barclays Bank Plc is a British multinational universal bank founded in 1690, operating in over 40 countries. With two main divisions – Barclays UK and Barclays International. Barclays provides retail, commercial, and investment banking services. NatWest Plc offers personal and business banking services, including current accounts, savings, loans, mortgages, and insurance. HSBC Bank is a British multinational bank with its headquarters in London. Operating in over 60 countries, HSBC provides a wide range of financial services, including retail banking, wealth management, commercial banking, and global banking and markets.

These banks may be considered systematically important to the UK economy for several reasons. These banks hold a significant portion of the UK's financial assets and liabilities (See Section 3.6.1), making their stability crucial to maintaining confidence in the financial system. Their operations support a wide range of economic activities, including lending, investment, and payment processing, which are essential for the functioning of the economy.

These banks are also major employers in the UK, providing jobs to thousands of people and supporting a wide range of ancillary services and industries. Additionally, banks like HSBC and Barclays have a strong international presence, which helps attract foreign investment into the UK and supports international trade. Their investment in technology and innovation drives advancements in financial services and contributes to the overall competitiveness of the UK economy.

1.7 Theoretical background

The study draws upon the rich theoretical foundations of financial intermediation and the efficient market hypothesis to understand how regulatory interventions aimed at ensuring financial stability may influence the core functions and market valuation of banks.

Financial intermediation theory posits that banks play a pivotal role in the economy by efficiently channelling funds from savers to borrowers. This process is essential for economic growth and development. However, information asymmetry and moral hazard can impede the smooth functioning of this intermediation process. Regulatory reforms, such as those aimed at enhancing liquidity and capital requirements, are designed to mitigate these market failures and promote financial stability. The efficient market hypothesis, on the other hand, suggests that asset prices, including bank stock prices, reflect all available information. This implies that regulatory announcements can have a significant impact on market expectations and, consequently, on bank valuations. By examining the market reaction to regulatory reforms, this study seeks to understand how investors perceive the implications of these reforms for banks' future profitability and risk profiles. In summary, this research aims to contribute to a deeper understanding of the complex interplay between regulatory reforms, bank performance, and market dynamics. By shedding light on the impact of liquidity and capital regulatory reforms on UK retail banks, this study offers valuable insights for policymakers, regulators, and industry practitioners.

1.8 Methodological Approach

This study delves into the intricate relationship between bank regulation and profitability within the UK banking sector, spanning from 2000 to 2023. It operates under a positivist paradigm, assuming an objective reality that can be empirically investigated, and employs a deductive research approach, testing hypotheses derived from established theories (Collis and Hussey 2014). The longitudinal design allows for the examination of how regulatory changes impact UK banks over time, providing a dynamic perspective on this critical relationship (Saunders, Lewis and Thornhill 2023). The sample selection is a key aspect of the methodology. It focuses on the top 4 UK banks based on market capitalization and total assets among other sampling selection criteria. This choice is strategic, as these banks not only dominate the domestic market but also hold significant international presence. Their combined assets account for a substantial portion of the UK banking sector's total assets and an even larger share of the market capitalization of listed leading retail banks in the UK. This dominance extends regionally, with their assets representing a significant portion of total assets among leading European banks. Furthermore, their relevance on the global stage is evident, as their combined assets constitute a notable percentage of the total assets of the 100 largest banks worldwide. This sample selection ensures that the study's findings are not only pertinent to the UK context but also have broader implications for the international banking landscape.

The study's methodology is structured around three core areas of analysis, each designed to address specific research questions and provide a comprehensive understanding of the multifaceted impact of bank regulation. To investigate the relationship between banking regulation and bank efficiency, this study uses a two-stage approach. The first stage employs Data Envelopment Analysis (DEA), a non-parametric mathematical programming technique, to assess the relative efficiency of banks (Decision-Making Units or DMUs) in converting multiple inputs into multiple outputs under regulatory constraints (Berger and Humphrey, 1997). The study specifically uses a Banker, Charnes, and Cooper (BCC) model with variable returns to scale (VRS), which is considered more appropriate than the constant returns to scale (CRS) model due to the diverse nature of the UK banking industry, where banks may experience varying levels of efficiency at different scales of operation (Banker, Chames and Cooper, 1984). The BCC model allows for a more flexible assessment of efficiency by considering the possibility of increasing, decreasing, or constant returns to scale. To capture the dynamic nature of efficiency over time, the Malmquist Index is applied. This index measures changes in efficiency by decomposing it into two components: technical efficiency change, which reflects improvements in a bank's ability to utilize its existing resources, and technological change, which represents shifts in the overall production frontier due to technological advancements or other external factors (Caves, Christensen, and Diewert 1982). By analysing the Malmquist Index, the study can discern whether changes in efficiency are primarily driven by internal improvements or external shifts in the operating environment.

The second stage of the analysis in investigating this relationship involves panel regression analysis with both fixed and random effects models. This approach allows for the identification of the specific factors that influence bank efficiency while controlling for unobserved heterogeneity across banks and time (Banker and Natarajan, 2008). The fixed effects model accounts for time-invariant bank-specific characteristics, such as management style or organizational culture, that might affect efficiency but are not explicitly included in the model. The random effects model, on the other hand, assumes that these unobserved effects are random and uncorrelated with the included explanatory variables. By comparing the results of both models and conducting a Hausman test, the study can determine which model is more appropriate for the data and research question at hand. This comprehensive approach allows for a robust assessment of the impact of regulatory constraints on bank efficiency, taking into account both internal and external factors that contribute to changes in efficiency over time. Inputs included Wages and salaries, Total Capital, Total Deposits, High-Quality Liquid Assets (HQLA), Loan Loss Provisions, Risk-weighted assets. And the outputs employed included Total Loans, and Operating income/Revenue.

In investigating the impact of banking regulation on bank market value, this study employs an Event Study Methodology (ESM) to assess the impact of regulatory events on bank stock prices (MacKinlay, 1997). The ESM is a well-established statistical method in finance that examines stock price movements around specific events to determine their impact on a firm's value. The study focuses on two key regulatory events in the UK: the enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). These acts introduced significant changes to the UK's financial regulatory framework, including structural reforms, increased capital requirements, and new supervisory mechanisms. To capture the market's reaction to these regulatory changes, the study examines specific events within the legislative process, such as the third reading in the House of Commons and the third reading in the House of Lords, as well as the Royal Assent, which marks the final approval of the legislation. By analysing stock price movements around these events, the study aims to isolate the abnormal returns, which are the returns that deviate from what would be expected based on normal market conditions.

The market model, a statistical model that relates a security's return to the return of the overall market, is used to estimate these abnormal returns (MacKinlay, 1997). The FTSE 100 index, a broad stock market index representing the 100 largest companies listed on the London Stock Exchange, serves as the market benchmark in in the application of this model. Estimated with the STATA statistical package, the market model compares the actual returns of the sampled banks' stocks to the expected returns predicted. This allowed the study to identify any abnormal returns that may be attributed to these regulatory events. To determine the statistical significance of these abnormal returns, the Wilcoxon signed-rank test is employed (Wilcoxon, 1945). This non-parametric test assesses whether the median of the differences in abnormal returns is significantly different from zero, indicating whether the regulatory events had a statistically significant impact on bank stock prices. The daily stock prices of the sampled banks, obtained from Yahoo Finance and Eikon Thomson Reuters, are used as the primary data for this analysis. The iShares Core FTSE 100 UCITS ETF used as a proxy for FTSE 100 index serves as the market benchmark to control for overall market movements and isolate the specific effects of the regulatory events.

This analysis utilises panel regression, a statistical method that analyses data over time and across different entities, to examine the relationship between regulatory variables and bank profitability (Greene, 2018). The study employs both fixed effects and random effects models to account for unobserved heterogeneity, which refers to factors that vary across banks but are not explicitly included in the model. The fixed effects model assumes that these unobserved effects are correlated with the independent variables, while the random effects model assumes they are not. To determine the most appropriate model for the data, the Hausman test is conducted (Hausman, 1978). This test assesses whether the unique errors associated with each bank are correlated with the regressors. If they are, the fixed effects model is preferred; if not, the random effects model is chosen. Additionally, the Breusch-Pagan test is used to check for heteroskedasticity, which is the presence of unequal variance in the error terms of the regression model (Breusch and Pagan, 1980). The study focuses on three key measures of bank profitability as dependent variables. They include the following. Return on Assets (ROA), which measures a bank's net income relative to its total assets, indicating how efficiently it generates profits from its assets (Golin, 2001; Hassan and Bashir, 2005). Return on Equity (ROE), which measures a bank's net income relative to its shareholders' equity, indicating how effectively it generates profits for its shareholders (Menicucci and Paolucci, 2016). Net Interest Margin (NIM), which measures the difference between the interest income a bank earns on its loans and investments and the interest it pays on deposits and borrowings, relative to its average earning assets. It reflects the bank's core profitability from its lending and investment activities (Berger, 1995).

The independent variables in this analysis are regulatory variables that are expected to be influenced by capital and liquidity regulations. They include Level 1 Assets to Total Assets Ratio, Total Capital, Tier 1 Capital Ratio, Tier 2 Capital Ratio, Gross Loans to Total Deposits Ratio, Annual Common Equity Growth, Loan Loss Provisions to Total Loans Ratio, and Staff Cost to Income Ratio. Control variables included to control for macroeconomic conditions are UK Inflation Rate, Bank of England Base Rate, and UK GDP Growth Rate. The study's comprehensive approach aims to provide a nuanced understanding of how banking regulations affect various aspects of bank performance, while controlling for macroeconomic factors further offering valuable insights for both policymakers and the banking industry.

1.9 Contributions to Literature (Knowledge)

This study makes contributions to the literature on the financial regulatory reforms and their impact on banks in the UK. The study particularly makes key contributions to literature in three unique ways. Drawing on the theory of financial intermediation the study first investigate the impact of liquidity and capital regulatory reforms on the efficiency of banks. The study specifically attempts to assess how the technical efficiency of banks in the UK is affected due to their compliance with regulatory reforms as well as try to identify which specific aspects of regulation has the most significant impact on them. This aspect of the contribution to knowledge is achieved by employing a two-stage data analysis approach using two main methods: Data Envelopment Analysis (DEA) and panel regression methods.

The second major contribution to knowledge made by this study is in the form of an investigation into the relationship between event surrounding regulatory reforms and the market value of banks in the UK. To achieve this, the study focuses Banking Reforms Act (2013) and Financial Services and Markets Act (2023). The direction and magnitude of this impact is also identified and evaluated by the study. Furthermore, contribution to knowledge is made through the study's assessment of the impact of liquidity and capital regulatory reforms on the profitability of UK banks. The study uses three main ratio measures of bank profitability namely: Return on Assets (ROA), Return on Equity (ROE) and Net Interest Margin (NIM). It is worth noting that no other study to the knowledge of this research has explored the impact of regulatory reforms on UK banks in the manner that this study has.

1.10 Thesis Structure

Chapter 2: Literature Review

In this chapter, the researcher conducts a critical analysis of existing research on the relationship between banking regulations and bank outcomes. The review examines how liquidity and capital regulations have affected bank efficiency, market value, and profitability. It also explores how regulatory reforms have influenced risk-taking behavior in banks. This comprehensive review ensures the researcher's study is positioned within the existing body of knowledge and identifies any gaps that their research aims to address. The researcher grounds the study within relevant theoretical frameworks, such as the financial intermediation theory and the efficient market hypothesis, providing a strong theoretical foundation for the analysis that follows.

Chapter 3: Methodology and Data

This chapter details the researcher's methodological approach. The researcher justifies the use of a positivist paradigm and deductive approach, explaining how these choices align with the research aim. The chapter details the sampling strategy, emphasizing the international relevance of the UK banking sector. The researcher systematically describes the specific methods used for each research question – Data Envelopment Analysis (DEA), Malmquist Index, panel regression, and event study methodology. All variables are defined, data sources are identified, and the statistical models used for analysis are outlined.

Chapter 4: Findings

This chapter presents the results of the researcher's investigation into all three research questions. The researcher presents the results of DEA and Malmquist Index analyses, assessing how regulatory reforms have impacted the technical efficiency of UK retail banks. The findings from the panel regression analysis shed light on the specific regulatory factors that influence bank efficiency. This chapter provides valuable insights into how banks have adapted to and been affected by changes in liquidity and capital requirements. The researcher also investigates the stock market's reaction to regulatory changes. An event study methodology is used to examine how the stock market value of retail banks were affected by two significant regulatory events: the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). This analysis helps understand whether investors viewed these reforms as positive or negative for the banking sector. The third main section of this chapter analyses how regulatory reforms have impacted the profitability of banks. Using panel regression, the relationship between various regulatory factors (like capital requirements and liquidity ratios) and the profitability measures of the sampled banks are examined. This chapter offers crucial insights into the financial health of the UK banking sector in the wake of regulatory changes.

Chapter 5: Discussion

This chapter critically examines the findings of the study in relation to existing literature, offering a comprehensive analysis of the impact of liquidity and capital regulatory reforms on UK retail banks. It dissects the research results concerning bank efficiency, market value, and profitability, providing an understanding of the complex interplay between regulatory changes and bank performance.

Chapter 6: Conclusion

This chapter brings the research together. The researcher summarizes the key findings, answers the research questions, and discusses their implications for regulators, the UK government, and the banking industry itself. The chapter highlights the research contributions, acknowledges any limitations, and suggests potential avenues for future research. It concludes with personal reflections on the research journey and its broader significance.

Chapter 2: Literature Review

2.1 Introduction

The 2007-2008 global financial crisis exposed critical vulnerabilities in the banking sector, prompting a wave of regulatory reforms aimed at enhancing financial stability and mitigating systemic risk. These reforms, including the Basel III framework, the Dodd-Frank Act (2010), and the Banking Reform Act (2013) introduced stricter capital and liquidity requirements, enhanced supervision, and imposed restrictions on certain banking activities. The impact of these regulatory changes on the banking industry has been a subject of extensive research and debate (Hicks, 1946; Goldstein and Turner, 2004; Helen, 2015; Casu, Di Pietro, and Trujillo-Ponce, 2019; and Ogunmola, et al 2022). This literature review provides a comprehensive overview of the existing research on the effects of banking regulation on various aspects of bank operations. It delves into the impact of liquidity and capital regulations on bank efficiency, market value, profitability, and risk-taking behaviour (Barth et al., 2013; and Chortareas, Girardone, and Ventouri, 2012). The review also explores the theoretical foundations of banking and banking regulation, including the financial intermediation theory, fractional reserve theory, credit creation theory, and efficient market hypothesis. These theories offer valuable insights into the rationale behind regulatory measures and their potential consequences for the banking sector and the broader economy (Rime 2001; and Chami and Cosimano 2010).

The literature review reveals a complex and nuanced picture of the impact of banking regulation. While some studies (e.g. see Pasiouras, Tanna and Zopounidis 2009; and Kisin and Manela 2016) suggest that stricter regulations can enhance bank stability and reduce systemic risk, others (e.g. see Tran, Lin and Nguyen 2016; and Teixeira, et al. 2020) argue that they may stifle bank profitability, hinder economic growth, and incentivize unintended consequences such as regulatory arbitrage. The review emphasizes the importance of considering various factors, such as the type of bank, the country's economic conditions, and the specific regulatory measures implemented, when assessing the overall impact of regulatory reforms. In addition to examining the empirical evidence on the effects of regulation, this chapter also discusses the ongoing debate regarding the optimal level of bank capital and liquidity. It explores the trade-offs between stricter regulations that promote stability and less stringent regulations that may foster innovation and growth. The review emphasizes the need for a balanced approach to regulation that considers both the potential benefits and costs of regulatory measures.

Overall, this chapter offers a valuable synthesis of the existing literature on the impact of banking regulation while highlighting existing gaps in the literature. It provides insights into the complex relationship between regulatory reforms and various aspects of banking operations, highlighting the need for further research to fully understand the near and long-term consequences of these reforms for a UK perspective. In the following sections, this literature review will delve deeper into the specific effects of banking regulation on different aspects of bank operations. Section 2.2, presents the theoretical framework for understanding banking and banking regulation, reviewing relevant theories and their implications for the research questions addressed in this study.

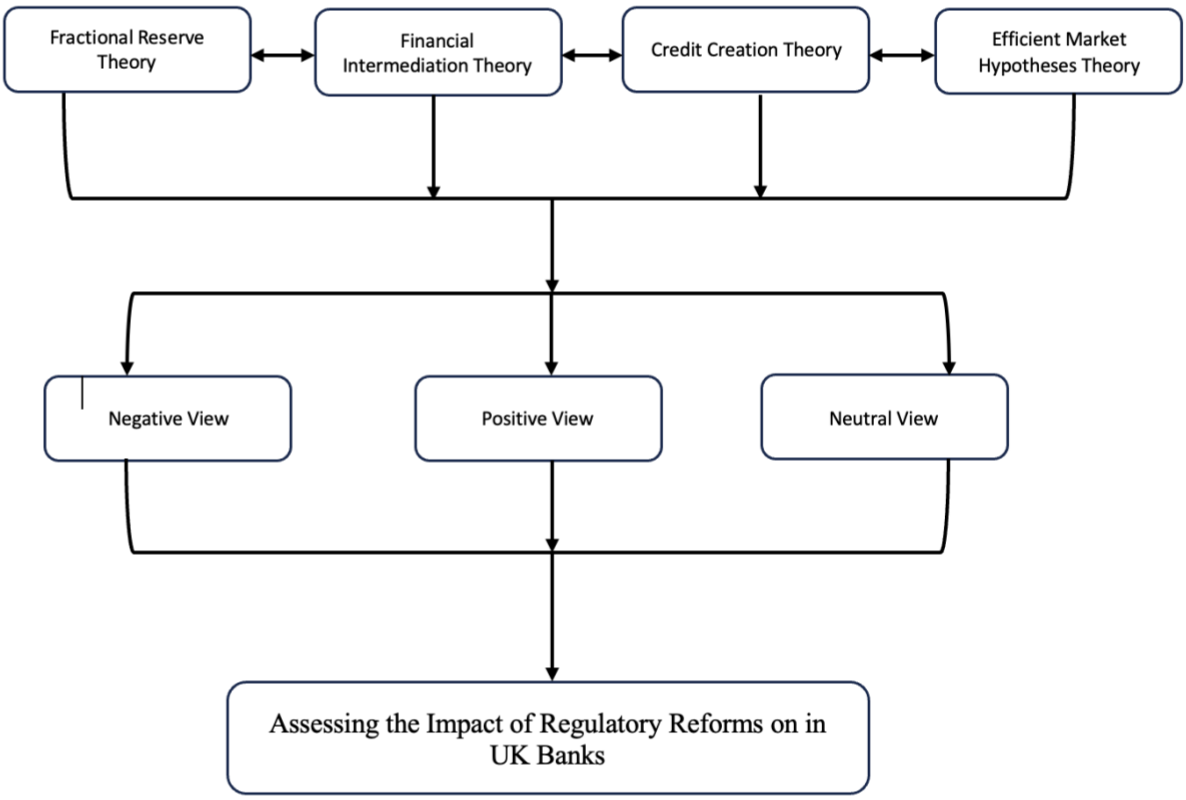
Section 2.3 critically analyses the impact of liquidity and capital regulatory reforms on banks, examining their effects on maturity transformation risk, asset and funding choices, and overall efficiency. Section 2.4 focuses on the relationship between banking regulations and bank efficiency, exploring the role of capital regulation, activity restrictions, and supervisory power. Section 2.4.1 provides an overview of banking regulation on US bank efficiency, highlighting key studies and findings. Section 2.5 examines the impact of banking regulations on the market value of banks, considering the reaction of stock markets to regulatory events and the role of information asymmetry. Section 2.6 investigates the relationship between banking regulations and bank profitability, focusing on the costs and benefits of compliance with stricter capital and liquidity requirements. Finally, Section 2.7 presents a conclusion to this chapter.

2.2 Theoretical Framework

This section reviews the relevant banking and banking regulation theories that are relevant to this study. The theoretical framework of this study encompasses a review of financial intermediation theories, the credit creation theory and the Efficient Market Hypothesis (EMH). The study also draws on the three inferential views used by Swamy, (2018). These three views are the positive view of holding higher capital cited in Allen, Carletti, and Marquez, (2011); Mehran and Thakor (2011), the negative views of holding higher capital presented by Berger and Udell, (1994); Thakor, (1996); Berger and Bouwman, (2013); and neutral view as expounded by Modigliani and Miller (1958) in their capital structure theory. Before taking a deeper look at these three views, the subsequent paragraphs first explore three fundamental banking theories and their connection to the main research question as illustrated in Figure 2.1.

Figure 2.1 provides a clear and insightful framework for analysing the complex impact of regulatory reforms on UK banks. It effectively links economic theories to different perspectives on the potential effects of reforms, aiding an assessment of the consequences of regulatory interventions. The Figure highlights how the Fractional Reserve Theory, Financial Intermediation Theory, Credit Creation Theory, and Efficient Market Hypotheses Theory can be applied to understand the potential effects of regulatory reforms. By considering the negative, positive, and neutral views associated with each theory, the study can explore a nuanced understanding of the potential consequences of different regulatory approaches. This framework is particularly valuable in the context of UK banks, where regulatory reforms have had a significant impact on the banking sector.

Figure 2.1 Banking Theories and Theoretical Framework of the Study



Source: Researcher's construction.

The four banking theories identified above have seen varying popularity over the past century. The most popular theory presently is the financial intermediation theory which describes banks as intermediaries who collect deposits and then lend these out. The fractional reserve theory of banking can also be classed as another form of a financial intermediation theory, although not as popular, which dictates that each bank within the banking system is a financial intermediary without the power to create money, but the banking system can collectively create money through the process of 'multiple deposit expansion' (the 'money multiplier'). The credit creation theory which contrasts the first two argues that each bank within the banking sector creates credit and money by granting a bank loan and does not consider banks as financial intermediaries that gather deposits to lend out (Werner, 2016).

The dominant financial intermediation theory further makes the argument that banks are identical to other non-bank financial institutions. However, they are not treated as such by central banks. This theory further provides a rationale for capital adequacy-based bank regulation, although limited in nature. On the contrary, the findings from Werner, (2016) question the rationality of regulating bank capital adequacy with the aim of avoiding banking crises. Moreover, support for all three theories identified above can be seen in the work of Keynes at various points in time. The same level of support of all three theories at the same time however from a central bank such as the Bank of England leads to ambiguity. The majority of central banks globally are rather strong proponents of the of the financial intermediation theory, which has propelled it to its dominant state in academic literature for decades (Werner, 2016).

Further evidence of the Bank of England's support for all three theories as set out in Werner, (2014, 2016) is outlined in this paragraph and consequently sets the precedent for the relevance of all three theories in this study. Firstly, in 2014 the then Governor Mark Carney in his Mais Lecture at the Cass Business School supported arguments made in his lecture by citing the work of Brunnermeier and Sannikov (2015) on monetary theory. After a thorough review of this paper, it is apparent the Brunnermeier and Sannikov (2015) view banks as financial intermediaries that take deposits to extend loans, implying that banks finance themselves by borrowing from households. Citing this paper by the then governor of the Bank of England indicates the central bank's support for the financial intermediation theory. This assertion by the governor was sharply contrasted in the same year in a statement about the financial system by a member of the financial policy committee, Dame Clara Furse in March of 2014. Based on these assertions Werner, (2014 and 2016); and Zoltan and Kumhof, (2015) conclude that the Bank of England supports all three of the theories of banking at the same time.

Further supporting the relevance of all three theories of banking to this study are the results of an empirical test conducted by Werner (2014) to examine operations and accounting entries that take place when a 'live' bank loan is granted and paid out. The results from the test revealed that only the credit creation theory proved consistent with the observed accounting records although all three bang theories held true theoretically. The results were however subject to the drawback of not being conducted in a fully controlled environment. That is with bank operations taking place 24 hours a day, it was unavoidable to observe other transactions being booked in addition to the specific test transaction used for the test. To attain robustness, this study will test the three theories of banking using historic data to run two panel regression models (random and fixed effects models) which have been discussed further in the methodology section below. In the interim, however, the next four sections will review in detail the three banking theories mentioned thus far and the three inferential views proposed by Swamy, (2018) as shown in Figure 1 above.

2.2.1 The Financial Intermediation Theories of Banking

von Mises, (1912); and von Mises (1980) is one of the earliest proponents of this theory. The activity of banks is described as negotiators of credit characterised by the lending of other people's borrowed money. Banking is seen as a negotiation between granters of credit (depositors) and grantees of credit (lenders). Additionally, the work of von Mises (1912) viewed bankers as only those who lend out money belonging to others and however described those involved in the lending out of their own money as capitalist. von Mises (1912) further argued that banks could either act as financial intermediaries or creators of money and credit. However, it was unclear in the arguments how bank accounting would reflect this. This argument however may have prepared the framework for the conception of the idea that banks could function both as financial intermediaries on the one hand and on the other create money, which is also a position maintained by the fractional reserve theory. On the contrary, in the more recent work of Dewatripont, Rochet, and Tirole, (2010), Banks are seen as liquidity creators who borrow short and lend long. This implies that banks borrow from depositors with short maturities and lend to borrowers at longer maturities, further highlighting the relevance of the financial intermediation theory.

Keynes (1936); Gurley and Shaw (1955, 1960); Tobin (1963); Sealey and Lindley (1977); and Baltensperger (1980) are among some of the earliest pieces of literature that recognise and support the financial intermediation theory of banking. In his General Economic Theory Keynes (1936) clearly states that savings first need to be gathered before investments can take place. This view can also be seen reflected in the Keynesian growth models presented by

Harrod (1939) and Domar (1947). These have also been argued to be based on the financial intermediation theory of banking. Their work also highlights the failure to incorporate banks and the way they operate into economic models. However, they have also had a significant impact on global economic policy, such that it has been interpreted to conclude that underdeveloped countries could be supported by international banks. The argument emanates from the fact that international banks could provide the missing domestic savings from their operations abroad to facilitate domestic lending in order to fund economic growth within these underdeveloped countries.

Further to this, Gurley and Shaw (1955, 1960) argue that there is nothing special about banks since banks and non-bank financial institutions largely share the function of being financial intermediaries. This view was later decanted by Tobin (1963) pointing out that differences are more importantly related to the special reserve requirements (such as that of capital and liquidity) and interest rate ceilings to which banks are subject. Tobin (1963) however went further to add that, the difference between banks and other financial intermediaries has been too sharply drawn as these differences are of degree and not of kind. Eventually, pointing out that the differences may exist has little intrinsically to do with the monetary nature of bank liabilities. Sealey and Lindley (1977) on the other hand in their developed production theory for depository institutions argue that the transformation process undertaken by these institutions involves the borrowing of funds from surplus spending units and lending those funds to deficit spending units, which is by definition the act of financial intermediation. Their production theory also acknowledges the key role played by capital, labour and material inputs in the multistage production process of financial intermediation.

Baltensperger (1980) also purports that banks are simply financial intermediaries and cannot credit money but rather engage in a perceived vague act of risk transformation. In this sense, financial firms such as banks are perceived to have the main function of consolidating and transforming risks on the one hand as well as serving as brokers in the credit markets. This lends justification to the use of 'Loan loss provision' as an independent variable to account for transformation risk within this study. Furthermore, Riordan (1993) specifically makes the argument that banks operating in a capitalist economy serve as financial intermediaries between borrowers and lenders. The rationale behind the argument is that in capitalist economies investment projects tend to be owned and managed by private entrepreneurs and firms. Therefore, given the amount of capital required to undertake these projects, these private players lack the ability to fully finance them and consequently seek bank loans to do this. Banks then serve as financial intermediaries as they aggregate deposits to facilitate these loans. Riordan (1993) also highlights the unique position banks find themselves due to their ability to take deposits, unlike other financial institutions. As a result, attributing the significant lending by banks to the ready availability of funds from deposits.

While envisaging a cash-based economy, Kashyap, Rajan and Stein, (2002) classify banks as pure financial intermediaries in a model of banking in which they propose that banks purchase assets with funds they acquire in the form of deposits, or the issuance of equity or bonds. Although this model is fatally flawed in the current global digital economy, their assertion lends voice to the relevance of the financial intermediation theory and is considered for this reason. More recently following the financial crisis of 2008, Krugman (2015); and Admati and Hellwig, (2012, p. 50) continue to argue that banks are financial intermediaries who profit by taking in deposits and lending the funds out at a higher rate of interest.

The justification for drawing on this theory for this study emanates from its accounting implications as outlined in Werner, (2016). The presented accounting implications under this theory when a loan is granted by a bank is that the bank balance sheet size is not significantly changed. That is, when a bank grants a loan, there is an increase in assets arising from its claim on the borrower. However, the act of disbursing the loaned amount involves the act of drawing down deposited funds (which are liabilities to the bank), hence resulting in the assertion that the bank's balance sheet size does not change significantly. A flaw of this theory's accounting implication is that income from the higher interest rates to be claimed from the borrower upon repayment of the loan, which could potentially result in bank profitability as well as the potential risk of default are not accounted for. It is for this reason that this study examines bank balance sheet variables such as Net Interest Margin and Loan Loss Provision as a means of assessing the contribution to profit as well as the bank's perceived risk exposure in attaining that profit.

A critique of this theory is given by Werner, (2016) in which it is argued that a rigorous application of basic accounting and financial regulation would provide ample evidence to disprove this theory. That is, if non-bank financial intermediaries who may also accept deposits have to keep these deposits safely with custodian banks in accordance with Client Money rules an equal treatment for banks would mean that they also conform to Client Money rules. This emanates from the argument of Gurley and Shaw (1955, 1960) that there is nothing special about banks since banks and non-bank financial institutions largely share the function of being financial intermediaries. However, this does not hold true in reality, as banks are able to record the creation and contributing to growth in their assets made possible by deposits on their balance sheets. This points out the peculiar characteristic that banks are exempt from Client Money rules and hence casts doubt on the validity of the financial intermediation theory.

This is particularly crucial as the financial intermediation theory purports the indistinguishability of banks from non-bank financial intermediaries in their accounting needs. Therefore, an attempt has been made by Tobin (1963) to argue the case for some perceived distinguishing features of banks including reserve requirements, regulations of interest rates, and capital requirements. As a result, this study cannot wholly accept the financial intermediation theory as the only relevant theory in evaluating the impact of capital and liquidity regulation on banks. It is for this reason that the fractional reserve theory and credit creation are equally considered and reviewed in the next two sections.

The Fractional Reserve Theory of Banking suggests that banks are financial intermediaries that collectively create money through multiple deposit expansions (Werner, 2016). This idea has been explored by economists such as Phillips (1920), Crick (1927), Hayek (1929), Keynes (1930), Whittlesey (1944), Samuelson (1948), Smith (1959), and Stiglitz (1997). Phillips (1920) formulated a framework for fractional reserve banking, noting that the collective actions of banks differ from individual bank operations. Crick (1927) supported the idea that the banking system as a whole creates money, although he downplayed its significance. Hayek (1929) argued that with a 10% reserve requirement, banks would lend out 90% of deposits, leading to multiple deposit creations.

Keynes (1930) expanded on the concept of deposit creation, arguing that all deposits are created by the bank holding them, while Whittlesey (1944) described banks as administrators of money supply. Samuelson (1948) supported the broader theory, arguing that while individual banks cannot create credit out of nothing, the collective system can. Smith (1959) and Stiglitz (1997) introduced the multiplier process, explaining that banks can create money through the expansion of credit.

A drawback of this theory is that it overlooks the accounting treatment of loans on a bank's balance sheet. Critics such as Samuelson (1948) argue that banks are not unique financial intermediaries and that the treatment of deposits in banks is distinct from non-banks. Werner

(2014c) notes that UK Client Money rules require financial intermediaries to hold client money off-balance sheet, highlighting the impracticality of classifying banks solely as financial intermediaries. The fractional reserve theory's relevance to this study requires assessing the accounting implications, as described by Samuelson (1948) and Stiglitz (1997).

2.2.2 The Banking Theory of Credit Creation

This theory appears to be in sharp contrast to the two theories previously reviewed. Unlike the other two, this theory does not view banks as financial intermediaries regardless of whether they are presented individually or collectively. This theory rather postulates that each bank creates credit and money out of nothing whenever it extends bank loans to borrowers or purchases assets. Debunking the need for banks to first gather deposits or reserves before they can lend. The result of this kind of lending is that an increase in total balances takes place without a commensurate decrease elsewhere. Therefore an important observation to be made from this theory is that if it is to hold true, bank balance sheets as well as measures of money supply in an economy would increase as outstanding bank credit increases. This is particularly contrary to the financial intermediation theory, where only already existing purchasing power can be reallocated with no acknowledged increasing effect on the money supply (Werner, 2016).

There also some notable pieces of literature that have over that years supported this theory including Macleod (1856); Macleod, (1906); Hawtrey (1919); Keynes and Moggridge, (1983); and Werner (2005). Macleod (1856) and Macleod, (1906) concluded that the essence of banking business is not solely to lend money but to create a vast structure of credit by multiplying their promises to pay repeatedly. These created credits being payable on demand allow them to therefore perform all the functions of an equal amount of cash. This strengthens the argument that banking is a business that brings about an increase in capital since its primary business is not to lend money but to create credit. Therefore, with the existence of clearing houses, these created credits are now easily transferred from one bank to another as can be done from one account to another in the same bank through instruments such as cheques. This essentially makes all created credits exactly equal to equivalent cash or currency.

Macleod, (1906, p. 408) also adds that the created credits although practically the same as money in equivalence cannot be used externally like money, but can internally create the same effect as an equivalent amount of money. Hawtrey (1919) further highlighted a significant difference between this theory and the fractional reserve theory being that one bank is able to create deposits not just the entire banking system as is the case with the fractional reserve theory. Keynes and Moggridge, (1983), also highlighted the important role of money and credit in advancing economic thought through the analysis of the trade cycle made possible by the prevailing understanding of these two mechanisms. It is also argued that banks are not financial intermediaries when creating credit. This is when a loan from one bank results in credit creation, which in turn creates equivalent amount of deposits with another bank or dispersed across various banks, amounting to the size of the loan. Therefore raising the point that if the extending the loan was a financial intermediary, it would not create a new deposit in this manner, but rather transfer the funds from another account, either inside or outside the bank.

Further lending support to this theory is Werner (2005) who examined where banks get the money from to credit the accounts of borrowers. The examination revealed that money used to credit the accounts of borrowers was neither withdrawn by the banks from other users nor transferred from any other part of the economy. According to Werner (2005), banks simply create the money by writing the figures into their books and the customer's account book. Therefore, each bank in the banking system can create money when it extends a loan. That is the banks merely write the loan amounts in books when crediting the accounts of borrowers.

The accounting implications of this theory dictates that banks do not separate customer funds from their own funds. This is because banks are able to credit the borrower's account with the borrowed amount when lending, although no new deposit may have taken place. Additionally, the balance sheets of banks increase in size due to the extension of loans, as neither cash, central bank reserves nor balances with other banks are needed to extend these loans. In other words, unlike the financial intermediation theories, a bank can extend a new loan, even though it has not received any new deposits or made met reserve requirements. That is the accounts of borrowers are credited with the amount of the loan, although there are no commensurate reductions in the balance of any other accounts such as the deposits, as would be the case had the funds been transferred under the two financial intermediation theories. Therefore, leading to the founded conclusion that, bank loans create new deposits, rather than the other way around (Werner, 2016).

2.2.3 Efficient Market Hypothesis.

The theory of an efficient market was first put forward by Roberts, (1967) with a distinction between weak and strong form tests being made which later became the classic taxonomy in Fama (1970). Roberts describes the weak form efficiency as a situation where all past trading information is already included in stock prices. Whereas, the strong form was said to be when stock prices fully reflect all information, both public and private. This distinction meant that there were no superior gains to be made by either conducting an analysis of past price trends (technical analysis) or by sourcing information as both are already factored into the prices of stocks. Fama (1970) later proposed the semi-strong form of market efficiency which is the situation in where stock prices adjust rapidly to the release of all new public information. A more definitive study on the EMH was also conducted by Fama (1970) where he defines efficient markets generally as one in which prices of securities always fully reflect the information available. Robert (1967) and Fama (1970) contributed significantly to the development of these concepts by discussing the implications of information availability and market behaviour. The EMH and its forms suggest that it is impossible to consistently outperform the market by using any information that the market already knows, whether through technical analysis and/or fundamental analysis. The market is efficient in processing information, and thus, securities are always fairly priced, reflecting all available information.

This theory is particularly relevant to this research due to strong arguments it makes for event studies such as the one undertaken in Chapter 5 of this study. There is significant evidence in literature regarding its relevance in event studies, particularly relating to regulatory events. A few of such studies that are anchored on the EMH include Fama et al. (1969); Kemp and Reid (1971); Pettway, (1980); Gabriel, et al. (2013); Syed and Bajwa (2018); Daniel Moreira Carvalho and Marcos Antônio de Camargos (2013); and Ndegwa (2023). The literature accredits the first ever event study to Fama et al. (1969) in which their results give considerable support to the conclusion that the stock markets are efficient. The conclusion in similar early literature was that share price movements on the stock market are noticeably non-random and disclosure of information can prevent risk taking. However, consistent excess returns after public announcements of firms' earnings are also evidenced in literature (Kemp and Reid 1971; Hirshleifer, 1971; and Ball 1978).

The earliest available piece of literature exploring the effects of bank regulatory events and the market value of banks in an event study while drawing on the EMH theory was presented by

Pettway, (1980). The EMH was tested and found to hold true. Evidence from Pettway (1980) revealed that regulatory events were not distinctly important. The markets quickly translated the events into an increasing potential for bankruptcy and then further into an increase of returns of stocks of affected banks. This presents evidence of the role played by the markets in bank regulation. The nature of the timings of the market risk perceptions prior to a piece of regulation may be effectively developed into an advance warning system of the possible impact of regulation. This may be particularly beneficial to regulators in identifying and, thereby, addressing any potentially disproportionate adverse effects on banks (Pettway, 1980).

Therefore, the EMH holding true will require evidence of a significant over or underreaction by investors to a news (event), which will considered abnormal returns as a result of the event. This has been criticised by behavioural scientists including De bondt and Thaler, (1985); and Nofsinger, (2008) as being more idealistic rather than realistic. They argue that psychological factors may cause market inefficiencies by limiting the ability of investors to make good investment decisions. The study by Ndegwa, (2023) which was also based on the viability of EMH used an event study method to assess the impact of board diversity reforms announcements on the market value of companies. Their findings of Cumulative Abnormal Returns (CAR) after the date of the board diversity reforms announcement to be positive and significant, further underscored the relevance of this theory in event study.

2.2.4 Inferences on the Relationship between Bank Regulation and Profitability

In concluding this theoretical framework section, a review of the three different inferences made by Swamy, (2018) regarding the relationship between bank capital requirements and profitability. The first which is the neutral view is grounded in the capital structure theory proposed by Modigliani and Miller (1958). According to this theory, the level of capital relative to total assets has no effect on the profitability of banks. This view therefore implies that the capital requirements that the banks considered under this study are subject may not have an impact on their profitability. This will either be confirmed or questioned by the results of the empirical tests conducted in this study.

The second view supposes that bank profitability is decreased by the availability of excess bank capital. This is referred to as the “negative view” by Berger and Bouwman, (2013) and Swamy, (2018), who argue that the performance of banks is reduced when they are faced with the challenge of tougher capital requirements. This argument was originally seen in Berger and Udell, (1994); and Thakor, (1996) where it was observed that higher capital requirements resulted in a shift in the type of assets invested in by banks from loans which are relatively high yield-high risk to lower yield securities. This shift in asset type tends to decrease bank profits as the lower risk-lower return nexus holds true for the affected banks.

In contrast, the third view claims that higher capital has a positive effect on banks' profitability, leading to potential value enhancement. That is capital requirements that require banks to hold a higher proportion of capital has a favourable effect on the profitability of banks. This is because, an increase in capital that banks are required to hold unencumbered reduces funds available to transact with, thereby reducing excessive risk taking. This further lowers the risk profile of banks, leading to lower risk premiums being demanded by debt holders of banks owing primarily to the fact that the banks are highly capitalized. In essence, higher capital requirements result in lower debt costs (cost of capital) for banks, which in turn translates to higher Return on Equity (ROE) (Berger and Bouwman, 2013). ROE is one of the measures of profitability used in this study and many other studies on bank profitability.

Mehran and Thakor (2011) further categorized the gains from higher capital ratios for banks to result from direct and indirect effects. According to Mehran and Thakor (2011), the direct effects stem from the higher interest payments charged to borrowers due to the stronger monitoring effort implying higher bank margins. Whereas, the indirect effect is argued to arise from the complimentary incentive to increase monitoring due to the higher probability of survival of banks following capital ratio increases. Therefore, enhancing the ability of banks to collect the return on investments in the future (Allen, Carletti and Marquez, 2011). This summarily concludes that increasing capital requirements is consistent with profit maximization for banks. Furthermore, empirical evidence from Mehran and Thakor, (2011); Kristiansen and Vale (2005); and Calomiris and Mason (2003) suggests that capital ratios have a positive effect on bank performance. This is because banks that have a high levels of capitalization also increase their market share and decrease their probability of default.

2.3 Critical Analysis of the Impact of Liquidity and Capital Regulatory Reforms on Banks

Hicks, (1946) found the role played by formal banking in the maturity transformation process to be a vital contribution that cannot be overlooked. Despite the notable evolution of banks over the years, they still act as an intermediary in the transfer of funds from parties with surplus funds to parties with various financing needs. The study described the maturity transformation risk as the likelihood of not attaining the optimum maturity match needed to facilitate the transfer of these funds while serving the needs of all parties involved. However, Goldstein and Turner, (2004); Casu, Di Pietro, and Trujillo-Ponce, (2019) asserts that although the need for supervision and controls on potential maturity mismatch has been identified to reduce the rollover of transformation risk and preserve financial stability, there is still no empirical literature on the evaluation of policies related to banks' maturity mismatch even with the introduction of the NSFR to tackle this risk.

Bonner, Lelyveld, and Zymek, (2015), finds that the main aim of the liquidity regulation in the UK is to ensure that maturity mismatches are limited. The Prudential Regulatory Authority (PRA) specifically sets institution limits that are specific to every institution for the allowed maximum net-cumulative mismatch they can have. The maximum net-cumulative mismatch is set as a percentage of total deposits ranging over an 8- and 30-day horizon. This is however in addition to the minimum amount of high-quality liquid assets which banks are required to have. These high-quality liquid assets include UK government bonds, central bank reserves and cash. However, it was found that banks appear to have decreased their share of financial assets and short-term wholesale funding in response to these liquidity requirements. This is also notwithstanding the fact that further findings suggested that some individual banks from time to time appear non-compliant, resulting in them drawing on their liquid asset buffer and returning to compliance shortly after.

According to Barth et al., (2013); and Chortareas, Girardone, and Ventouri, (2012), the aspects of regulatory reforms that could potentially affect bank efficiency include activity restricting regulation, capital regulation, and supervisory and market monitoring power. Capital regulation may be described as the required amount of capital that owners of a bank must have at risk. This is intended to control bank risk taking, and to some extent promote bank efficiency. Agoraki, Delis, and Pasiouras, (2011), argue that when capital requirements are more stringent, it raises barriers to entry for new banks and impedes competition. This results in banks making lending decisions that are more prudent, hence leading to higher bank efficiency. On the contrary, earlier studies by Pasiouras et al., (2009); and Laeven and Levine, (2009), found that rigorous capital regulation results in the management of banks seeking to atone for the loss of benefits due to capital regulation. This is done by pursuing relatively more expensive and riskier financing sources which leads the banks to be inefficient.

The recent consultation paper from the Bank of England's proposes changes to the definition of capital for financial institutions. This could potentially alter the definition of capital regulation and its impact on banks in the near future. These proposed changes focus on restating existing requirements from the Capital Requirements Regulation (CRR) into the PRA Rulebook, with some modifications to improve proportionality and transparency. Specifically, key proposed changes include simplifying the notification process for new capital instruments, allowing the inclusion of interim profits in Common Equity Tier 1 capital, and permitting capital reductions in certain circumstances. The PRA also proposes to clarify the treatment of non-CET1 shares and the possibility of future capital reductions in CET1 instruments (Bank of England, 2024).

The impact of these proposed changes on financial institutions may vary depending on the type of institution but they may generally include reduced compliance costs, improved capital allocation and greater flexibility. For instance, simplifying the notification process for new capital instruments and allowing the inclusion of interim profits in CET1 capital may reduce the administrative burden on firms. Also, permitting capital reductions in certain circumstances may allow firms to manage their capital more efficiently. Additionally, clarifying the treatment of non-CET1 shares and the possibility of future capital reductions in CET1 instruments may provide firms with more options for managing their capital (Bank of England, 2024).

Activity restricting regulation, which is mostly geared towards liquidity and capital, may hinder the ability of banks to diversify their sources of income. This may additionally reduce the franchise value of banks, which may in turn collectively disincentivise them from acting efficiently in the short term. Activity restricting regulation tends to result in limitations with regards to the variety of services that can be provided to clients, as well as the ability to exploit economies of scale in collecting and processing information about clients and other firms (Djankov et al., 2002). However, allowing banks engage in broad financial activities beyond their core business may intensify the issue of moral hazard due to the opportunity for banks to increase their risk appetite. The undertaking of broad financial activities by banks if left unchecked may result in the formation of exceedingly large and complex entities which become a challenge to monitor and regulate. These entities are sometimes referred to as “too big to fail” and “too big to discipline”. Therefore, the impact of activity restricting regulation on the efficiency of banks need to be further investigated (Boyd et al., 1998; and Laeven and Levine, 2007).

Additionally, Helen, (2015) argues that the Banking Reform Act (2013) sought to curtail the risk of moral hazards around banks that are deemed “too big to fail” and improve the safety of the banking system by sustaining stability in the financial system–thereby protecting retail clients and leaving the banks to bear the additional cost involved. In response, Korotana, (2016) argued that taxpayers’ funds as well as the banking system may still be kept safe if bank regulation is based on the premise of whistle blowing and economic benefits such as what is found in the Dodd-Frank Act. This is opposed to the proposed ring-fencing approach in the Banking Reform Act (2013). As mentioned by Andriosopoulos et al., (2017) the rationale behind studying the relationship between the stock market and financial regulation emanates from the view that the stock market is believed to be the best judge of the effectiveness of financial reforms. The stock market as well gives an indication of the impact financial reforms have on the returns of shares of financial institutions such as banks. Additionally, the lack of studies on the impact that the Banking Reform Act 2013 has on banks’ value as well as the English legal systems lagging response to financial crisis are among the reasons why this relationship should be studied (Putnis 2014; and Casu et al.,2015).

The issue of market failure is to a large extent the result of information asymmetry compounded by negative externalities. This may further be regarded as one of the motivations for bank regulation (Parise and Shenai, 2018). Casu et al. (2015) identified the various forms of bank regulation that are relevant to the study of the relationship between regulatory reforms and stock market value of banks. These include but are not limited to bank licensing, minimum capital requirements, deposit insurance, and the periodic assessment of banks in accordance with predefined and regularly reviewed benchmarks. Their study further revealed that some regulatory requirements such as deposit insurance may lead to moral hazards. This may then result in market failures since the banks may be taking more risk given that they do not bear the entire cost associated with the said risk but gain the entire benefits associated with the said risk.

In the UK for instance, there is an issue of non-compliance cost in the form of fines due to Payment Protection Insurance (PPI) and other financial products mis-selling by retail banks. The damage caused by the mis-selling of financial products was identified as one of the issues that prompted an overhaul of the UK financial services industry and the establishment of the FSA. The total amount of compensation paid out by financial services firms in the UK in respect of mis-sold mortgage endowments, stood at more than £2.8 billion as at the end of March 2007 (Ferran, 2012). Additionally, the FSA begun facing challenges with the issue of mis-sold PPI in 2005 which dragged till 2011. An amount in the region of £1.9 billion was paid out in compensation to consumers who were mis-sold PPI by the industry. As at 2011, the FSA estimated that the likely final total amount to be paid out in compensation would be around £9 billion as more complaints were being processed and investigations were being carried out. However, according to the FCA's monthly PPI refunds and compensation data published on 7 May 2020, the total amount paid since January 2011 up until December 2019 is £38.3 billion. This figure exceeds the estimate by far and still counting (FCA, 2020; and Ferran, 2012).

A report by Barclays, (2014) examined the cost of evolving bank regulation focusing on the persistent increase in capital requirements. The analysis revealed that increasing capital requirements either through a defined minimum equity or minimum wholesale debt as a percentage of a bank's balance sheet, would restrict a bank's ability to serve clients and as a result impair revenue. This was identified as a double-edged sword which would impact both the banks and their clients (corporate and individual). It would lead to banks missing out on profitable lending opportunities and associated service income, while their clients would be confronted with growing impaired access to credit at an incrementally higher price. The report also acknowledged the relevance of the geographical location of the banks when assessing the impact of the new capital requirement. This will be less expensive for European banks as compared to US banks, since they have typically funded themselves with a higher proportion of wholesale funding. As a result, this could limit the costs of complying with the higher capital requirement by shifting debt balances lower and leaving customer-centric liabilities unchanged (Meli, Monteleone and Pigott, 2014).

There exists a variety of literature that assess the impact of various aspects of regulatory reforms on the profitability of various types of financial institutions. Literature such as Giordana and Schumacher, (2017); Banerjee and Mio, (2017); and Mashamba, (2018) assess the impacts of Basel accords on the performance of commercial banks. The study conducted by Giordana and Schumacher, (2017) was concentrated on the impact of Basel III standards on banks profitability and probability of default. The three standards identified by the study are the Liquidity Coverage Ratio (LCR), the Net Stable Funding Ratio (NSFR) as well as the leverage ratio which is defined as the Capital-to-Asset Ratio (CAR). The study went further to indicate that since these standards are aimed at very different aspects of banks risk, and as such complying with them may impact the balance sheets as well as profits of banks differently. On the other hand, there is no doubt that the COVID-19 pandemic will impact the global economy, while banks as well as regulators are not immune to this impact. It is for this reason that the Basel Committee on Banking Supervision (BCBS) agreed to delay the implementation of the revised Basel III standards by one year, to 1 January 2023. This measure is primarily intended to create operational space within which banks and regulators may rely on while responding to the economic impact of the pandemic (Deloitte, 2020; and bis.org, 2020).

2.4 Banking Regulations and Bank Efficiency

It may be argued that the 2007 global financial crisis, directly affected competitiveness and risk-taking of banks, which as a result had an influence on their efficiency. One of the motives of this study is to look at how the banking sector's regulatory reforms after the crisis impacted the transformational efficiency of banks. The global financial crisis was followed shortly by the stricter implementation of the Base II guidelines, which were accompanied by certain liquidity, capital, and bank supervision requirements (Haque, and Brown, 2017).

According to Barth et al., (2013); and Chortareas, Girardone, and Ventouri, (2012), the aspects of regulatory reforms that could potentially affect bank efficiency include activity restricting regulation, capital regulation, as well as supervisory and market monitoring power. Capital regulation maybe described as the required amount of capital that owners of a bank must have at risk. This is intended to control bank risk taking as well as to some extent promote bank efficiency. Agoraki, Delis, and Pasiouras, (2011), argue that when capital requirements are more stringent, it raise barriers to entry for new banks and impedes competition. This results in banks making lending decisions that are more prudent and hence leading to higher bank efficiency. On the contrary, earlier studies by Pasiouras et al., (2009); and Laeven and Levine, (2009), found that rigorous capital regulation results in the management of banks seeking to atone for the loss of benefits due to capital regulation. This is done by pursuing relatively more expensive and riskier financing sources which leads the banks to be inefficient.

A bank's ability to diversify its sources of income alongside enhancing its franchise value may be hampered by activity restricting regulation. This may collectively disincentivise it to act efficiently in the short term. Activity restricting regulation tends to result in limitations with regards to the variety of services that can be provided to clients as well as the ability to exploit economies of scale in collecting and processing information about clients and other firms (Djankov et al., 2002). However, allowing banks engage in broad financial activities beyond their core business may intensify the issue of moral hazard due to the opportunity for banks to increase their risk appetite. The undertaking of broad financial activities by banks if left unchecked may result in the formation of exceedingly large and complex entities which become a challenge to monitor as well as regulate. These entities are sometimes referred to as "too big to fail" and "too big to discipline". Therefore, impact of activity restricting regulation on the efficiency of banks need to be further investigated (Boyd et al., 1998; and Laeven and Levine, 2007).

Barth et al., (2013) describes a bank supervisory agency as the institution that has the responsibility of overcoming market failures due to imperfect information by using their expertise. These agencies monitor and, in some cases, discipline noncompliant banks which enhances their corporate governance practices. As such, effective supervision tends to lead to better bank efficiency, given that the supervisory agencies are independent. Independent supervisory agencies are found to be more effective in monitoring the financial conditions of banks in a truly professional and consistent manner. Although, some studies such as Beck et al. (2006), have pointed out that the extremely powerful supervisors may use their power to forcefully induce banks to apportion credit in a manner that is geared towards generating political or private benefits. In this sense the regulators will be rather concerned with promoting private benefits instead of mitigating market failures which is one of their core mandates. Hence, this might create an inverse relationship between bank regulation and bank efficiency.

Furthermore, Beck et al. (2006) argued that effective regulatory monitoring and governance over banks could be accomplished if bank supervisory policies are geared toward strengthening the ability as well as encouraging private investors overcome market informational barriers. The study further identified that steps were being taken by the bank regulatory authorities in many countries to ensure that accurate information is disclosed periodically. These include compelling banks to make available consolidated information about all their business activities as well as their procedures for managing risk in a manner that is reliable and comprehensive.

This is further enforced by holding the management of banks legally accountable for any shortfalls in the information disclosed. This along with greater emphasis on market discipline were found to be relevant for the proper functioning of banks.

This study adopts the intermediation approach, which was originally introduced by Sealey and Lindley, (1977) in order to find answers to the associated research question. The approach is based on the premise that banks are intermediators of financial services, instead of just being responsible for producing loans and securing deposits. The fundamental concept of banking maintains that after banks secure deposits from customers they transform them into loans and investments for clients, primarily through the application of the required amount of labour as well as capital. Therefore, in line with Berger and Humphrey, (1997); and Dell'Atti, Pacelli, and Mazzarelli, (2015), the intermediation approach is perceived to be most appropriate in the analysis of the efficiency of banking groups. This is because the approach is better able to capture the influence of cost in the financing of banks.

2.4.1 US Bank Efficiency

The efficiency of banks is a pivotal aspect of the stability and performance of any country's financial sector as alluded to in previous sections. This section reviews findings from academic literature to provide an overview of the efficiency of banks in the United States, highlighting methodological approaches. The United States is recognized as the largest economy in the world and its financial system has developed steadily through the guidance of the Federal Reserve System for over one hundred years to become one of the most stable (IMF, 2024). The US financial system has been suffered many international financial crises, majority of which originated from that very system (i.e. the Global Financial Crisis) but successfully emerged from these difficulties (Ogunmola, et al 2022). In a bid to keep the financial system resilient, the U.S. government through the Federal Reserve Bank has gradually instructed banks to raise the core capital quantity although challenging economic conditions persists. A number of studies have thus far attempted to investigate the drivers of bank efficiency in the US including Haslem, Scheraga and Bedingfiel (1999); Al-Sharkas, Hassan and Lawrence (2008); Bailey, Klein and Schardin (2017); Tarullo (2019); Liu (2019) Darrell (2019); Vučinić, (2020); Shobande and Shodipe, (2021).

Contributing factor to the efficiency of US banks is offered by Al-Sharkas, Hassan and Lawrence (2008) to be merges and acquisitions among banks. They present evidence to show that merged banks have lower costs than non-merged banks because they are using the most efficient technology available (technical efficiency) as well as a cost minimizing input mix (allocative efficiency). This further suggests there is an economic rationale for future mergers in the banking industry. Using the DEA analysis, Al-Sharkas, Hassan and Lawrence (2008) present empirical evidence to suggest that merged US banks tend to have greater productivity growth compared to non-merged banks. Additionally, technological advancements rather than increased technological efficiency is credited for these advancements.

Further evidence from DEA by Haslem, Scheraga and Bedingfield, (1999) suggests that the efficiency of US banks is enhanced when management focuses on improving the quality of inputs such as cash and real capital, rather than outputs such as foreign loans. It is also worth highlighting that US banks over the years have been subjected to various forces that have significantly contributed to the changed nature of the industry. Economic events, structural institutional changes, globalization and regulatory changes are among a few of such forces. However, Graham and Horner (1988); and Park (1994) additionally highlighted the extremely important role of management behaviours. These studies found that certain managers may contributed to increased bank risk by adopting relatively high risk strategies. These actions coupled with inadequate cost controls and poor investment choices, presented adverse results indicating their contribution to bank inefficiency.

In addition to enhancing efficiency, the Dodd- Frank Act (2010) is also believed to allow financial institutions better cope with financial stress events and crises, according to Bailey, Klein and Schardin (2017); and Tarullo (2019). However, promoting market discipline in the US tends to encourage the accumulation of sufficient capital and liquidity for large banks and investment banks, whereas radical regulation is deemed to be counterproductive (Darrell, 2019). Additionally, literature from Vučinić, (2020); and Shobande and Shodipe (2021) attribute the correlation between regulation (for instance, capital requirements) and the operational efficiency of US bank to the following factors: They argue for the relationship between business cycle and capital adequacy ratio to be considered. Additionally, the perspective of risk management is highlighted to make clearer the need for banks to reduce banks' risk taking in order to maintain required levels of capital. On the other hand, regulation such as deposit insurance may also be argued to increase risk taking behaviour of banks (Vučinić, 2020).

Ogunmola, et al (2022) more recently found that rising levels of Core and Tier 1 capital ratios gradually tends to positively impact short term bank performance but less operating efficiency, and in the long run improve stability of the financial market and make the U.S. banking industry more stable. On the other hand, an increase in the Tier 2 capital ratio has no significant impact on bank performance. The findings from their study allow for a few generalizations to be made about the US banking sector. The evidence from their study suggests that US banks will prefer to increase the cheaper Tier 2 capital to meet the higher level of capital adequacy ratios, because that has no significant impact on bank performance.

There are also a number of studies that have explored the relationship between bank performance, efficiency and the US economy. A few of these studies include, Jokipii and Milne (2006); Chami and Cosimano (2010); Hyun and Rhee (2011); Rime (2001); Aikman, et al (2019); and Garcia (2019). The level of asset liquidity tends to be maintained counter-cyclically whereas capital buffer are maintained in a manner consistent with business cycle fluctuations in order to control credit risk, portfolio risk, and arbitrage risk (Jokipii and Milne, 2006; Aikman, et al 2019; and Garcia, 2019). However, Borio, Furline and Lowe (2001); Rime (2001); Chami and Cosimano (2010); Hyun and Rhee (2011) warned that if banks are allowed to excessively reduce loans to maintain a high capital adequacy ratio, it could result in a decrease in the flow of capital to financial markets and consequently a decline in economic development. A decrease in the capital ratio will be experienced during periods of economic recession due to a corresponding increase in loan loss provision in response to the economic crisis (Jokipii and Milne, 2008).

The review of literature in this section reveals that while there has been extensive research on US bank efficiency, several critical issues remain unaddressed. The debate over the appropriate input-output selection is ongoing, with no consensus on the most effective method for efficiency measurement. Additionally, the comparison of efficiency between banks in different countries, requires further investigation (Ogunmola, et al., 2022).

2.5 Banking Regulations and Market Value of Banks

The response by several countries to the global financial crisis of 2007 was mainly through heightened regulation of their financial services industry. These reforms included the implementation of the Banking Reforms Act 2013 in the UK, the Dodd–Frank Act in the U.S, and Basel III across the world. Nevertheless, all these regulatory reforms have been criticized by industry organisations most especially financial institutions (Parise and Shenai, 2018). This aspect of the study seeks assess the impact that the implementation of the Banking Reform Act

2013 in response to the 2007 global financial crises had on the stock market value of banks in the UK. One of the key objectives of the Banking Reform Act 2013 is to ensure that extremely high losses of the investment banking divisions of large banking groups do not affect the sustainability of its retail banking operations. This was to be achieved by “ring fencing” the retail banking division of banks from their wholesale funding and investment banking divisions (Mashiandaro and Suardi, 2014; and Casu et al., 2015).

Although the Banking Reform Act (2013) sought to improve the safety of the banking system by sustaining stability in the financial system and protecting retail clients, the banks were left to bear the additional cost involved (Helen, 2015). In response, it is argued that taxpayer’s funds as well as the banking system may still be kept safe if bank regulation is based on the premise of whistle blowing and economic benefits, such as what is found in the Dodd-Frank Act. This is opposed to the proposed ring-fencing approach in the Banking Reform Act (2013) (Korotana, 2016).

As mentioned by Andriosopoulos et al., (2017) the rationale behind studying the relationship between the stock market and financial regulation emanates from the view that the stock market is believed to be the best judge of the effectiveness of financial reforms. The stock market as well gives an indication of the impact that financial reforms have on the returns of shares of financial institutions such as banks. Additionally, the lack of studies on the impact that the 2013 Banking Reform Act on banks’ value as well as the English legal system’s lagging response to financial crisis are among the reasons why this relationship should be studied (Putnis 2014; and Casu et al.,2015).

The issue of market failure is to a large extent the result of information asymmetry compounded by negative externalities. This may further be regarded as one of the motivations for bank regulation (Parise and Shenai, 2018). Casu et al. (2015) identified the various forms of bank regulation that are relevant to the study of the relationship between regulatory reforms and stock market value of banks. These include but are not limited to bank licensing, minimum capital requirements, deposit insurance, and the periodic assessment of banks in accordance with predefined and regularly reviewed benchmarks. Their study further revealed that some regulatory requirements such as deposit insurance may lead to moral hazards. This may then result in market failures since the banks may be taking more risk due to the fact that they do not bear the entire cost associated with said risk, but gain the entire benefits associated with said risk.

Likewise, Elsas et al. (2010) explored the relationship between bank diversification its performance and risk. The study found that diversification by banks does not reduce the value of their shareholders but instead increases the profitability as well as market value of banks. Therefore, activity restricting regulation may adversely affect the stock market value of banks. However, an earlier study by Leaven and Leaven (2007) found evidence to the contrary despite acknowledging that certain instruments counter the adverse impacts. In addition, Beale et al. (2007); Stiroh and Rumble (2006); and Mercieca et al. (2007) examined the effects of diversification on financial institutions. They found that although bank performance could be enhanced by the varied sources of revenue that accompanies diversification, it is counteracted by the higher exposure to more high-risk activities.

Similar studies by Andriosopoulos et al. (2017); Carow and Heron (2002); Amoako-Adu and Smith (1995) examined the reaction of the US stock markets following the implementation of regulations and Acts in the US financial services industry. It was found that the stock market value of both commercial banks and investment banks reacted differently to the passage of the Financial Services Modernization Act of 1999 (FSMA) in the US. It was revealed that the shares of commercial banks yielded negative returns whilst the shares of investment banks produced positive returns over the period of the announcement of the Act (Carow and Heron 2002). However, these findings are in contradiction with the findings produced by an earlier study conducted by Madura and Bartunek (1995). Their study found evidence that the market equity value of small and medium-sized banks which are mostly commercial banks responded positively to the passage of the 1991 Federal Deposit Insurance Corporation Improvement Act. Whereas the market equity value of large banks mostly investment banks were impacted negatively. This brings to light the need for considering the direction of the financial reforms being studied, whether they are geared towards more or less liberalization of the industry.

A more recent study by Schafer et al., (2013) took a broader approach in analysing the relationship between regulatory reforms and stock market returns of banks. The study considered the following four major reforms; the too-big-to fail regulation in Switzerland, the reforms proposed by the Vickers report in the U.K., structuring law and bank levy in Germany, and the Dodd–Frank Act in the U.S. Employing an event study methodology, the study revealed that the equity returns of the banks studied were adversely affected. This was due to a reduction in bailout expectations following the regulatory, most especially for banks that were deemed systemic, which ultimately affected the profitability of the banks.

There exists very little literature that examine the stock market returns of banks in the UK in response to the Banking Reform Act 2013. This study through answering this research question seeks to add to the little literature in existence by probing the effects of significant legislative dates associated with the implementation of the Banking Reform Act 2013. In an attempt to answer this research question, this study will employ the event study approach published by Brown and Warner, (1985). This approach has been found to be most effective in assessing the impact of events such as the processes involved in the implementation of the Banking Reform Act (2013) on the stock prices of financial institutions. This approach will be combined with drawing from relevant literature, such as reports on bank regulation presented to the UK parliament, publications by the Bank of England, reports from professional services providers, and review published quality peer reviewed articles.

2.6 Banking Regulations and Bank Profitability

The Thomson Reuters 2018 annual cost of compliance report revealed that complying with the MiFID II and GDPR remained challenging for both boards and compliance functions of financial institutions. The report covered nearly 800 financial services firms across the world, drawing information from their Compliance and risk practitioners. These financial services firms included, banks brokers, asset managers and insurance companies. The report revealed 61% of the firms studied were expecting the cost of senior compliance staff to increase by 60% above the cost incurred in 2017. The report further found that there was an expectation among nearly two thirds of firms studied to see a 53% increase in their total compliance budget for the year 2019 (English and Hammond, 2018).

A report by Barclays, (2014) examined the cost of evolving bank regulation focusing on the persistent increase in capital requirements. The analysis revealed that increasing capital requirements either through a defined minimum equity or minimum wholesale debt as a percentage of a bank’s balance sheet, would restrict a bank’s ability to serve clients and as result impair revenue. This was identified as a double-edged sword which would impact both the banks and their corporate as well as individual clients. It would lead to banks missing out on profitable lending opportunities and associated service income, while their clients would be confronted with growing impaired access to credit at an incrementally higher price. The report also acknowledged the relevance of the geographical location of the banks when assessing the impact of the new capital requirement. This will be less expensive for European banks as compared to US banks, since they have typically funded themselves with a higher proportion of wholesale funding. As result could limit the costs of complying with the higher capital requirement by shifting debt balances lower and leaving customer-centric liabilities unchanged (Meli, Monteleone and Pigott, 2014).

There exists a variety of literature that assess the impact of various aspects of regulatory reforms on the profitability various types of financial institutions. Literature such as Giordana and Schumacher, (2017); Banerjee and Mio, (2017); and Mashamba, (2018) assess the impacts of Basel accords on the performance of commercial banks. The study conducted by Giordana and Schumacher, (2017) was concentrated on the impact of Basel III standards on the impact of banks profitability and probability of default. The three standards identified by the study are the Liquidity Coverage Ratio (LCR), the Net Stable Funding Ratio (NSFR) as well as the leverage ratio which is defined as the Capital-to-Asset Ratio (CAR). The study went further to indicate that since these standards are aimed at very different aspects of banks risk, and as such complying with them may impact the balance sheets as well as profits of banks differently. On the other hand, there is no doubt that the COVID-19 pandemic will impact the global economy, while banks as well as regulators are not immune to this impact. It is for this reason that the Basel Committee on Banking Supervision (BCBS) agreed to delay the implementation of the revised Basel III standards by one year, to 1 January 2023. This measure is primarily intended to create operational space within which banks and regulators may rely on while responding to the economic impact of the pandemic (Deloitte, 2020; and bis.org, 2020).

The CAR restricts the ability and extent to which banks may leverage up their balance sheets. The purpose of the CAR may then be perceived as countercyclical by design owing to the procyclical nature of leverage. In essence, CAR provides a measure of the degree to which banks can readily absorb losses as a result of their operations. The NSFR aims to incentivise banks to fund the operations with more relatively stable ongoing sources of funding. This ratio further aims to measure the mismatch short term and medium to long term sources of funding employed by banks. The ultimate goal of this standard is to ensure that banks are resilient in employing more medium to long term funding. The LCR measures the amounts of highly liquid assets that are available to banks on an ongoing basis, enabling them to cater for the needs of their short-term liabilities. This ratio fundamentally provides a measure of the degree of exposure a bank has to short term liquidity risk (Adrian and Shin 2010; and Giordana and Schumacher, 2017).

Giordana and Schumacher, (2017) further identified that the compliance burden incurred by small banks in the US from the Dodd–Frank Act was as a result of the embedded ability to repay as well as its definition of a qualified mortgage. Also, the new capital requirement rules that accompanied the act saw a much narrower definition of capital which precluded the inclusion of trust preferred securities as capital. This had a great adverse effect on large banks that have been declared. Systemically Important Financial Institutions (SIFI) with a relatively less impact on community and small banks. The study found the following upsides of the Act that may potentially mitigate any of its associated compliance cost. The Act was found to promote transparency with regards CEO pay, as well as risky bank activities resulting in improved confidence in banks and reduced funding costs.

This research question will be answered by looking at the impact of regulatory reforms on banks from three dimensions; these are the liquidity, minimum capital, and the personnel or labour requirements needed. These measures are chosen because they play a significant role in both the Basel III and the Financial Services Act (2013) under that Capital Requirements Directive IV. The study will then assess how the cost of complying with each of these affects the profitability of the retail banks in the UK. In line with Giordana and Schumacher, (2017) this study will be relying on the Return-On-Assets (ROA) as one of the indicators of the profitability of the banks considered under the study. The ROA may be described as a bank's managements to generate profits with a given set of assets. Hence, since the accounting equation describes assets as the sum of liabilities and shareholders' equity, the chosen measure of bank profitability is most appropriate since the regulatory requirements of liquidity and capital affects the overall assets of banks (Jin and Nadal de Simone October, (2011); Berger et al. 2009; Berger et al. 2009; Wolff and Papanikolaou (2015); and Giordana and Schumacher, (2017)).

2.6.1 The Impact of Capital Regulation on Banks

Stricter banking regulation has been found by Teixeira, et al. (2020) to reduce the profitability of banks. Their study used at the time what was a country's sovereign rating as a measure of the country's risk. The adverse effect of stricter regulation was also found to be less pronounced during years of financial crisis. They found stronger results to this effect during the 2007 -2009 Global Financial Crisis (GFC) and less compelling results from the time period around the Eurozone crisis between 2009 and 2015. The effects as measured by magnitude varied depending on the level of development of the countries where the banks operated and the size of the bank in question. Less-developed countries and larger banks evidenced a lesser magnitude of the negative effects of stricter banking regulation on profitability. Additional findings also revealed that banks in the Eurozone on average outperformed their US counterparts, although profitability remained low for banks operating in both regions during the 2007 -2009 Global Financial Crisis (GFC). The findings of Teixeira, et al. (2020) are not appropriately suited to provide a generalised view of the impact of banking regulation on bank profits as they did not consider other influencing factors such as the economic conditions of countries.

In a similar study conducted on banks operating in the US market, Chronopoulos, Wilson and Yilmaz (2023) posit that a reduction in regulatory oversight at first instance resulted in increased risk-taking by banks who subsequently saw improved profitability and reduced compliance expenses. The increased risk taking manifested through adjustments to both the balance sheet and off-balance sheet asset portfolios of the banks studied. The premise of the study was set on the enactment of the Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA) which sought the removal of some of the regulations enacted under the Dodd-Frank Act (2010). The result was a decline in regulatory requirements and the oversight of some large banks such as stress tests, resolution plans and capital planning. These were intended to limit the risks posed to the financial system by the large banks, and their absence led to an increase in systematic risk alongside bank specific risk. Although the findings from Chronopoulos, Wilson and Yilmaz (2023) were tested for robustness against alternative modelling choices, sample composition, endogeneity concerns, placebo tests and bank risk indicators, their findings are not internationally comparable since they failed to account for country specific macroeconomic indicators such as the GDP growth rate and the rate of inflation. The study also needed to distinguish between the retail and investment banking divisions of banks considered under the Act, as the impact from regulation may have varied across divisions.

The shortfalls identified in the findings of Chronopoulos, Wilson and Yilmaz (2023) were addressed in similar studies by Pasiouras, Tanna and Zopounidis (2009); and Kisin and Manela (2016). Their studies presented international evidence on the impact of banking regulations on the cost and profit efficiency of banks with a particular focus on the Basel Accords. Pasiouras, Tanna and Zopounidis (2009), focused on capital requirements, official supervisory power and market discipline as specified by the three pillars of Basel II, as well as restrictions on bank activities by regulators. The evidence obtained from their study indicated that the cost and profit efficiency of banks were improved following the adoption of banking regulation that enhanced market discipline and supervisory power of regulators. The findings regarding capital regulation were less than symmetrical as they found that stringent capital requirements reduced profit efficiency but enhanced cost efficiency, with a reverse effect being found to be true for regulation that restricted the activities of banks.

Kisin and Manela (2016) further asserted that despite the acknowledgement of the importance of capital requirements in regulating financial intermediaries such as banks, the attempts at increasing capital requirements have in the past faced fierce and successful opposition from the very financial intermediaries they are intended to support. The reason identified for the unwillingness to accept the said increases emanated from the perceived impact on their private costs of capital requirements. The inability to empirically measure the cost of regulation is an acknowledged limitation in Kisin and Manela (2016) that this study intends to address.

Swamy (2018) shed more light on the role macroeconomic indicators play when addressing the impact of new capital regulation on the profitability of banks. The study, similar to that which was conducted by Pasiouras, Tanna and Zopounidis (2009) considered the capital requirements framework under Basel III. Swamy (2018) argued in favour of the significant macroeconomic benefits that emanate from raising the minimum required bank capital. This argument was supported by the assertion that higher capital requirements translated into lower leverage which subsequently decreased the risk of bank insolvency. The distinct revelation here was that not only did new capital regulation impact the profitability of banks, but it also significantly decreased the chances of a bailout of banks with taxpayers' funds due to insolvency (Admati, et al., 2010).

This is however sharply contrasted by works from the Bank of International Settlements, (2010) and Angelini et al., (2011). It is argued that the positive effects of a higher capital requirements regime may counteract the corresponding cost implication for banks. The basis for this argument is that the impact of Basel III capital requirements regulation cuts across day-to-day decision-making in lending, funding, treasury, capital and liquidity operations of banks. Due to the interconnected nature of all these areas of business for banks, there tends to be a direct effect on their profit. A concept which could help further understand the stated interconnectedness is modelling the effects regulation in these areas of a bank's business. Unfortunately, very few studies have done this, with one of such studies being by Michael

(2010) that modelled the impact of capital and liquidity requirements on bank profitability. In line with the earlier critique of Chronopoulos, Wilson and Yilmaz (2023) in this section, Michael (2010) similarly underscores the importance of conducting country-specific studies when estimating the impact of new capital regulations on the profitability of banks. The perceived rationale for this assertion is that it will equip the study with the invaluable logic required to build a body of literature that captures the unique features of specific countries.

Other aspects of literature such as Francis and Osborne (2012), examine the impact of capital requirements on financial health indicators of banks such as bank capital ratios, lending activity and balance sheet growth. They analyse the connection between bank balance sheet growth and capital adequacy. Specific consideration is given to examining the effect capital requirements have on long-term capital targets of banks and their incentive to lend and grow. The method used by their study was a model of the impact of unique capital requirements set for each bank by the UK's then Financial Services Authority on banks' internal capital targets. They found evidence to suggest that bank specific capital requirements imposed by the regulator are significant in determining the internal capital targets of banks. It was also found to be a significant determinant of bank balance sheet growth and lending activity.

The findings from Francis and Osborne (2012) further revealed that, depending on the extent to which banks' actual capital ratios differ from their revised target, banks raise or lower targeted capital ratios in response to increasing or decreasing capital requirements respectively. Their findings specifically revealed that rather than adjusting the volume of loans, banks tend to adjust their portfolios by altering the composition of the loans. A common practice observed among banks was a substitution towards lower risk weighted assets. That is increasing their proportion of less risky loans. The findings from their study provides justification for the currently higher required proportion of higher-quality capital such as Tire 1 capital and its use as the basis for countercyclical capital requirements.

A broader view of the impact of capital regulation on banks is provided in the literature from Barth et al., (2013). Their study examined the relationship between capital regulation and several factors including, bank development and performance during periods of banking crises as well as financial stability. They first asserted that although there is a positive correlation between stringent capital regulation and bank development, this relationship ceased to exist when the study control for other features of bank regulation and supervision. However, it was observed that more stringent capital regulation is negatively associated with nonperforming loans. They further presented evidence in their study to indicate that capital regulations have no positive impact on banking sector outcomes when there are perceived favourable banking sector conditions such as generous deposit insurance, weak official supervisory agencies, or ineffective regulations concerning private-sector monitoring of banks.

The study also failed to provide conclusive evidence of a strong relationship between a range of official supervisory indicators such as measures of supervisory power, resources, independence, loan classification stringency, provisioning stringency, and bank performance or stability. They argued that their findings invalidate the strategies of many international agencies that focus on greater official supervisory oversight of banks. There was however an exception with banks that were sufficiently diversified, with these banks seeing a decreased likelihood of being affected by a major crisis (Barth et al., 2013). This exception is on the other hand rendered null with the imposition of activity restricting regulation.

Bank capital and liquidity ratios account for the majority of the variables used in modelling the impact of capital and liquidity requirements on bank profitability. Cohen and Scatigna (2016), show that the financial crisis bank capital ratios have increased consistently. This was found to be true when they sampled 101 large banks operating within developed and emerging economies. Evidence for the sample indicated that banks increased the amount of earnings retained as opposed to reducing their risky assets when required to meet higher risk-weighted capital ratios. The use of retained earnings meant that the need to lower dividend payouts and wider lending spreads have contributed. This was evidenced by the continued increase in real terms lending by all banks with the exception of European banks. This led to banks emerging from the crisis with the ability to expand lending due to higher capital ratios and stronger profitability. This study failed to acknowledge the impact of increasing retained earnings by banks on the other operations, and subsequently on the profit that these operations could have generated.

Cohen and Scatigna (2016) can be further critiqued in that they focused heavily on the impact of banks' compliance on the macroeconomy without first accounting for how the profitability of banks is affected. Although a long-term neutral relationship between bank lending—which makes up a significant portion of bank assets—and the macroeconomy was identified by observing banks faced with higher capital ratios, it was observed that the willingness of banks to lend was constrained by evidence seen in the form of tighter bank lending standards and wider lending spreads. It is important to highlight that they may have overlooked the impact of bank profitability on the economy unlike in Teixeira, et al. (2020). Cohen and Scatigna (2016) further asserted that requiring banks to rapidly acquire capital would cause banks to temporarily pause lending in order to finance investments and inadvertently create macroeconomic costs in the short term. This does not account for the internal associated costs and loss in profits.

Further evidence presented addressed the capital ratio standing of banks following the financial crisis. This varied depending on whether the banks were operating in emerging or advanced economies. A majority of the banks in developed economies emerged from the crisis with higher capital ratios achieved through a reduction in dividend payouts and an accumulation of retained earnings along with a shift to assets with lower risk weights. Additionally, these banks benefited from wider net interest margins which is a measure of profitability used in literature such as Berger, (1995); and Naceur and Goaied, (2001). This was particularly true among banks that had strong profitability in the post-crisis years to begin with. Banks in emerging economies also emerged from the crisis with significantly higher capital ratios than before the crisis, however the contributing factors differed. These factors included high earnings and asset growth (Cohen and Scatigna 2016).

A working paper by Raja, (2022) further investigate how banks respond to capital regulation using confidential data on bank-specific requirements in the UK. The paper highlighted that banks do adjust their capital ratios following changes in requirements, but only partially. Much of the observed reaction comes through capital accumulation, in particular the level of Tier 2 capital; however, the quantity of loans is unchanged. The paper also presented evidence of a composition effect, whereby banks adjust the average riskiness of their asset portfolio.

In addition, UK banks were observed to only react to decreases in capital requirements with an increase in requirements being absorbed by banks' pre-existing capital buffers. Comparing the impact of a capital requirement change in the pre- and post-financial crisis periods, the paper argues that the pre-crisis response were characterized by quantity effects in capital and loans, but no composition effect. In particular, total lending falls by 5% on average one year after a 1pp increase in capital requirements. Instead, the post-crisis period was associated with no significant change in the quantity of loans, though there is a composition effect towards less risky assets (Raja, 2022).

2.6.2 The Impact Capital Regulation on Bank Risk

This section reviews literature that explores the relationship between the implementation of capital regulation and bank risk taking behaviour. Some early literature such as Barth et al. (2004) and Blum (1999) are on opposing sides concerning the impact of regulation on bank risk taking. Barth et al. (2004) suggest that the effect of capital stringency on banks' risk is inverse. The rationale behind this assertion is that when banks are faced with higher regulatory capital requirements, they tend to be more comfortable due to the solid balance sheet this allows them to have. This subsequently offers a greater buffer that protects against losses and contributes to reducing their risk. With further validation from Beltratti and Stulz (2012); and Danisman and Demirel (2019) the tendency of banks to engage in riskier investments is curtailed if they have to fulfil higher levels of capital requirements.

Blum (1999) on the other hand argues that capital stringent regulation has a positive effect on the risk of banks. As the cost associated with increased capital requirements becomes high, banks are compelled to invest in riskier ventures to ensure increased profitability to fund the increased costs associated with regulation. A similar position was found in literature such as Besanko and Kanatas (1996); Calem and Rob (1999); and more recently in Ashraf (2017). Contrary to this, however, is Klomp and de Haan, (2014), who found evidence to suggest that bank regulation and supervision reduce banking risk. An aspect of their study that was not captured in the previous literature is the consideration of the level of development of the countries in which banks operate, which further highlights the importance and relevance of their study. They found the effect of bank regulation and supervision on banking risk to be stronger in emerging economies than in developing countries. The role played by the level of country development was previously expanded on by Lee and Hsieh (2013) reviewed below.

It is also worth noting that a similar method to what has been used in this study, a two-step system GMM dynamic panel data technique, has been employed in examining this relationship with some important discoveries worth highlighting (Lee and Hsieh, 2013). They presented empirical evidence to suggest that the effect of increasing bank capital on risk is significantly negative, implying that bank regulation requiring banks to increase their capital levels results in lower bank risk, giving some validity to the concept of moral hazards. The role played by the level of country development was investigated by categorizing the level of country development as follows: low-income, lower-middle income, upper-middle-income, high-income countries.

They found evidence that banks in lower-middle income countries have the highest negative relationship between capital and bank risk, whereas banks in high-income countries also presented a negative relationship but at a much lower level. As seen in earlier literature by Claessens (2009), this implies that changes in capital requirements have varying effects on banks depending on the income level of the countries they operate. That is, bank risk resulting from changes in capital requirements tends to be lower in developed economies than in developing countries and emerging markets. Using the Asian crisis as a case study, Lee and Hsieh (2013) concluded that bank risk declined more in the post-crisis period relative to the pre-crisis period. Overall, this presents a strong argument for regulators to enforce closer monitoring to prohibit banks from gambling in excessively risky undertakings.

A much broader conclusion is presented by the more recent Dutra, Teixeira and Dias (2023) regarding the relationship between bank regulation and bank risk. They find this relationship to depend on the level of protection available to investors, the role this protection plays in reinforcing specific effects of bank regulation, banks' size and periods of systemic banking crisis. They first asserted that activity restrictions and capital stringency have positive effects on bank risk, whereas supervisory power has a negative effect with an appropriate degree of statistical significance. They went further to identify that these effects are reinforced in banks where protection is available to investors. In assessing this relationship while considering bank size, the above conclusion held true for larger banks. On the other hand, there was a distinction in the relationship with regard to smaller banks. The bank risk of smaller banks was said to decrease with stricter activity restrictions with this being eventually mitigated as investor protection increases and further strengthened as creditor protection increases. However, during a systemic banking crisis, the positive effects of activity restrictions and capital stringency on banks' risk are amplified, whereas the negative effect of supervisory power on banks' risk is less evident.

Similarly, a recent working paper by Eccles et al. (2023) finds that increasing capital requirements, while intended to reduce risk, can have unintended consequences. This is because competitive banks, which are those banks that cater to depositors who embrace open banking technology, can pass on the increased costs associated with higher capital requirements by lowering the deposit rates they offer to depositors. Monopolistic banks, which serve those who do not adopt open banking, cannot lower their deposit rates because they are already offering the lowest possible deposit rate to captured depositors. As a result, increasing capital requirements makes the riskier competitive sector more attractive to banks, potentially increasing overall risk in the system.

2.6.3 Impact of Capital Regulation on Profitability

Lee and Hsieh (2013) in their study using the two-step system GMM dynamic panel data technique produced results indicating that increasing bank capital has a significantly positive relationship on bank profits. Thereby implying that bank capital regulation that resulted in the increase of a bank's minimum capital results in higher profits for the bank. They also found that different profitability variables (measures) produced different results in terms of the persistence of profitability. They specifically found that profitability variables such as Return on Assets (ROA) and Return on Equity (ROE) failed to display persistent profitability whereas, Net Interest Margin (NIM) and Net Revenue (NR) did.

This leads to the conclusion that the impact of capital regulation on the profitability of banks to a great degree depends on the measures of profitability employed by the study. Lee and Hsieh (2013) further supported this conclusion by providing empirical evidence to indicate that the effects on bank profits further relied on the income levels of the countries in which the observed banks operated as much as the measure of profitability used. They particularly found that banks operating in upper-middle-income countries displayed the greatest positive capital effect on ROE, whereas banks operating in high-income countries such as the UK where this study was based displayed the lowest positive capital effect on NR.

Tran, Lin and Nguyen (2016), on the other hand, took a much more theoretical approach in examining this relationship. They make reference to the Dupont Analysis, where Return on Equity (ROE), which is a measure of bank profitability, is calculated by taking the product of Return on Assets (ROA) and an equity multiplier (total assets/equity). They argue that a bank forced to keep a higher capital due to regulatory requirements, and as a result, a lower equity multiplier would experience lower profitability as measured by ROE. They further strengthened this argument by highlighting the effect of corporate tax on the equation. An increase in equity including Tier1 equity (a portion of bank capital), leads to a corresponding decrease in debt which in turn reduces tax-shield savings and by extension lowers after-tax earnings of banks. Altogether, this makes a stronger argument that a higher capital ratio as a result of regulatory requirements tends to lower bank profitability.

It is however imperative to acknowledge that there are other factors that may impact the relationship between capital regulatory requirements and bank profitability since banks do not operate in a vacuum. Early literature from Berger (1995) asserts that the influence of factors as rare as bankruptcy costs and as common as asymmetric information could undo the impact of capital regulation on profitability. The assertion was primarily based on the static trade-off theory, which states that the optimal capital structure is obtained when the total benefits (including tax shields) are equal to the total costs of debt (including bankruptcy costs). As such, a bank with a capital structure below this defined optimal structure may benefit from capital regulatory requirements that leads to the creation of additional capital. However, when it comes to the role played by information asymmetry, particularly between banks and investors, adequately capitalized banks may seize the opportunity to feed the markets positive signals that result in a reduction in their cost of capital and an increase in their profitability.

Other literature such as Bourke (1989); Iannotta, Nocera and Sironi (2007) and more recently Lee and Hsieh (2013) present mixed empirical findings on the relationship between regulatory capital requirements and the profitability of banks. Regulatory capital is reported to be positively related to bank profitability across different countries by Bourke (1989). The rationale underpinning this finding is that well-capitalized banks tend to be exposed to better financing sources with accompanying lower cost and risk along with better access to higher quality asset markets than under-capitalized banks. As similarly reviewed in the previous paragraph, Berger (1995) asserts that regulatory capital has a positive effect on earnings (as a measure of profitability) because it has the tendency to fall below its optimal level. The reverse between the two variables is also true because, profitable banks are able to retain more earnings (Iannotta, Nocera and Sironi 2007; and Lee and Hsieh 2013).

There is opposing literature from Altunbas, et al. (2007); Goddard et al. (2010); Kashyap, Stein, and Hanson (2010); Baker and Wurgler (2015) and Tran, Lin and Nguyen (2016). The study by Altunbas, et al. (2007) presents empirical evidence to suggest that the inefficient and unprofitable European banks in their study appeared to be rather highly capitalized banks. This conclusion was further supported by findings from a similar study by Goddard et al. (2010), who found that well-capitalized banks observed in their study appeared to have lower profitability in eight European Union member countries from the period between 1992 and 2007. A slightly different approach involving the impact of higher capital requirements on the overall cost of bank capital and profitability was adopted by Kashyap, Stein, and Hanson

(2010). They found that a 10% increase in bank capital ratios following increased regulatory requirements will increase the cost of funding by up to 0.45 % in a worst case scenario leading to a corresponding decline in bank profits. Similar results are presented by Baker and Wurgler (2015) who using Fama and French's three-factor model, find that higher capital requirements are also related to higher cost of bank equity. This leads to an initial low risk anomaly mechanism where banks with higher capital ratios have lower risk but higher realized returns. This is ultimately corrected as higher capital requirements continue to lead to a higher cost of equity and eventually lower profitability (Tran, Lin and Nguyen 2016).

The non-linear nature of the relationship between required regulatory capital and bank profitability was also highlighted by Tran, Lin and Nguyen (2016). They stressed that the relationship depended on the existing level of capitalization of the bank. It was revealed in their findings that regulatory capital is negatively related to bank profitability when the banks in question are already highly capitalized. This relationship was observed to be reversed for banks with a lower capitalization prior to the introduction of new capital requirements. These results are seen to be consistent with the trade-off theory of capital structure, which maintains that sustained deviations from optimal capital structure affect bank performance. Therefore, increasing the amount of capital held by a bank improves the profitability of the bank if it has a lower capitalization but weakens bank profitability for higher capitalized banks. In line with earlier literature by Lee and Hsieh (2013), the reviewed findings from Tran, Lin and Nguyen (2016) caution against a one-size-fits-all approach to bank capital regulations and the need for regulators to avoid using a single measure of profitability which may result in an adequate impact assessment of regulation. Both findings also stress the need for higher capital requirements to be imposed on large and systemically important banks such as the banks considered in this study.

A more recent exploration of this relationship is presented by de Bandt, et al. (2018) who also drew from the trade-off theory of capital structure but with a focus on capital regulatory requirements after the global financial crisis. They conclude that banks have been undercapitalized relative to the increased risks induced by the crisis. Their novel approach used in exploring this relationship accounted for the distinction between regulatory constraints and voluntary increases in capital. Through the development of a two-step estimation procedure for the strict identification of the effect of regulatory constraints exerted on banks, their study provided evidence which indicates that voluntary increases in capital have a positive impact on the profitability of banks as measured by ROA. On the contrary, capital increases due to regulatory requirements proved detrimental to banks' performance during the crisis. However, when considered on average, the effect of regulatory capital on profitability appears to be insignificant, indicating that the increase in capital requirements has not been detrimental to bank profitability.

2.6.4 The Impact of Liquidity Regulation on Banks

This section reviews literature that examines the effects of liquidity regulation on banks. This relationship has been explored in literature such as King (2013); Wei, Gong and Wu (2017); Hugonnier and Morellec (2017); and Bruno, Onali and Schaeck (2018). The literature mostly focuses on regulatory liquidity requirement tools such as the Net Stable Funding Ratio (NSFR) and Liquidity Coverage Ratio (LCR) as well as their constituents. These were initially announced by the BCBS between July 2009 and December 2010 as part of a series of reforms known as Basel III to increase the resilience of the banking sector (BCBS, 2010b). The LCR allows for the identification of the unencumbered, high-quality liquid assets that banks need to survive one month without access to wholesale funding while still being able to offset cash outflows. Whereas, the NSFR is a longer-term structural ratio that addresses funding risk, such as the inability of banks to raise funding when needed. The minimum requirement for both ratios currently stands at 100% as at 1 January 2019.

According to the study by King (2013), unavailable data on bank inflows and outflows inhibited the ability to estimate the LCR and NSFR. This resulted in the study being able to only indirectly explore the effects of liquidity regulation on banks by limiting the assets within the given liquidity ratios. Empirical evidence from the study underlines an important trade-off between liquidity regulation, bank risk and profitability. As a relatively new piece of regulation, liquidity regulation may have unintended consequences such as reducing traditional banking activities including liquidity creation or market making. Wei, Gong and Wu (2017), on the other hand, approached the exploration of this topic with a focus on the decisions bank managers make when faced with new liquidity regulatory requirements. Their study particularly focuses on the impacts of the NSFR requirement on the bank manager's choices of asset composition and debt maturity structure, with consequences for the banks' profitability and on social welfare.

A bank's short-term debt is given a sufficiently low weight in available stable funding, then the NSFR could lower the use of short-term debt and as a result reduces its exposure to roll-over risk. Furthermore, under the same scenario¸ NSFR may increase the probability of bank survival and unconditional expected profits. The rationale behind this assertion is that the constraint on the debt maturity structure remedies the agency problem between the bank owner and the manager. Therefore, the NSFR decreases the probability of bank failures and increases the profits of surviving banks (Wei, Gong and Wu, 2017). Further enforcing these assertions is Hugonnier and Morellec (2017) in a study of the effects of micro-prudential banking regulation. Evidence presented within their study indicates that increased liquidity requirements decrease the magnitude of losses in default, although at the cost of an increased likelihood of bank defaults. Additionally, leverage requirements such as the LCR tends to increase the willingness of bank shareholders to absorb losses and by so doing reduce risk, although such requirements have insignificant effects on the magnitude of losses in the event of default.

The likelihood of default and losses in default is reduced only when liquidity and leverage requirements are combined. For instance, a bank's one year probability of default is reduced by 31.26% when a bank complies with a 9% minimum Tier 1 leverage ratio and a liquidity requirement of 5% of deposits along with 30 calendar days of cash outflow. Therefore, supporting the argument for the imposition of both liquidity and leverage requirements required by Basel III for the successful reduction of both the likelihood of bank defaults and the magnitude of bank losses in the event of default (Hugonnier and Morellec, 2017). Bruno, Onali and Schaeck (2018) argue that by requiring banks to switch toward more stable funding sources with higher quality and more liquid assets, the new standards are likely to affect banks' operations. This is particularly evident in the structure of their balance sheets in terms of maturity structure of asset and funding choices. Although acknowledged to be important for financial stability, compliance with these requirements has the potential to affect bank profitability and valuation, particularly arguing that the associated costs arising from the requirements would reduce profits.

2.6.5 The Impact Liquidity Regulation on Bank Risk

An analysis of policies the banks use in response to capital and liquidity shocks indicates that banks utilize both de-risking and regulatory arbitrage, which is contrary to the aim of regulators for banks to make substantial transitions into safer or long-term funding. An alternative, banks concentrate on decreasing the risk of their portfolio of assets while using the liquidity buffer to support and sustain the same volume of assets. Contrary to expectation, liquidity regulatory requirements appear to increase the exposure of banks to securities and government securities instead of incentivising them to undertake more long term corporate lending. A distinction in post-shock behaviour is also observed between larger and smaller banks. Banks with larger assets shift from corporate lending into securities trading in response to capital shocks. These are also periods in which central banks heavily rely on unconventional monetary policy tools. In a sharply contrasting behaviour, smaller banks reduce corporate loans while increasing retail loans during the same period (Baros, et al., 2023).

In contrast with the findings of Drehmann and Nikolaou (2013); Klomp and de Haan (2014); and Khan, Scheule and Wu (2017), Baros, et al. (2023) argue that a double constraint environment such as capital and liquidity regulatory requirements pose a risk to financial stability and may decrease the supply of capital during periods of frequent shock. This they further argued was an outcome that was not displayed in the aggregated analyses performed by regulators. The reason presented for this assertion is that, in order to ensure continued financial stability in the event of a shock, banks may result to changing their asset composition to meet capital and liquidity requirements in a way that may not be fully consistent with regulatory intention. This could further affect monetary policy implementation, since compliance with regulation by banks in the event of a capital shock may lead to partial shortages in corporate lending, due to banks prioritizing investment in government securities (Baros, et al., 2023).

Khan, Scheule and Wu (2017) in their study examine the relationship between funding liquidity and bank risk taking by using quarterly data for U.S. bank holding companies from 1986 to 2014. They present evidence that suggests that banks having lower funding liquidity risk as proxied by higher deposit ratios, tend to take more risk. It is argued that a reduction in the funding liquidity risk of banks increases their overall risk taking behaviour supported by higher risk-weighted assets and greater liquidity creation. This therefore suggests that the imposition of liquidity regulation on banks may lead to increased risk taking on their part. However, different results were observed when bank size and existing capital buffers were considered. Capital buffers limit banks from taking additional risk when they have lower funding liquidity risk. Additionally, during the economic contraction that followed, the Global Financial Crisis banks with lower funding liquidity risk took less risk.

On the contrary, Hugonnier and Morellec (2017) argue that regulatory liquidity requirements increases the cost of debt to banks since more debt results in tighter requirements. This then leads to a decrease in the optimal debt levels that banks can hold, along with the probability of default. In other words, regulatory leverage requirements ensure that the amount of debt that banks are able to issue remains constrained whereas, regulatory liquidity requirements limit the amount of debt that banks are willing to issue. This overall minimises the risky activities of banks as intended by regulators. This was also previously concluded in a similar study by Klomp and de Haan (2014) where Liquidity and activity restricting regulation were found to curtail bank risk taking under the condition that there is a high level of institutional quality. Institutional quality is also linked to the level of development of the countries in which the banks and regulators operate. For instance, the study cited that bank liquidity regulation and supervision has a more significant effect on bank risk taking in developed and emerging economies than in developing countries.

Drehmann and Nikolaou (2013) acknowledged that bank risk can be measured in many different ways, focusing specifically on the overall riskiness of banks and their asset risk. They define funding liquidity risk as the banks' failure to settle obligations as they fall and measure funding liquidity risk based on banks' aggressive bidding at central bank auctions to secure liquidity. Similar to the findings from Khan, Scheule and Wu (2017), their study also provides a clear understanding of the link between funding liquidity risk as captured by deposit ratios and bank risk taking behaviour, which may help regulators redesign the banking regulatory framework to better discipline and control the perverse incentives of bank managers to take too much risk in the future, when bank deposits change.

2.6.6 Bank Liquidity Regulation and Bank Profitability

There is a lot of literature that explores the relationship between bank liquidity requirements and bank profitability. This section reviews the exploration of this relationship by reviewing literature from authors such as Molyneux and Thornton (1992); Berger and Bouwman (2009); Goddard et al. (2010); Bordeleau and Graham (2010); Bonner and Eijffinger (2016); and Banerjee and Mio (2018) to name a few. Bonner and Eijffinger (2016) show the impact of specific liquidity requirements on the role of banks as successful financial intermediaries in their study. They specifically analyse whether the Dutch quantitative liquidity requirement changes banks' behaviour in unsecured interbank money markets and whether these changes have an impact on private sector lending and subsequently monetary policy implementation. Their study presents empirical evidence which suggests that quantitative liquidity requirement causes long-term interest rates along with the demand for long-term loans of banks to increase. This is more apparent as lower market-wide liquidity increases the observed estimated effect.

Short-term rates increase with lower levels of aggregate liquidity. However, their results further suggest that bank profits as measured by interest margins are reduced by liquidity requirements (Bonner and Eijffinger, 2016).

The examination of the relationship between liquidity creation and bank profitability by Molyneux and Thornton (1992) and Goddard et al. (2010) presents similar findings although sharply contrasted by Berger and Bouwman (2009). Berger and Bouwman (2009) argue that as more liquidity is created, higher net surpluses are shared among stakeholders including banks, borrowers, and depositors. The effect of this liquidity creation on bank value is therefore positive as banks are mainly responsible for liquidity creation and stand to benefit the most from it. This then implies that regulatory liquidity requirements that inhibit the liquidity creation ability of banks also adversely affect their profitability. This relationship was later confirmed by Bordeleau and Graham (2010) and Tran, Lin and Nguyen (2016) although using different arguments and methodologies. Bordeleau and Graham (2010) approached the examination of the relationship with consideration for illiquid risk and the probability of default. They argued that holding more liquid assets reduces a bank's exposure to insolvency risk and hence the probability of default. This tends to reduce financing costs and generate higher profits for banks, therefore asserting their argument that the benefits of lower default risk with more liquid assets may outweigh the costs of lower returns in the long run.

A much simpler study of this relationship by Dietrich and Wanzenried, (2011) allows for inferences to be made from their findings. Using a dynamic model specification that allows for the observation of profit persistence, they present large differences in profitability among the banks in their observed sample. The factors responsible for a significant amount of this variation included operational efficiency, the growth of total loans, funding costs and the business model. What this review will focus on is the impact of factors such as the growth of banks total loans and funding costs as they are most influenced by liquidity regulation. Dietrich and Wanzenried, (2011) presented evidence that suggests that banks with an above-average loan volume growth would see profitability affected positively, whereas incurring higher funding costs would result in lower profitability.

Therefore, Net Stable Funding Ratio (NSFR) requirements that inhibit the ability of banks to create liquidity and subsequently reduce the volume of total loans they can issue, would reduce their profitability as measured by net interest margin. This is particularly true for banks that are heavily dependent on interest income, relative to banks whose income is more diversified.

Other factors explored by their study including bank ownership structure and financial crisis, although not entirely relevant to this section of the reviewed literature, point to the role played by other micro and macro factors in bank profitability. An example is the Swiss banking industry where bank profitability was observed to be significantly impacted by the financial crisis (Dietrich and Wanzenried, 2011).

While considering the effectiveness of sufficient liquidity as a viable option to protect against the mismatching of maturities and subsequently hedge against liquidity risk, Tran, Lin and Nguyen (2016) found that banks may reduce liquidity creation by holding more liquid assets. Holding liquid assets lowers bank revenues since liquid assets tend to generate lower returns relative to illiquid assets. Consequently, liquidity regulation that enhances liquidity creation should positively impact bank profitability. Conversely, King (2013) previously observed that requiring banks to adjust their balance sheets to meet the NSFR standard will mostly be expensive for many large banks using 2009 bank balance sheet data. The study revealed that bank profitability as measured by net interest margin is reduced from 158 to 88 basis points on average if banks meet the 100% NSFR requirement. One of the most cost-effective strategies used by banks to meet the NSFR involves increasing holdings of higher-rated securities and the extension of the maturity of wholesale funding. Tarullo, (2014) adds that this may cause banks to attempt circumventing this regulatory requirement through the exploitation of any available liquidity arbitrage. This tends to be similar to banks' efforts to circumvent risk based capital minimums by moving credit risk exposures off their balance sheets.

King (2013) further mentioned the UK along with France, Germany, and Switzerland as countries where banks experience the most decline in profitability as measured by NIMs resulting from meeting the NSFR. The Net Stable Funding Ratio (NSFR), a new structural liquidity requirement at the time introduced under Basel III and designed to address funding risk, required banks that do not meet this minimum requirement to modify the composition of their balance sheets to increase stable sources of funding and to reduce assets requiring stable funding. This ultimately has a knock on effect on the profitability of those banks. Therefore, King (2013) adds that banks in these four countries experienced a 156 basis points decline in NIMs with about 30% being attributable to banks from the UK alone. This is compared with a decline of 27 basis points from banks operating in six other countries where they do not need to comply with NSFRs. Although, King (2013) acknowledges limitations with the NSFR estimates in the study, results produced still with great significance point to the existence of a trade-off between liquidity regulation, bank risk and profitability.

While investigating the relationship between less stringent liquidity requirements and bank profitability measures such as the return on assets, the return on equity and the net interest margin Dietrich, Hess and Wanzenried (2014) make some interesting discoveries. Using historical data on a sample of 921 Western European banks between 1996 and 2010, their study observed that a majority of these banks have historically not fulfilled NSFR minimum requirements, in particular, larger and faster-growing institutions including the four banks this study focuses on. Dietrich, Hess and Wanzenried (2014) argued that the potential advantages in funding costs for banks who up until the imposition of liquidity requirements kept low NSFR do not seem to translate into higher profitability, but rather higher volatile results for these banks. Contrary to other reviewed literature thus far, their study presents results that are inconclusive as to whether lower NSFR in fact negatively influences bank profitability. Even though is it acknowledged that the funding costs for banks with a lower NSFR are significantly lower as expected, this when argued from the perspective of regulators, suggests that the new liquidity framework might have beneficial impacts on the stability and resilience of the banking system since the study presents evidence that low NSFR banks exhibit higher earnings volatility.

De Young and Kang (2016) explored a slightly different approach with a focus on U.S. commercial banks as well as a comparison between the liquidity management regime, traditional loans-to-core deposits (LTCD) ratio and the more recent net stable funding ratio (NSFR). They present evidence of homogeneity in the targeting of LTCD and (implicit) NSFR at banks of all sizes, although strongest for small banks and weakest for designated Systematically Important Financial Institutions (SIFI) banks. They uniquely find that as banks increase in size, they set lower liquidity targets which is often in violation of the Basel III standards but also manage those targets more efficiently. Similar to previous findings in literature such as King (2013) and Tran, Lin and Nguyen (2016) they argue that small banks tend to adjust the composition of assets and liabilities, which temporarily decreases profitability, but finds little effect on larger banks. This implies that Basel III Net Stable Funding Ratio (NSFR) would have heterogeneous effects on banks by firm size in the long term (De Young and Kang, 2016).

Similar assertions are made by Banerjee and Mio (2018) with regard to the adjustment of the composition of both assets and liabilities, increasing the share of high quality liquid assets and non-financial deposits while reducing intra-financial loans and short-term wholesale funding by banks in order to meet liquidity requirements. However, they do not present evidence of stricter liquidity regulation, adversely affecting bank profits through a decline in their balance sheets or a reduction in the amount of lending to the non-financial sector. In specifically analysing the impact of the Individual Liquidity Guidance (ILG) on banks in the UK, they observed that banks made distinct adjustments to their asset and liabilities in their balance sheets. The Individual Liquidity Guidance (ILG) had similar components to the LCR and NSFR currently used such as preset level High Quality Liquid Assets (HQLA).

When considering their asset composition, banks significantly increased the share of HQLA to total assets by around 12 percentage points following the introduction of the ILG. The adjustment in the share of HQLA to total assets was observed to be entirely offset by an equal and opposite reduction in the share of short-term intra-financial loans, with the share of other assets remaining unaffected. Whereas when it came to the adjustment of their liabilities, banks increased funding from more stable non-bank and non-financial corporation deposits and decreased their reliance on less stable short-term wholesale and non-UK funding. A strong correlation was not observed between tightening liquidity regulation and an increase in the interest rate on loans to the nonfinancial sector or the interest rate paid on UK non-financial deposits (Banerjee and Mio, 2018). Overall the findings from the study by Banerjee and Mio (2018) support previously reviewed literature in this section from authors who argue that tighter liquidity regulation does not impede bank profitability when solely considering interest income.

2.7 Chapter Summary

The literature review begun by discussing the theoretical frameworks that have underpinned this study's analysis of the impact banking regulation, including the financial intermediation theory, fractional reserve theory, credit creation theory, and efficient market hypothesis. These theories provide different perspectives on the role of banks in the economy and the rationale for regulatory intervention. This chapter has reviewed literature on the impact of banking regulations, with a focus on capital and liquidity requirements, on various aspects of bank operations, including efficiency, market value, profitability, and risk-taking. The role of banks in maturity transformation and the associated risks has also been reviewed in this chapter.

A review of the specific regulatory reforms implemented in response to the 2007-2008 financial crisis, such as the Basel III framework, the Dodd-Frank Act (2010) and the Banking Reforms Act (2013) has also been presented. The chapter explored the impact of capital regulation on bank efficiency, highlighting the conflicting findings in the literature. While some studies suggest that stricter capital requirements can enhance bank efficiency by promoting prudent lending decisions, others argue that they may lead to banks seeking riskier financing sources to compensate for lost profits. The review also examined the effects of activity restrictions on bank efficiency, noting that while such restrictions may limit risk-taking, they can also hinder banks' ability to diversify income and exploit economies of scale.

Furthermore, the chapter investigated the relationship between banking regulations and the market value of banks. The review included the impact of regulatory reforms on stock market returns, highlighting the importance of considering factors such as investor protection, bank size, and the occurrence of systemic banking crises. The review also explored the effects of capital and liquidity regulations on bank profitability, noting the potential trade-offs between stricter regulations that promote stability and less stringent regulations that may foster profitability.

This highlights some critical areas where further research is needed. One of such identified areas is on the impact of regulatory reforms on bank efficiency. For instance, some studies suggest that higher capital requirements lead to increased bank efficiency by promoting prudent lending decisions (Agoraki, Delis, and Pasiouras, 2011). Others argue that it forces banks to seek riskier and more expensive financing sources, reducing efficiency (Pasiouras, Tanna and Zopounidis, 2009; Laeven and Levine, 2009). This conflict highlights the need for more nuanced research that considers factors like bank size, business model, and market conditions. Additionally, activity restrictions may limit banks' ability to diversify their income sources and exploit economies of scale (Djankov et al., 2002). This could potentially reduce their franchise value and disincentivize efficiency. However, this area requires further investigation to understand the complex interplay between diversification, risk-taking, and efficiency under different regulatory regimes.

This chapter also revealed an ongoing debate on input-output selection in efficiency studies. Measuring bank efficiency relies on selecting appropriate inputs (e.g., labour, capital) and outputs (e.g., loans, deposits). However, there's no consensus on the best approach, especially in the US context, where the banking sector is diverse. This lack of standardization makes it challenging to compare efficiency across banks and time periods. Reviewed literature also highlights, the need to develop consistent input-output selections that allow for meaningful comparisons of bank efficiency across different countries with varying banking structures and regulatory environments (Ogunmola et al., 2022). This would provide valuable insights for policymakers and regulators globally.

The Banking Reform Act 2013 introduced significant changes to the UK banking sector, including ring-fencing retail banking operations. However, there's limited research on its impact on banks' stock market value, profitability, and overall performance. This knowledge gap hinders a comprehensive evaluation of the Act's effectiveness. There is also a need to assess the specific effects of ring-fencing on bank risk-taking, lending behaviour, and cost of capital.

There is also limited country-specific studies which fails to address the reality that each country has its own unique financial system, with different banking structures, regulatory frameworks, and macroeconomic conditions. Therefore, generalizing findings from one country to another can be misleading. Country-specific studies are crucial to understand how capital regulations interact with these unique features and affect bank profitability (Michael, 2010). This tailored analysis can inform policymakers in designing effective and contextually relevant regulations.

The review identified that while liquidity regulations aim to enhance bank resilience, they can also have unintended consequences. For example, they might incentivize banks to reduce traditional lending activities, impacting credit availability and economic growth. Research needs to identify these unintended consequences and propose solutions to mitigate them. In conclusion, the review emphasizes the need for further research to fully understand the complex impact of banking regulation on the financial services sector and the broader economy.

Chapter 3: Methodology and Data

3.1 Chapter Introduction

In this chapter, the methodology employed to scrutinize the impact of bank regulation on the performance of banks within the UK is presented. This analysis is framed within a positivist paradigm, embracing the notion of an objective reality that can be empirically examined. A deductive research approach to test hypotheses derived from established theories, combined with a longitudinal design to observe changes over time, specifically from 2000 to 2023 is employed. This study places a strong emphasis on the reliability and validity of its findings, aiming for results that could potentially be generalized beyond the specific context of UK banking regulations. However, the inherent limitations of this approach due to the unique regulatory environment of the UK is acknowledged. The sample for this study comprises the top four UK banks, selected based on their market capitalization and total assets, ensuring the findings are relevant to both domestic and international banking sectors.

Various methods are explored to assess the impact of banking regulation on factors such as bank efficiency, market value, and profitability. These methods include Data Envelopment Analysis (DEA), Event Study Methodology (ESM), and Fixed and Random Effects Panel Regression Analysis. Each variable used in these analyses is carefully defined and sourced from reputable databases like Capital IQ Pro and Yahoo Finance. The chapter concludes with a detailed overview of the model estimation process, including the specific DEA and ESM models, panel regression specifications, and the statistical tests employed to ensure the robustness and reliability of the results.

3.2 Research Paradigm

As a philosophical framework, a research paradigm guides the manner in which research is conducted (Saunders, Lewis and Thornhill, 2023). Waite and Hawker (2009); and Waite (2013) describe philosophy as a set of beliefs that come from the study of knowledge in its fundamental state. There are various research paradigms that have emerged over time including positivism, interpretivism, realism, pragmatism and empiricism. Kuhn, (1962) asserts the universal recognizability of paradigms through scientific achievements over a period where a model of problems and solutions are provided to the research community. Hence only paradigms that are relevant to this study will be addressed. This aspect of the study aligns with the doctrines of the positivist paradigm to investigate the relationship between bank regulation and bank profitability among banks in the UK.

This study will be based on the methodological philosophical assumption drawing from a mixture of both positivism and interpretivism paradigms, while relying heavily on the concept of pragmatism. According to Collis and Hussey, (2014), the positivist researcher under this assumption will usually take a deductive or inferential approach where causes and effects can be studied. Furthermore, with the aid of a static design used to identify categories the positivist researcher can provide prediction and explanations based on generalizations made. Any association existing between variables previously identified will be found in the analysis stage. However, the interpretivist researcher on the other hand uses an inductive process to examine a considerably small sample over a stated period of time. This may be accomplished by using several research methods under clearly defined contexts. This helps to develop different patterns to be explained at the analysis stage, providing findings that are fairly accurate and reliable.

The concept of positivism emanates from philosophical point of view that involves natural scientist as well as working on social facts to discover broad view that is law-like in nature. This allows the research it is being used in to appear unambiguous, thereby providing knowledge that is accurate. As positivism simply mean what is given, it accordingly accentuates the strict focus on methods that are not influenced by the researcher's bias. This would involve methods that are designed to produce genuine data and facts, such as a scientific empiricist method. Therefore, it is for these reasons that this study cannot adopt an extreme positivist position but rather a mixture of both positions. Also, adopting an excessively positivist approach would require the retail banks considered in the study to be viewed as real natural phenomena, which cannot be the case (Saunders, Lewis, and Thornhill, 2016). The study will draw from only the relevant positivisms' out of the 12 varieties identified in Crotty, (1998).

However, Saunders, Lewis and Thornhill, (2016) mentions that it may be argued that the decision to adopt a positivist approach in order to maintain a value-free perspective on its own is indicative of a certain degree of value stance. The adoption of positivist approach for parts of this study is reasonable due to the quantifiable data that will be collected when searching for answers to the research questions stated above. In addition to this, the collection of data will be done in manner that does not affect the data collected.

On the other hand, the overarching purpose of research conducted in an interpretivist manner is produce new and stronger understandings through the interpretations of social phenomena. This fits well with the aspects of this research that examines the aspects of the regulatory reforms that impact the people in the retail banks being studied. The Interpretations goes beyond the surface of seemingly similar factors to ascertain the difference in the context of historical periods of time, by account for the complexities involved in collecting meaningful data. Furthermore, owing to its complexities and multiple interpretations interpretivism is unambiguously subjective. Arguments have been made in support of this approach being most suitable for business related research due to the complex and often exceptional situations faced in business world (Collis and Hussey, 2014). The identified challenge of interpretivism according to Saunders, Lewis and Thornhill, (2016), is the need for this study to understand the point of view of the creators of the qualitative data that has been employed by this study.

The approach that was heavily relied on by this study is the pragmatic approach. This approach asserts that the research philosophies and methods employed by the study should be determined by each research question, since more than one paradigm may prove useful for the same study. This approach proved most appropriate owing to the point that the various aspects of regulatory reforms and the varied ways in which they impact retail banks required an approach to research that is flexible in nature. Throughout this study, the most appropriate paradigm was employed depending on the research question being investigated, instead of being constrained to use a specific paradigm throughout the study (Collis and Hussey, 2014). Creswell, (2014) identifies three factors associated with pragmatism, all of which have been accommodated by this study. The first, pragmatism is not aligned with a single philosophy nor reality. This study neither relies excessively on the positivist nor the interpretivist, but rather maintains mixture that is appropriate for the research. The second consideration is that the researcher has the freedom to rationally choose which paradigm best fits the study. Also, in line with this approach reality or the laws of nature do not offer any relevance to this study.

3.3 Research Approach

Adams et al., (2007), describes two complementary approaches to scientific enquiry which are relevant for this study. These are the inductivism approach and deductivism approach. The inductivism approach is traced as far back as to the early works of Mill, (1843). This approach relies on fixed number of observations to draw general conclusion about an issue. Hence, pointing to its reliance on empirical verification to provide results. The relatively newer approach, the deductivist approach is known to have been developed by Poincaré, (1902); and Popper, (1934). This approach is employed in the testing of hypotheses developed from a theoretical framework against their suggested predictions. In the event that the suggested predictions are found to be false, then that serves as an indication that theoretical framework needs to be revised. Therefore, since these two approaches are not exact opposite, but rather complement each other, this study will switch between them as and when each one is needed.

The primary approach employed by this study is the deductive research approach. This research approach allows for the study to be conducted in a manner where concepts and theoretical structures are empirically tested to make general inferences. This approach involves collecting specific data relating to variables associated with the theories discussed earlier on in the study. The deductive research approach is a scientific method which has traditionally been associated with the positivist paradigm (Collis and Hussey 2014). According to Saunders, Lewis and Thornhill (2023), a deductive research process is said to display the following traits. These include an intent to explain relationships between variables, the collection of quantitative data, the use of controls to allow the testing of hypotheses and replicability.

This study adopts the five sequential stages involved in the application of deductive research provided by Robson (2002); and Robson (2023). The first stage has to do with deducing a hypothesis from the identified theory. These hypotheses can be tested to understand the relationship between bank efficiency, market value and profitability variables; and bank capital/liquidity variables. The second is to express the hypothesis in operational terms. This stage requires the researcher to indicate how the variables contained in the hypothesis are to be measured. Testing the expressed operational hypothesis comes in the third stage. For this study, this involved the use of the empirical test. The fourth stage examines the individual results from the tests conducted in the previous stage. This examination will either be aligned with a relevant theory or signal the need for adjustments to be made. The final stage has to do with the possibility for the modification of theory following the findings from the empirical. A subsequent attempt may be made to verify the amended theory by repeating the first stage, which triggers the entire cycle once more.

3.4 A Longitudinal Study

The study conducted can be described as a longitudinal study. Saunders, Lewis and Thornhill, (2023) describe this type of study as the exploration of variables over a long period. It is also often linked to the positivist methodology. The primary objective of such a study is to investigate the same set of variables continuously throughout the period of a research problem allowing for the examination of the associated dynamics of the problem. The period of examination can range between 20 and 30 years or more. The repeated observations taken are able to reveal the relative stability of the phenomena under study. This type of study also allows the researcher to observe the processes of change found within social, economic and political contexts. This therefore makes it possible to explain patterns that may emerge from the observed data.

Longitudinal data is suitable for the study because it allowed the researcher to examine the impact of regulatory changes on UK banks over time, providing a dynamic perspective on the relationship between bank regulation and various aspects of banks operation. This type of data, collected from multiple entities at different time points, offered several advantages over cross-sectional or time-series data sets. It provided a richer understanding of the factors that drive changes in efficiency and technological innovation within the banking sector in response to regulation. It also allowed for the observation of processes of change within social, economic and political contexts, thereby enabling the explanation of patterns that may emerge from the observed data (Greene, 2018). The study adopted the use of longitudinal data by collecting data on bank liquidity, capital, and profitability variables over a period of 23 years (2000-2023). This allowed for the application of time series analysis techniques to quantitatively analyse the panel data obtained. The repeated observations taken revealed the relative stability of the phenomena under study.

According to Collis and Hussey (2014), it is possible to conduct a longitudinal study by using secondary data. This research put this into practice by conducting this longitudinal study using secondary data. With a concentration on bank liquidity, capital and profitability variables, this study uses time series analysis techniques to quantitatively analyse the panel data obtained. This ability to study change and associated developments is considered a strength of a longitudinal study. However, Adams and Schvaneveldt (1991) identify the risk for the researcher in such studies to lose control over variables being studied if they are affected by the research process. For this reason, a panel data regression analysis is used to determine trends, relationships and make forecasts from the variables in this longitudinal study. An in-depth explanation of the types of regression analysis used is presented in subsequent sections.

3.5 Research Methods Employed in the Study

The study employed a quantitative research approach. This approach involved the collection and analysis of numerical data to examine the relationships between variables (Collis and Hussey, 2014). The study used statistical and econometric techniques to test hypotheses and draw conclusions about the impact of regulatory reforms on retail banks in the UK. A quantitative research approach is a systematic investigation that uses numerical or statistical data to quantify the problem and determine the relationship between two or more defined variables (Greene, 2018).

This approach was most suited for the study because it allowed for the examination of the impact of regulatory reforms on the top four banks in the UK with Ring-Fenced Bodies (RFB), which is the part of a bank that provides essential retail banking services to individuals and companies. The approach also allowed the study to test the relationships between the quantifiable concepts of bank efficiency, market value, and profitability. Additionally, using this approach, the study was able to determine the impact of regulatory reforms on the variables of bank profitability, efficiency, and market value. Finally, the approach allowed the study to generalize the results to a wider population of banks in the UK.

Specific methods employed include, Data Envelopment Analysis (DEA), Malmquist index, fixed and random effects panel regression analysis and Event Study Methodology (ESM). Data Envelopment Analysis (DEA) is a non-parametric method used to analyse the efficiency of decision-making units (DMUs). In this study, the DMUs are the top 4 UK banks. DEA measures the efficiency of each bank by comparing its inputs and outputs to those of the other banks in the sample. The bank with the highest ratio of outputs to inputs is considered to be the most efficient. The study used the Banker, Charnes, and Cooper (BCC) model with variable returns to scale (VRS) to account for the diverse nature of the UK banking industry. The BCC model is a type of DEA model that allows for increasing, decreasing, or constant returns to scale. This means that the efficiency of a bank can change depending on its size. The VRS model is more appropriate for the UK banking industry because it is diverse in terms of size and business model (Chortareas, Girardone, and Ventouri, 2012; and Barth et al., 2013).

The Malmquist Index is a method used to measure changes in efficiency over time. It is based on the concept of the production frontier, which represents the maximum possible output that can be produced with a given set of inputs. The Malmquist Index measures how far each bank is from the production frontier in each time period. The closer a bank is to the frontier, the more efficient it is. The Malmquist Index can be used to identify whether external shifts in the operating environment drive efficiency changes. External shifts, such as changes in the regulatory environment, can also lead to changes in efficiency (Zhu, 2015).

Panel regression analysis is a statistical method that is used to study the relationship between two or more variables over time (Greene, 2018). In this study, panel regression analysis was used to identify the specific factors that influence bank efficiency and profitability. The study used both fixed and random effects models to control for unobserved heterogeneity across banks and time. Fixed effects models control for time-invariant bank-specific characteristics, such as management style or organizational culture. Random effects models assume that these unobserved effects are random and uncorrelated with the included explanatory variables.

ESM is a statistical method that is used to study the impact of events on stock prices (MacKinlay, 1997). In this study, ESM was used to examine the impact of regulatory events on bank stock prices. The study focused on the enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). ESM measures the impact of an event by comparing the actual stock price to the expected stock price in a period around the event. The expected stock price is estimated using a statistical model that takes into account the overall market movements and other factors that may affect the stock price. The difference between the actual stock price and the expected stock price is called the "abnormal return".

The study also included appropriate statistical tests to support the validity of the study. The include the Hausman, Breusch Pagan Lagrange multiplier and the Wilcoxon Signed-Rank test. The Wilcoxon Signed-Rank Test is a non-parametric test that is used to determine the statistical significance of abnormal returns. It is a non-parametric test, which means that it does not make any assumptions about the distribution of the data. This makes it a suitable test for event studies, as the distribution of abnormal returns is often not known. The Hausman test is a statistical test that is used to compare two different estimators. In this study, the Hausman test was used to compare the fixed effects and random effects estimators. The Hausman test is used to test the null hypothesis that the two estimators are both consistent. If the null hypothesis is rejected, then the fixed effects estimator is preferred. The Breusch Pagan Lagrange Multiplier (LM) test is a statistical test used to determine whether a random effects model is more appropriate than a pooled OLS model for panel data. The null hypothesis of the LM test is that the variance of the unobserved individual-specific effects is zero. In other words, there are no significant differences across individuals, and a random effects model is unnecessary. These specific methods are expanded upon in Sections 3.8 and 3.9.

3.5.1 Hypothesis Development

The hypotheses of this research were formulated based on the assumption that regulatory reforms, particularly those related to liquidity and capital adequacy, have had a significant impact on the UK banking sector. These reforms, introduced in response to the 2007-2008 financial crisis, aimed to enhance the stability and resilience of the banking system. However, they also imposed additional costs and constraints on banks, potentially affecting their efficiency, market value, and profitability. However, they also imposed additional costs and constraints on banks, potentially affecting their efficiency, market value, and profitability. Additionally, these hypotheses are also influenced by the theoretical framework and literature review presented in Chapter 2. The hypotheses are further based on the three research questions of this study presented in Section 1.6.

This study evaluated the impact of regulatory reforms on the efficiency of banks. Regulatory reforms may involve capital regulations, activity restrictions imposed by regulators, and regulatory supervision and monitoring. The impact of these on bank efficiency has been assessed in the literature. For instance, Pasiouras et al. (2009) and Laeven and Levine (2009) found that capital regulation results in the management of banks seeking to atone for the loss of benefits due to capital regulation. This is done by pursuing relatively more expensive and riskier financing sources, which leads the banks to be inefficient. On the other hand, Agoraki, Delis, and Pasiouras (2011) argue that capital requirements, when more stringent, raise barriers to entry for new banks and impede competition. This results in banks making lending decisions that are more prudent, hence leading to higher bank efficiency.

The undertaking of broad financial activities by banks, if left unchecked, may result in the formation of exceedingly large and complex entities that become a challenge to monitor and regulate. These entities are sometimes referred to as "too big to fail" and "too big to discipline." Therefore, the impact of activity restricting regulation on the efficiency of banks needs to be investigated (Boyd et al., 1998; and Laeven and Levine, 2007). Barth et al. (2013) found that bank efficiency is enhanced by regulatory supervision and monitoring. Independent supervisory agencies are found to be more effective in monitoring the financial conditions of banks in a truly professional and consistent manner. Although, some studies, such as Beck et al. (2006), have pointed out that extremely powerful supervisors may use their power to forcefully induce banks to apportion credit in a manner that is geared toward generating political or private benefits. Hence, this might create an inverse relationship between bank regulation and bank efficiency.

A number of studies and banking theories have explored the relationship between the market value of banks and the regulatory reforms that they are subject to. For instance, Schafer et al. (2013) examined the relationship between regulatory reforms and stock market returns of banks. Employing an event study methodology, the study revealed that the equity returns of the banks studied were adversely affected. Given the theoretical and empirical evidence presented in Chapter 2, this study developed the following hypotheses:

H_1: Liquidity and capital regulatory reforms in the UK have a significant impact on the technical efficiency of UK retail banks.

H_2: Events associated with regulatory reforms have a significant impact on the market value of UK retail banks.

H_3: Regulatory reforms in the UK have a significant impact on the profitability of UK retail banks.

These hypotheses reflect the study's aim to examine the varied impact of regulatory reforms on the UK banking sector. The first hypothesis relates to the potential trade-off between bank stability and efficiency, suggesting that stricter regulations may lead to a significant on banks' ability to efficiently convert inputs into outputs. The second hypothesis focuses on the market's perception of regulatory changes, implying that investors may view these reforms as significantly impacting the future cash flows and revenue of banks. The third hypothesis addresses the direct financial implications of regulatory compliance, suggesting that the costs associated with meeting stricter capital and liquidity requirements may significantly impact banks' profitability.

3.6 Reliability, Validity, Generalization and Replication of the Study

Reliability in research relates to the extent to which data collection and analysis techniques will produce consistent results if replicated. This refers to the accuracy of findings and a lack of significant differences if a study were to be repeated. According to Raimond (1993), reliability can be divided into two aspects: one being the credibility of research findings and the other being the validity of those findings. The focal point is whether the empirical evidence and the conclusions drawn thereof can withstand scrutiny. Replicability is of paramount importance in a positivist study, hence the high degree of reliability among these studies. This can be achieved by establishing protocols that further establish the authenticity of the study findings.

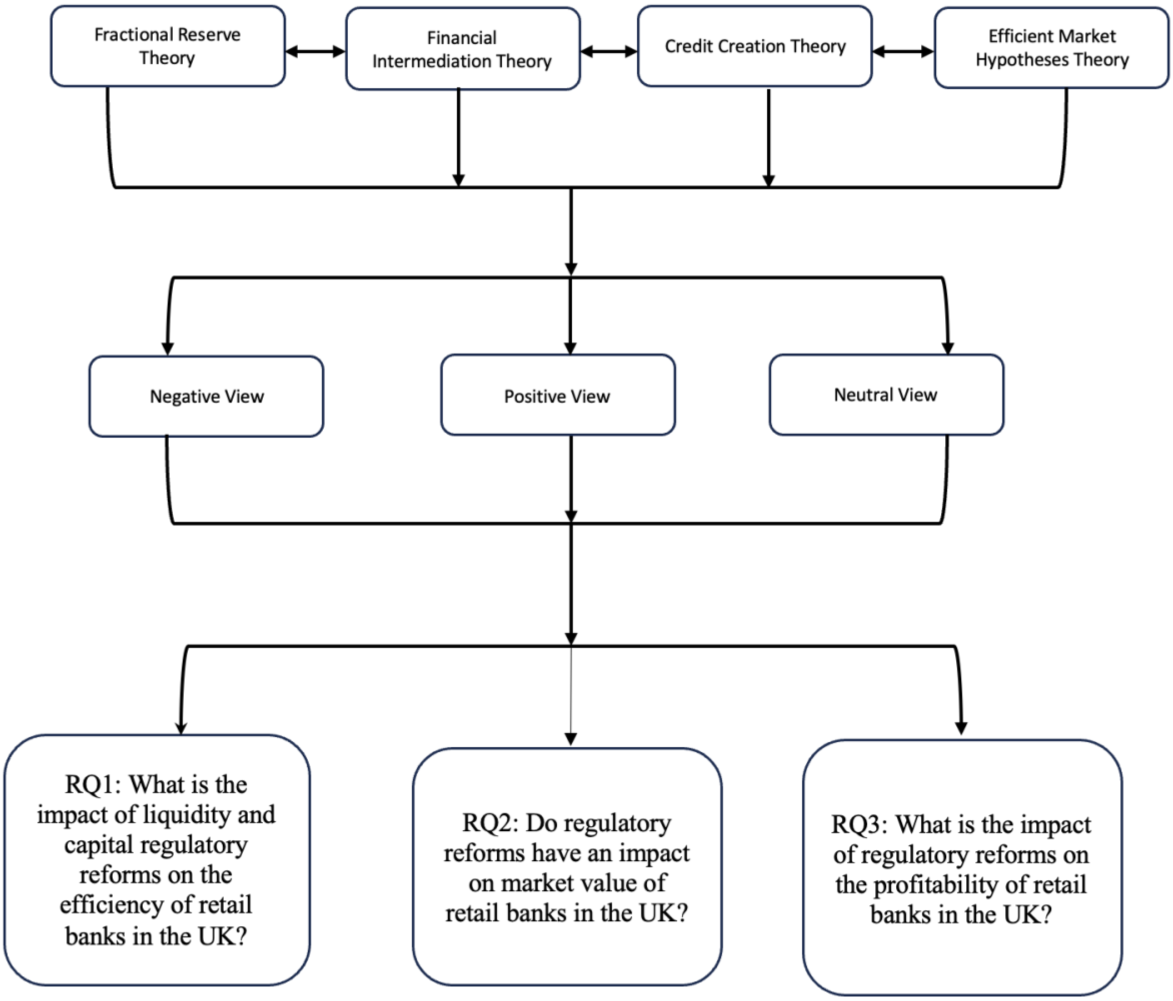
The threats to research reliability as identified by Robson (2002) include participant error, participant bias, problems with research design and errors during data analysis. To mitigate these threats, this study uses the following three steps provided by Easterby-Smith, Thorpe and Jackson (2018). First, the study ensure that the measures used will yield the same results on other occasions. The study then conclude with a reasonable degree of certainty that the observations in this study will be reach by other observers.

The study has gone to great lengths to ensure the validity of its findings. According to Collis and Hussey (2014); and Saunders, Lewis and Thornhill, (2023) the validity of a study can be assessed by the extent to which tests in the study measures what the researcher intends to measure and produce results that appropriately reflect the social issues under study. Validity can be undermined by inaccurate measurement, poorly selected samples and flawed research procedures. A possible inhibiting factor to the validity of research is ambiguity regarding the direction of a relationship between variables (Robson, 2002). This study assessed the validity of the findings presented by using the face validity assessment suggested by Collis and Hussey (2014). This was done by ensuring that the tests conducted appropriately measured the relationship between the variables defined in Section 3.8, while taking the panel nature of the data into account.

External validity may also be referred to as generalisability, which is the extent to which research results can be applied to other research settings. This may come into question in a study such as this when research is conducted on a relatively smaller sample size (Vogt and Burke Johnson, 2016). Collis and Hussey (2014) suggest that by following the positivist paradigm, there is an inclination to determine the degree to which characteristics found in the sample will be present in the population from which the sample was drawn. However, given the remarkable difference in the regulations UK banks have to comply with, it is necessary to note that the primary aim of this study is not to produce results that are generalisable to the entire global population of banks. Rather, the results produced by this study are aimed at explaining the impact of UK banking reforms specifically, liquidity and capital regulation on UK incorporated banks. Emphasis is placed on their UK operations. Nonetheless, Normann (1970); and Gummesson (2000) contend that it is feasible to generalize research results from a small sample size provided the analysis in the study captures the interactions and characteristics of the phenomena that are being studied. Therefore, variable estimates in this study are illustrative of the potential magnitude of the impact of similar regulatory reforms, but a more accurate estimate would require more detailed data and knowledge of each bank's competitive setting which is unattainable at the time of this specific study (King, 2013).

Figure 3.1 illustrates the link between the theoretical framework of the study and the three main research questions the study intends to answer. Using the methods that are outlined in this chapter, the theories discussed in Section 2.4 will be applied appropriately to find answers to the identified questions.

Figure 3 1 An illustration of the Applied Theoretical Framework and Research Questions



3.6.1 Ethical Consideration

This thesis research was conducted with careful attention to ethical considerations, ensuring the integrity and responsibility of the study. There are no ethical issues to be considered under this study since there will be no human interaction. This is since only secondary data will was used. However, the following ethical considerations were central to the research process. All data used in this study were secondary data, obtained from publicly available sources. No private or confidential data was collected or utilized, ensuring the privacy of individuals and organizations was not breached. Data was handled and stored securely, with anonymity maintained where necessary, to prevent misuse or unauthorized access.

The research methodology and design were chosen to ensure the validity and reliability of the study's findings. Appropriate statistical and econometric techniques were applied to analyse the data, with transparency maintained in the data analysis process. The limitations of the study, including potential biases or limitations of the data, are acknowledged in the thesis to ensure the transparency of the research process.

The research was conducted with the aim of providing a neutral and objective assessment of the impact of regulatory reforms on retail banks in the UK. While the study has implications for policymakers and bank managers, the research does not advocate for any particular policy or business strategy. The findings of the study are presented in a balanced manner, acknowledging both the positive and negative impacts of regulatory reforms. The findings of the thesis will be disseminated responsibly, with the primary aim of contributing to the body of knowledge on bank regulation and performance. The thesis will be made available through the University's open access repository, ensuring the accessibility of the research for academic and public use. The researcher will continue to adhere to ethical guidelines for academic publication, including proper citation and acknowledgement of sources, to maintain the integrity of the research.

3.7 Sample Selection

A non-probability sampling method has been used to select the sample for this study based on predetermined criteria. This is a sampling technique in which the chance or probability of each component of the sample being selected is not known (Saunders, Lewis and Thornhill, 2023). The choice of a non-probability sampling approach is also influenced by the nature of the research questions presented in Section 1.6 and the chosen deductive research strategy. The combination of a deductive research strategy with a non-probability sampling method may initially seem contradictory, as deductive approaches often align with probability sampling methods due to their emphasis on generalisability. However, it's still possible to use non-probability sampling if the following hold true. If the nature of the study's research questions are more exploratory, making it impractical to use probability sampling. If the study focuses on a specific group where random sampling is impossible or unnecessary, non-probability sampling can be justified (Greene, 2018). These conditions are satisfied in this study hence the use of non-probability sampling.

A sampling frame is described by Collis and Hussey (2014) as the record of the population from which a sample can be drawn. The sampling frame used in this study was the list of all UK incorporated banks obtained from the Bank of England's (BoE) website. The sample was obtained with the following criteria: the first is that all selected banks had to have been in operation since the year 2000 with regularly published annual reports available from the years 2000 to 2023. All selected banks need to be listed on the London Stock Exchange (LSE) since the year 2000 and a constituent of the FTSE 100 as at the 1st of June 2023. All selected banks also needed to have a minimum total market capitalization of GBP 20B as of the 1st of June 2023. All chosen banks must also have UK retail banking Ring-Fenced Bodies (RFB) as at 1st of June 2023, as identified by the BoE in pursuant to section 142A of the Financial Services and Markets Act 2000 (FSMA). The selected banks should be regulated by the FCA and PRA.

Figure 3 2 Sample Population, Sample Selection Criteria and Selected Sample.

Banks Incorporated in the UK

AIB Group (UK) Plc
Al Rayan Bank PLC
Alpha Bank London Limited
Arbuthnot Latham & Co Limited
Bank of Ireland (UK) Plc
HSBC Bank Plc
HSBC INNOVATION BANK LIMITED
HSBC Private Bank (UK) Limited
HSBC Trust Company (UK) Ltd
HSBC UK Bank Plc
Barclays Bank Plc
Barclays Bank UK PLC
Close Brothers Limited
LLOYDS BANKING GROUP PLC
Lloyds Bank Corporate Markets Plc
Metro Bank PLC TD Bank Europe Limited
Monzo Bank Ltd TSB Bank plc
NatWest Markets Plc
NATWEST GROUP PLC
OneSavings Bank Plc
Royal Bank of Scotland Plc, The
Santander Financial Services plc
Santander UK Plc
Secure Trust Bank Plc
Shawbrook Bank Limited (Private Bank)
Standard Chartered Bank
Nordea Bank Abp
United National Bank Limited (Private Bank)
VTB Capital plc
Banco de Sabadell
BNP Paribas
Caixabank SA
Credit Agricole Corporate and Investment Bank
Credit Agricole S.A.
Danske Bank A/S
DNB Bank ASA
Deutsche Bank AG
Societe Generale

Sample Selection criteria.

1. Incorporated in the UK
2. Continues UK operations including 2000 to 2023.
3. Financial Reports Available on Capital IQ Pro.
4. Listed on the London Stock Exchange (LSE) continuously since the year 2000.
5. A constituent of the FTSE 100 as at the 1st of June 2023.
6. A minimum total market capitalization of GBP 20 billion as of the 1st of June 2023.
7. UK retail banking Ring-Fenced Bodies (RFB) as at 1st of June 2023.
8. Regulated by the FCA and PRA.

Selected Sample

1. HSBC Bank Plc.
2. Lloyds Banking Group Plc.
3. Barclays Bank Plc.
4. Natwest Group Plc.

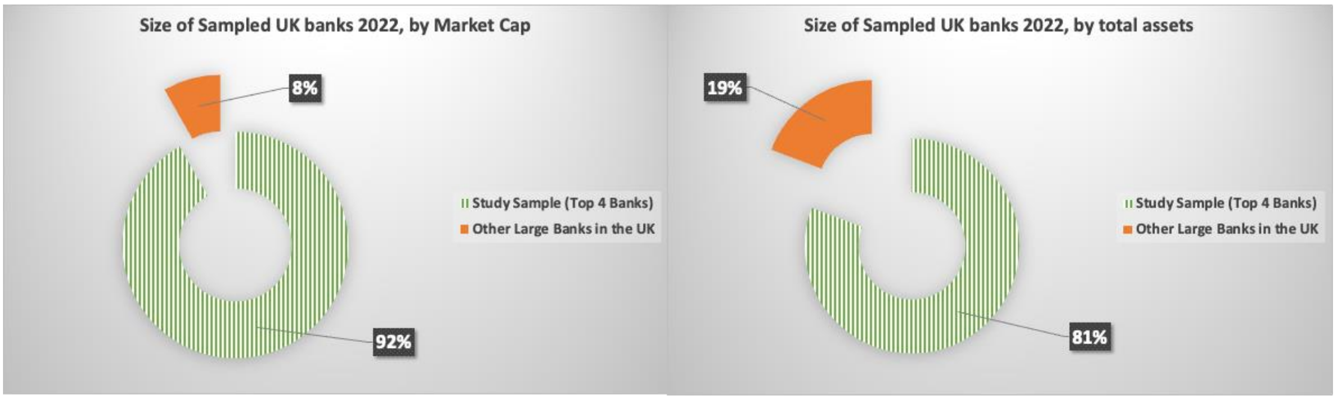
Source: Constructed with data from the Bank of England

3.7.1 International and Domestic relevance of the UK banking sector

The UK's well established practice of imposing firm-specific capital requirements coupled with the nature of its banking sector allows for the effects of capital regulation on banks to be ideally evaluated. This rationale comes from the fact that the UK banking sector is predominantly composed of large domestic retail banks that also have their headquarters in the UK. The sector consists of relatively few large domestic banks with the top four sampled banks accounting for over 90% of the sector's total assets as shown in Figure 2. With the assets of banks distributed more broadly across the UK, domestic economic conditions would likely affect all banks similarly through credit standards and credit demands. This feature better allows for the observation of the effects of liquidity and capital regulation on the 4 sampled banks operating in the sector. Although the datasets from the study's sample only focus on the top 4 banks in the UK by market capitalization and total assets, the obtained findings may have far-reaching implications beyond these 5 banks in the UK banking sector.

The national and international dominance of the sampled banks in this study is illustrated further in Figure 3.3 below. Data gathered from Statista (2023) and the S&P Global Market Intelligence (2023) databases is collectively used to assess the national, regional and international dominance of these sampled banks, and by extension their relevance to not only the UK, but the global banking industry as a whole. According to this data the combined total assets of the 4 sampled banks accounted for 81% of the total banking assets in the UK with a value of £6,736 Billion in 2022. The dominance of these sampled banks was even higher when assessed by their combined market capitalization amount. These banks collectively accounted for 92% of the total market capitalization of listed leading retail banks in the UK, with a total market capitalization amount of USD 250,677.821440 billion.

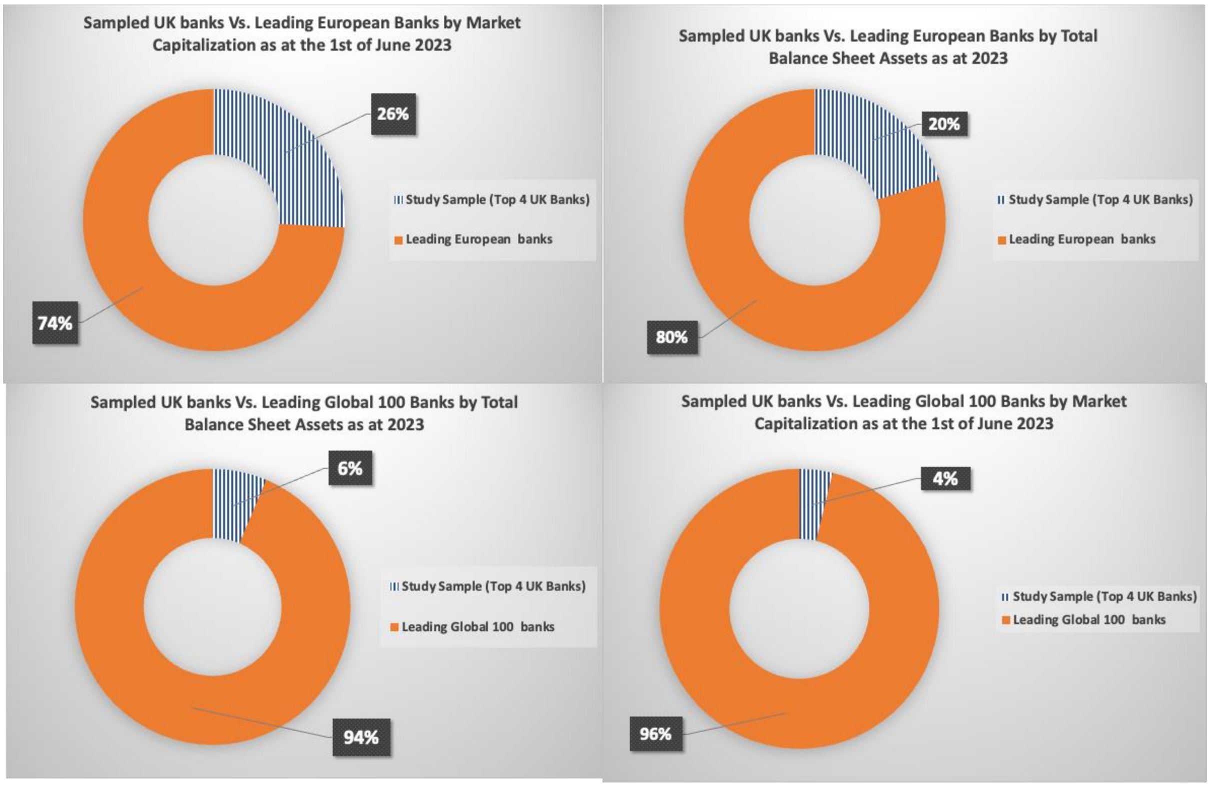
Figure 3 3 Domestic market share of sampled banks in the UK retail banking sector



Source: Constructed with data from Statista (2023) and S&P Global Market Intelligence (2023)

Figure 3.4 highlights the regional relevance of the sampled banks by comparing their total assets and market capitalization against that of other leading European banks. The combined total assets of the sampled banks accounted for 20% of the total assets of the region's leading banks at an estimated value of USD 6,924.753 billion from a regional total of USD 27,687.081 billion according to 2023 balance sheets figures. The combined total assets of the sampled banks is observed to have grown by 2.8% between 2022 and 2023. Additionally, the combined market capitalization amount of USD 250,677.821440 billion accounts for 26% of the total regional market capitalization of USD 990,133.027481 billion. The sampled banks also retain their relevance when compared with the largest 100 banks globally by both total assets and market capitalization. The combined sampled total assets of USD 6,924.753 billion accounts for 6.3% of the total assets of the 100 largest banks globally which is estimated at USD 102,282.450 billion from 2023 balance sheet figures. However, the sample's market capitalization of USD 250,677.821440 billion accounts for approximately 4% of the combined market capitalization of the 100 largest banks globally which was USD 6,331.51. trillion as at 2023.

Figure 3 4 Regional and International Market Share of Sampled UK Retail Banks



Source: Constructed with data from Statista (2023) and S&P Global Market Intelligence (2023)

Furthermore, the feature of broadly distributed assets in the UK banking sector aids in the isolation of the impact of capital and liquidity regulation. This also curtails the potential problem of a significant correlation between capitalization and domestic economic conditions (Peek and Rosengren, 1995). The dataset used in this study (discussed further in Section 3.3 below) includes the 4 largest banks in the UK and provides results that may be generalizable for the UK banking sector as a whole. However, some implications of the study may extend beyond the UK considering the reach of sampled banks depicted in Figure 3. Additionally, Francis and Osborne (2012) reveal that prior to the 2007 Financial Crisis, the balance sheets of UK banks showed claims amounting to over $4 trillion on foreign counterparties. According to The Bank for International Settlements (2024), this figure currently sits at over $4.4 trillion. These balances at the time accounted for over 14% of all known global foreign counterparty claims, further reinforcing the large international presence of UK banks and the extent of their connection with the global economy (McGuire and Tarashev, 2008).

3.8 Methods, Variable Definition and Data Sources

This study employs a number of methods and systematic approach in addressing of the three research objectives. This section outlines the methodological framework employed to investigate the research questions presented in Section 1.6. The chosen methods – Data Envelopment Analysis (DEA), Event Study Methodology, and Fixed and Random Effects Panel Regression Analysis – correspond directly to the three research questions. Each method serves as a robust framework to rigorously examine each research question and derive meaningful conclusions. The methods also offer distinct advantages suited to address the specific nature of the inquiry (Greene, 2018). Data Envelopment Analysis (DEA) stands as a powerful tool in evaluating the relative efficiency of decision-making units (which are the 4 sampled banks in the case of this study) within a given context. In the study's study, DEA serves as a cornerstone method for assessing the efficiency of banks in spite of the increasingly stringent regulatory reforms they face (Zhu, 2015).

Event Study Methodology is a vital analytical approach particularly suited for investigating the impact of regulatory events on financial markets (MacKinlay, 1997). Through a thorough examination of stock price movements surrounding these significant events, this method enables the quantification of market reactions and the assessment of their implications. In Chapter 5 of this study, this methodology provides an understanding of how key events surrounding the enactment of the Banking Reforms Act (2013) and Financial Services and

Markets Act (2023) influence the valuation and performance of banking stocks, offering valuable insights for investors and policymakers alike. Likewise, Fixed and Random Effects Panel Regression Analysis served as an indispensable tool for exploring the relationships between multiple variables over time and across different entities. By accounting for individual heterogeneity and time-invariant factors, panel regression analysis facilitates the identification of causal relationships and the estimation of their magnitude and significance (Greene, 2018). Through this method coupled with the Hausman Statistical Test, the study uncover the complex dynamics shaping various aspects of the study's research questions in Chapters 4.

Additionally, the variables analysed are defined within the context of each research question and its corresponding method. The selection of specific variables within each data source is guided by the theoretical underpinnings of each research question (discussed in section 2.2) and the chosen analytical method. For instance, the DEA analysis, which focuses on relative efficiency, necessitated the categorization of variables into inputs and outputs–with inputs including Wages and Salaries, Total Capital, Total Deposits, HQLA, Loan Loss Provisions, and Risk-weighted assets; and outputs including Total Loans and Revenue. Conversely, the panel regression analysis is designed to examine the relationship between variables impacted by regulatory reforms and profitability over timeframe considered by the study. Whereas the variables used for the event study analysis are the share prices of the sampled banks. By carefully tailoring the variable selection to each research question and method, a robust and informative analysis is achieved.

To ensure a comprehensive and reliable analysis, this study leverages data from two secondary sources, Capital IQ Pro and Yahoo Finance. Capital IQ Pro, a comprehensive financial database, provides a rich set of financial data relevant to the research questions. This data encompasses financial statements and firm-specific characteristics that are relied on for the variables employed in the DEA and panel regression analyses. On the other hand, Yahoo Finance serves as the source for stock price data of the sampled banks, which is crucial for the event study methodology. By utilizing these two well-established data sources, the study was able to draw on a robust and dependable foundation for analysis.

The following subsections will delve deeper into each chosen method, providing a detailed explanation of its theoretical background, implementation process, and the specific variables included within the analysis. This breakdown will ensure transparency and allow for a clear understanding of how the research questions are addressed through the selected methodologies and data sources. Section 3.8.1 outlines and justifies the methods, as well as the specific variables used by the study to assess the impact of banking regulation on bank efficiency. Section 3.8.2 outlines the methods used by the study to assess the impact of banking regulatory change events on the market value of banks. Section 3.8.3 outlines the methods and statistical tests used by the study to evaluate the impact of banking regulation on bank profits.

3.8.1 Banking Regulation and Bank Efficiency

This section discusses in detail the specific methods and variables used in assessing the impact of regulatory reforms on the efficiency of the sampled banks. The analysis employed are in two stages with the DAE based Malmquist index being the primary method applied in an attempt to answer the associated research question. The selected input and output variables are also detailed in this section. With inputs including: (i) Wages and salaries; (ii) Total Capital; (iii) Total Deposits; (iv) HQLA; (v) Loan Loss Provisions; and (vi) Risk-weighted assets. Whereas, the outputs include: (i) Total Loans; and (ii) Operating income/ Revenue. The second stage employs a fixed and random effect panel regression analysis in an attempt to discern the factors responsible for the identified levels of efficiency of the sampled banks. This stage introduces the addition of two main variables namely the estimated DEA scores and control variables. All variables employed in this aspect of the study are presented in Table 3.1.

This section is structured as follows. Sub-section 3.8.1.a reviews the applied Data Envelopment Analysis (DEA) in depth with a basic DEA model illustration. The Malmquist Index applied to consider the effects for efficiency changeover is detailed in subsection 3.8.1.b. The studies justification for applying the DEA approach is presented by highlighting the effectiveness of DEA as a measure of efficiency in sub section 3.8.1.c. The assumption and basic models of the panel regression analysis (fixed and random effects) which are applied in the second stage analysis are detailed in Subsection 3.8.1.d. The selected DEA input and output variables are detailed in subsection 3.8.1.e. Similarly, the rationale for the use of DEA scores as a variable in the second stage regression analysis is outlined in 3.8.1.f. The last subsection, 3.8.1.g, presents an overview of the control variables included as part of the regression analysis.

a. Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a non-parametric mathematical programming technique used extensively to evaluate the relative efficiency of a set of homogenous Decision Making Units (DMUs). These DMUs convert multiple inputs into multiple outputs within the context of an organizational or industry setting. DEA's roots lie in the seminal work of Farrell (1957), later formalized by Charnes, Cooper, and Rhodes (1978), who introduced the first DEA model (known as the CCR model). Its power lies in its ability to handle complex input-output relationships without requiring assumptions of a functional form or the need for subjective weights. DEA's strength lies in its adaptability. The concept of a DMU (decision-making unit) is broad and can be applied to various entities. In recent years, DEA has been successfully used to assess the performance of a wide range of organizations across diverse industries, activities, and countries (Cooper, Seiford and Zhu, 2011).

The strength of Data Envelopment Analysis (DEA) comes from its ability to compare the efficiency of individual entities (Decision Making Units - DMUs) within a specific industry or context, like banking, healthcare, or transportation (Liu, et al., 2013). This method is valuable because it allows researchers and decision-makers to achieve several goals as outlined by Golany and Roll, (1989). These goals include pinpointing areas where efficiency can be improved, ranking DMUs for benchmarking, assessing management effectiveness, evaluating program success, and guiding resource allocation decisions with data-driven insights. More relevant application of DEA in the field of banking include: Sealey and Lindley (1977); Drake and Weyman-Jones (1996); Bauer et al. (1998); Tortosa-Ausina (2002); Drake and Hall (2003); and Maudos and Pastor (2003).

For instance, Sealey and Lindley (1977) investigated how well Data Envelopment Analysis (DEA) could assess the efficiency of banks. Their study examined the relationship between a bank's inputs (deposits, labour, physical capital) and outputs (loans, securities) within the framework of production and cost theory. DEA allows researchers to identify the most efficient banks, forming a benchmark for others. These less efficient banks deviate from this ideal frontier. The authors then propose a specific DEA model based on the traditional financial intermediation theory. This theory, also introduced by Sealey and Lindley (1977), views deposits as an input, and loans and securities as outputs. This approach to modelling bank efficiency has become widely accepted and used in many research studies.

Following the applications of the method by Casu et al., (2004); and Drake, Hall, and Simper (2006) the financial intermediation theory is relied upon as the theoretical basis for this analysis. There are advantages to using a non-parametric technique like DEA for analysing bank efficiency, compared to parametric techniques like stochastic frontier approaches in such an approach. Parametric techniques require assuming a specific mathematical relationship between inputs and outputs, potentially distorting results if this assumption is incorrect. DEA, however, is more adaptable. It identifies the most efficient banks based on real data, forming a realistic efficiency boundary. This means that DEA-derived efficiency measures are not distorted by potentially inaccurate assumptions about the underlying production function, providing a more reliable picture of bank performance (Drake, Hall, and Simper, 2006).

Additional benefits of the using the DEA in this study includes the fact that the individualized assessment of the method enables more granular analysis, as evidenced in the work of Banker and Natarajan (2008). Furthermore, DEA facilitates performance benchmarking against the best-practice frontier, constructed from the most efficient units in the dataset. This highlights top performers and deviates from parametric methods that emphasize central tendencies. This also suggests that DEA-based procedures can provide superior individual DMU efficiency estimations compared to parametric techniques (Drake, Hall, and Simper, 2006; Banker and Natarajan, 2008). Another strength of DEA lies in its potential to address contextual variables. By employing a two-stage process that combines DEA with maximum likelihood estimation, analysts can consistently account for how contextual factors influence efficiency scores (Banker and Natarajan, 2008). In the context of operational efficiency, DEA calculates a bank's efficiency score by determining the proportional reduction in inputs required for that bank to reach the efficient frontier while maintaining its current output levels (Novickytė and Droždz, 2018).

To put the application of this method into context, a basic mathematical formulation is given as a linear programming problem in equation (1.1) below (Cooper, Seiford and Tone, 2000). This equation is based on the Charnes Cooper and Rhodes (CCR) model (1978). The underlying idea of the model is presented in equation (1).

$$\frac{Outputs}{Inputs} \text{ -------------------------- } (1)$$

$$\text{Maximize } \theta_j = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \text{ ------------------------------------- } (1.1)$$

Subject to:

$$\text{Maximize } \theta_j = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \leq 1, \quad \forall \text{k}$$

$$u_r, v_i \geq 0, \qquad \forall i, r$$

Where:

θ: is the efficiency score of DMU_j. It represents how well the DMU converts inputs into outputs compared to other units.

y_{rj}: is the amount of output r produced by DMU_j.

x_{ij}: is the amount of input i used by DMU_j.

u_r and v_i: are weights assigned to outputs and inputs, respectively. These weights determine the relative importance of different outputs in the efficiency calculation.

$\forall i, r$: means "for all i and r (inputs and outputs)".

b. Malmquist Index

Malmquist Index (MI) also known as the Malmquist Productivity Index (MPI) was originally introduced by Sten Malmquist in 1953 as part of his concept of distance functions for use in consumer theory. These functions measured how far a consumption bundle is from a reference point. This concept was later refined into the Malmquist Productivity Index (MPI) by Caves, Christensen, and Diewert (1982), and has significant prominence in the analysis of banking efficiency and productivity dynamics. Unlike static efficiency measures, the MPI enables the researcher to decompose overall productivity change into two core components: technical efficiency change and technological change. This decomposition offers valuable insights into the underlying drivers of performance improvement or decline in the banking sector.

The technical efficiency component of the MPI quantifies the extent to which a bank catches up with or falls behind the best-practice production frontier over time. Technical efficiency gains indicate improved resource utilization while maintaining the same output levels. Conversely, technical efficiency declines signal a deterioration in a bank's ability to optimize its input-output mix. On the other hand, the technological change component of the MPI reflects the shift of the production frontier itself. Technological progress translates into the feasibility of producing more outputs with the same inputs, while technological regression implies a contraction in production possibilities (Caves, Christensen, and Diewert 1982; and Ray 2004).

This study's small sample size (DMU's) brings a number of limitations to light concerning the use of the basic DEA approach, rendering the approach ineffective for the analysis required in this aspect of the study. Nonetheless, given that the study uses a well balance panel dataset spanning the years 2000 to 2023 to address this specific research question, the study acknowledges the suitability of alternative non-parametric approach including the Fischer index (1922); Tornqvist index (1936); and Malmquist Index (1953). However, as the most popular method, the Malmquist Index allows the researcher to assess Total Factor Productivity (TFP) changes which can be further decomposed into technological change, efficiency change, pure technical efficiency change and scale efficiency change.

Studies (e.g. Berger and Humphrey, (1992); hang, Hasan and Hunter (1998); Wheelock and Wilson, (1999); Tortosa-Ausina, (2002); and Sufian (2011)) often use panel data to track banks' productivity and efficiency change trajectories across multiple periods. This longitudinal dimension facilitates a richer understanding of whether specific events, strategic initiatives, or macroeconomic conditions lead to sustained advancements in efficiency and technological innovation. Moreover, certain studies have incorporated contextual variables alongside the MPI in a two-stage approach to shed light on factors such as ownership structure, market concentration, or regulatory environment potentially influencing a bank's efficiency.

In line with similar studies including, Chang, Hasan and Hunter (1998); Wheelock and Wilson, (1999); Isik and Hassan (2003); Jaffry, Ghulam, Pascoe, and Cox (2007); Tanna (2009); and Sufian (2011) this study adopts the non-parametric DEA based MPI method to assess the impact of regulatory changes on the efficiency of the UK retail banking sector. An advantage of applying the MPI is its ability to accommodate multiple inputs and outputs, with a smaller number of DMU's, reflecting the UK's banking industry and the diverse functions they perform within the financial system. Despite its strengths, it's important to recognize certain limitations of the Malmquist Index. Like other DEA-based methods, the MPI is sensitive to the selection of inputs and outputs incorporated in the model. Therefore, careful consideration of the banking functions being represented is crucial for meaningful results. Subsection 3.8.1.e carefully selects inputs and outputs most affected by liquidity and capital regulatory requirements. The MPI model applied by the study is discussed in subsection 3.9.1.a. The capacity of the MPI to distinguish technical efficiency change from technological change, will allow this study offer granular insights for strategic decision-making to policymakers concerned with banking efficiency. In line with Ray (2004); Cooper, Seiford and Zhu (2011); and Zhu (2015) the study present a basic mathematical presentation of the Malmquist Index (MI) in equation (1.2) below.

$$MI = EC \text{ x } TC \text{ ---------------------------- (1.2)}$$

Where:

EC: is the Efficiency Change calculated in STATA

TC: is the Technological Change calculated in STATA

Furthermore, the two main components of MI given in Equation (1.2) can further be decomposed to give the formulae for calculating them. This is given by Lee et, al., (2011) where a basic input oriented geometric mean of MI is decomposed using the concept of input oriented technical change (TECHCH) and input oriented efficiency change (EFFCH) as presented in equation (1.3). The first and second components represent the efficiency change and the technology change respectively defined by drawing on basic DEA concepts.

$$\text{TFPCH} = (\text{TECCH}) \text{ x } (\text{TECH}) = \left(\frac{E_I^{t+1}\left(x^{t+1}, y^{t+1}\right)}{E_I^t(x^t, y^t)}\right) \text{ x } [\left(\frac{E_I^t(x^t, y^t)}{E_I^{t+1}(x^t, y^t)}\right) \text{ x } \left(\frac{E_I^t(x^{t+1}, y^{t+1})}{E_I^{t+1}(x^{t+1}, y^{t+1})}\right)]^{1/2} \text{ ------- (1.3)}$$

Where:

Total Factor Productivity Change (TFPCH): is the estimated MI.

TECCH (Technical Efficiency Change): is the efficiency change calculated in STATA

TECH (Technological Change): is the technological change calculated in STATA

t and t+1: denote the observations at time t and time t+1.

I: denotes the orientation in the MI model

E: denotes the estimated distance to the DEA frontier

c. Effectiveness of DEA as a Measure of Efficiency

This section discusses the suitability of the DEA approach in analysing the efficiency of the sampled banks following changes in regulation that affect their liquidity and profitability. One of the largest application areas of DEA has been in the analysis of banks and bank branches. The majority of these studies have compared banks as opposed to comparing the branches of one or more banks (Paradi, Sherman and Tam, 2018). As highlighted by Paradi and Zhu (2013) the application of bank-level DEA studies is most effective in assessing efficiency changes over time due to regulatory change. The DEA method allows the study to make useful comparisons on the average efficiency levels of sampled UK financial institutions and their US counterparts (Berger and Humphrey, 1997).

This non parametric method also allows us assess how well banks perform their two crucial roles in the financial system given the changing regulatory landscape they contend with. These roles involve providing everyday transaction services to customers and acting as financial intermediaries to connect savers with investors (Fethi and Pasiouras, 2010). Additionally, the study is also able to consider bank efficiencies both from the perspective of maximizing profit and minimizing cost. This is accomplished through the inclusion of additional environmental variables concerning economic conditions (such as interest rates, inflation and GDP growth rates) as well as considerating of the effects of these factors on efficiency results (Berger 2007). In addition to measuring the technical and technological efficiency of the sampled banks, DEA allows us to conduct an investigation into the determinants of bank efficiency by considering a number of firm specific and macroeconomic factors. These factors are generally considered through post analysis regression (Simar and Wilson, 2007).

The approach applied by this study allows us to mitigate the measurement and methodology challenges in DEA banking literature (Atkinson and Wilson 1995; Berger and Humphrey 1997; and Paradi and Zhu 2013). For instance, instead of drawing conclusions from the point estimates of efficiency obtained from DEA, the statistical significance of these efficiency estimates are determined in a fixed and random effects panel regression analysis. Additionally, the study's application of the Malmquist index allows the efficiency estimates to include efficiency change over time.

d. Panel Regression Analysis: Fixed and Random Effects

A panel data analysis is the main econometric analysis method applied in the second stage of this aspect of the study. Panel or longitudinal data allows for the development of estimation techniques and theoretical results in a rich research environment created as a result of the data used. This data typically has a large number of cross-sectional units and only a few periods. This makes the use of time-series methods unsuitable for the analysis of this kind of panel data (Greene, 2018). Concerning finance and economic research, Hsiao (2000) presents several other strengths of panel data sets over conventional cross-sectional or time-series data sets. These include a relatively larger number of data points, improving the efficiency of econometric estimates as a result of reduced collinearity among explanatory variables and significantly higher degrees of freedom. These benefits make longitudinal data the preferred choice for addressing important research questions that cannot be analysed via cross-sectional or time-series data sets (Hsiao, 2003).

Greene, (2018) presents a further advantage of panel data over cross sectional data in that, it allows a study greater flexibility in modelling differences in behaviour across various individual observations. The general modelling framework for analysing panel data obtained from Greene, (2018) is presented in Equation 1 below.

$$y_{it} = x'_{it}\beta + z'_{i}\alpha + \varepsilon_{it} \text{ ---------------------------- (1)}$$

As it is presented, equation 1 is essentially the classical regression model and its constituents are defined as follows.

Assuming there are K number of regressors in x'_{it}, excluding the constant term.

y_{it} : is the dependent variable

x'_{it}: represents the regressors or independent variables

$z'_{i}\alpha$: captures the heterogeneity or individual effects of group-specific or individual variables where z_i represents the constant term.

ε_{it}: the error term

Fixed Effect Regression

This type of regression assumes that an entity's fixed effects is correlated with the error term and predictor variables of the entity. This is because entities have unique attributes that may or may not influence their outcome and/or predictor variables. Since an entity's unique attributes are not random and may impact the independent variables, it is important to control for them. This ensures that the effect of the independent variables are not influenced by these fixed attributes (Greene, 2018). This study uses an entity and time fixed effects regression model as presented by Bartels (2008) in modelling for all three dependent variables. Equation (1) is amended to arrive at the basic entity and time fixed effects regression model seen in equation (2) below.

$$y_{it} = a_i + \beta x_{it} + \delta_t + u_i + \varepsilon_{it} \text{ -- (2)}$$

$$i = 1\ldots\ldots.n \text{ ; } t = 1\ldots\ldots.T$$

Where:

y_{it}: dependent variable (for entity i at time t)

a_i: is the unknown intercept for each entity (n entity-specific intercepts).

x_{it}: is a vector of predictors (for entity i at time t)

δ_t: is the unknown coefficient for the time regressors (t)

u_i: within-entity error term

ε_{it} : overall error term

β: represents a common effect across entities controlling for individual and time heterogeneity

It is important to note that a β coefficient can only be interpreted in the following, assuming no transformation is applied. If this assumption holds true, then for a given entity, when an independent variable changes one unit over time, the outcome will increase/decrease by β units.

Moreover, Kohler and Kreuter (2005); and Stock and Watson (2007) argue that the estimated coefficients of the fixed effects models cannot be biased because of omitted time invariant characteristics since the model controls for all time invariant differences between the entities. This however brings to light a drawback of the fixed effect model, which is its inability to be used to investigate the causes of dependent variables. As a result, fixed-effects models are designed to study the causes of changes within an entity (in the case of this study, the sampled banks) (Kohler and Kreuter, 2005).

Random Effects Regression

The rationale behind the inclusion of a random effects model in this study is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. A distinguishing feature of random effects is that it accounts for differences across entities that may have some influence on the dependent variable but are not correlated with the predictors or independent variables (Stock and Watson, 2007). Moreover, a decisive distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not. An added advantage of the random effects model is that it allows for the inclusion of time-invariant variables that are otherwise absorbed by the intercept under the fixed effects model (Greene, 2018).

In essence, random effects assume that an entity's error term is not correlated with predictors which in turn allows time invariant variables to play a role as explanatory variables if needed. However, there may be a need to specify the individual characteristics of an entity that may or may not influence the predictor variables. This may be a challenge if some variables are unavailable, leading to omitted variable bias in the model. Despite this, random effects models allow for inferences to be generalized beyond the sample used in the model (Stock and Watson, 2007).

Greene (2018) expands on equation (1) to present a basic formulation of the random effects model which can be seen in equation (4) below. This formulation is later modified in equation (5) to include the variables used in this study. The basic formulation of the random effects module is presented as follows:

$y_{it} = x'_{it}\beta + \alpha + u_i + \varepsilon_{it}$ ---------------------------- (3)

Where the description of all components remain the same with the exception of following:

u_i: is a group specific random element

ε_{it}: the error term

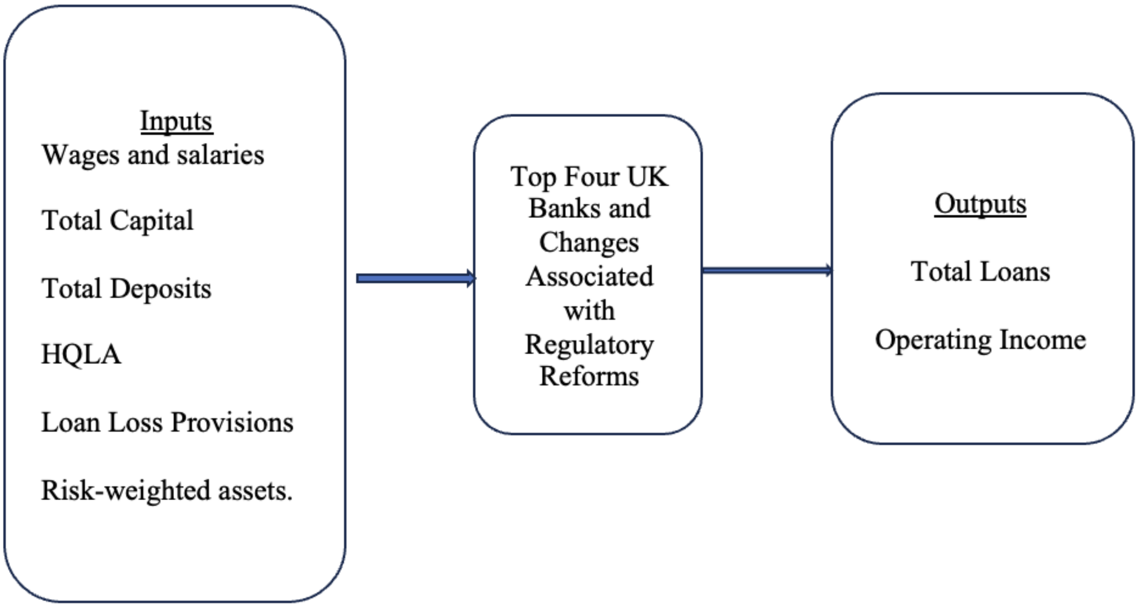
e. DEA Input and Output Variables

The selection of appropriate inputs and outputs is critical when using DEA to assess UK bank efficiency. The production and intermediation approaches are the two common approaches widely used to identify the inputs and outputs of banks as identified by studies including Sealey and Lindley, (1977); Sherman and Gold, (1985); Aly et al., (1990); Berger and Humphrey, (1992); Yue, (1992); Favero and Pepi, (1995); Miller and Noulas, (1996); Matthews and Thompson, (2008); Barros et al., (2014); Stewart, Matousek and Nguyen (2016); and Wanke, Maredza and Gupta (2017). With the production approach, banks are seen as creating accounts by handling deposits and loans. Labour and capital costs are inputs, while outputs are measured by the number of deposit and loan accounts. Whereas, intermediation approach views banks as financial intermediaries, converting deposits and other acquired funds into loans and investments. Inputs may include operating costs, interest costs, and deposits; outputs are measured in total monetary value.

The specific approach chosen for a study generally depends on data and research focus. However, given the UK banking system's emphasis on diversified financial products and services, the intermediation approach is more suitable for DEA analysis. Additionally, given the nature of the research question the study aim to answer, the study's DEA model is further tailored to reflect the study's specific regulatory focus, thereby influencing the study's choice of input and output. The selection of input and output balances commonly use metrics from literature, with consideration of the practical realities of available data on physical and financial resources. As banks are core financial intermediaries, it's vital to assess their efficiency in allocating resources like deposits, loans, and securities. Additionally, because banks pursue profit, effective risk management is crucial, reflected in metrics like loan loss provision, net interest income, operating profit, and net profit (Stewart, Matousek and Nguyen 2016; and Wanke, Maredza and Gupta 2017).

The study's chosen inputs and outputs under the financial intermediation approach is in line with similar studies by Barth et al., (2013); and Novickytė and Droždz (2018). As presented in Table 3.1 the chosen inputs and outputs in this study are as follows. The inputs include: (i) Wages and salaries; (ii) Total Capital; (iii) Total Deposits; (iv) HQLA; (v) Loan Loss Provisions; and (vi) Risk-weighted assets. Each input is chosen because they either directly or indirectly capture changes associated with liquidity and capital specific regulatory reforms on UK banks. For instance, Total Capital and HQLA are expected to capture the effect of changes to the minimum capital and liquidity requirements over the 22 years examined respectively. The exception is the inclusion of Loan Loss Provisions which have been included to capture the perceived risk exposure of the sampled banks (Barth et. Al., 2013). The outputs include: (i) Total Loans; and (ii) Operating income/ Revenue. These are further clearly outlined in figure 3.5 below. These have been chosen to allow the study to examine the ability of banks to efficiently create loans given the changing regulatory requirements while maintaining acceptable revenue levels. Furthermore, the major output of a bank is loans, but they are always a risky output because there is always an ex-ante risk for a loan to become non- performing (Huang and Kao, 2006; Valverde, Humphrey and Lopey del Paso, 2007; Curie and Lozano-Vivas, 2015; and Ogunmola, et. al. 2022).

Figure 3 5Overview of Selected DEA Inputs and Outputs.



f. DEA Scores as a Variable in the Second Stage Regression Analysis

The efficiency score stands out as the most noticeable result generated by DEA analysis. Understandably, many studies place a heavy emphasis on this score. Each DMU receives an efficiency score ranging from 0 to 1.0 (or 0% to 100%). DMUs receiving a perfect score of 100% are deemed exemplars of best practices, residing on the efficiency frontier as outlined by Paradi, Sherman, and Tam (2018). A score below 100% signals a degree of inefficiency when benchmarked against the top performing DMUs. For instance, a DMU with an 80% score could, according to certain DEA models (such as the input-oriented radial model), achieve the same output levels with a 20% reduction in inputs. Conversely, it implies that the DMU could potentially increase its output by 25% if it were to match the efficiency of the best practice DMUs while maintaining its current resource usage. Researchers who seek to pinpoint the origins of inefficiencies may need to conduct further analysis beyond these efficiency scores.

The average efficiency scores in this study allow us to compare different groups of DMUs or to track the efficiency of DMUs across time. This might lead to the conclusion that one group consistently outperforms another, or that the overall efficiency of a group has improved or deteriorated. Additionally, these scores are used to rank DMUs, suggesting a clear hierarchy in terms of efficiency. The DEA scores calculated in this study enable comparisons between banks across different countries (specifically, the UK and the US). However, it's vital that care is taken when interpreting efficiency scores, as they have inherent limitations that must be considered. For instance, while ranking DMUs by efficiency score is a common practice, it does provide a helpful classification system. It identifies best practice units, inefficient units, and those in a grey area. However, a closer look reveals limitations in this ranking mechanism (Fethi and Pasiouras, 2010; and Paradi, Sherman, and Tam 2018).

An efficiency score of 90% indicates a higher ranking compared to an 88% score. This seems straightforward. However, the technical accuracy of the ranking hinges on a key assumption: both DMUs must be compared against the same set of "best practice" units. In reality, it's unlikely that all inefficient DMUs share the same reference set. This introduces some ambiguity into the ranking process. As long as this limitation is acknowledged, efficiency scores can still be a useful ranking tool, particularly in situations such as this study where precise ranking isn't crucial. Another factor to consider is the size of the DMU at each point in time. Although the study’s sample size is made up of the four largest banks in the UK, the size of their balance significantly varied over the 22 years examined (Paradi and Zhu 2013; and Paradi, Sherman, and Tam 2018). Addressing these limitations will help in evaluating the influence of regulatory reforms on bank efficiency in the UK.

To ensure conclusions are made on robust findings, this study moves a step further to apply DEA-generated efficiency scores as the dependent variable in fixed effects and random effects panel regression models. This has also been found to hold particular significance within the banking literature (e.g Ouenniche and Carrales (2018); Goswami, Hussain and Kumar (2019); and Gržeta, Žiković, and Tomas Žiković (2023)). This approach allows us to pinpoint the factors influencing efficiency (Berger and Mester, 1997). These factors might be internal to a bank, such as decline in staff costs, HQLA and technological capabilities, or external, such as shifting regulations and macroeconomic factors (Casu and Molyneux, 2003). Understanding these drivers empowers banks to make informed strategic decisions.

Furthermore, panel regression analysis enables isolation of how specific regulatory changes impact bank efficiency over time (Kumar and Gulati, 2008). This provides valuable insights for policymakers aiming to assess the effectiveness of their regulations. By identifying what's within a bank's control versus external influences, banks gain a roadmap of where to concentrate their efforts for maximum efficiency gains. The choice of both fixed effects and random effects panel regression models are significant in the banking context. Fixed effects models help account for time-invariant differences between banks, letting us focus on changes that occur within a bank over time (Berger and Mester, 1997). Random effects models can offer greater statistical efficiency but carry specific assumptions about the relationship between explanatory variables and individual bank characteristics. A Hausman Test (see subsection 3.9.3.b) is conducted to determine the most appropriate model to report (Greene, 2018).

g. Control Variables

There are numerous examples of the use of macroeconomic variables as control variables in banking regulation literature. These include Demirgüç-Kunt and Huizinga (1999); Barth, et al. (2003, 2013); Bonner and Eijffinger (2016); Ananou, et al. (2021); and Veeramoothoo and Hammoudeh (2022) among others. To control for the overall macroeconomic environment in which banks operate in different countries, Demirgüç-Kunt and Huizinga (1999); Barth, et al. (2003); and Barth, et al. (2013) included the following three macroeconomic control variables: real GDP per capita (GNPP); the growth rate of real GDP per capita (GRO); and the percentage change in the GDP deflator (INF). Whereas, Bonner and Eijffinger (2016); Ananou, et al. (2021); and Veeramoothoo and Hammoudeh (2022) ensure their results are robust by adding more macroeconomic variables namely: year-to-year growth rate of real GDP, inflation and the European Central Bank (ECB) interest rate.

This study found it essential to include macroeconomic variables as control variables in observed relationships between main variables associated with bank efficiency (dependent variables) and the selected regulatory variables (independent variables). The main purpose of this is to ensure that the observed relationships are not confounded by these macroeconomic external factors. The macroeconomic variables included in this study are discussed in subsequent paragraphs below. As done in similar studies including Issah and Antwi (2017); Ouenniche and Carrales (2018); and Homapour et Al. (2022) three key control variables are included in this study. They include the UK GDP growth rate, the BoE base rate and the UK rate of inflation. Inflation tends to have a significant impact on a bank's operations as it is known to affect the real value of money, interest rates, and the overall economic environment. The rate of inflation in a country may also influence interest income, loan demand, and the purchasing power of consumers and businesses, all of which can, in turn, impact a bank's efficiency. Including UK inflation as a control variable allows us to account for its potential effects on the dependent variables and hence isolate the impact of liquidity and capital regulations more accurately (Barth, et al. 2013; and Bonner and Eijffinger 2016).

The bank base rates are a critical factor influencing the cost of funds and interest income for banks. This is due to the significant influence it has on the interest rates at which banks borrow and lend money. Changes in the base rate may affect a bank's efficiency particularly when considering Net Interest Margin as a measure as well as the lending decisions of the bank. The existing economic conditions of a country may affect loan demand, credit quality, and the overall business activities of banks operating within that country. Broadly speaking, a growing economy generally leads to increased business activities, lending opportunities, and higher bank efficiency. Therefore, including UK GDP growth as a control variable helps capture the broader economic context in which banks operate (Demirgüç-Kunt and Huizinga 1999; Barth, et al. (2003); and Barth, et al. (2013). Including these control variables in this study aims to strengthen the robustness of the study's results by considering external factors that could influence the variables that may explain how bank efficiency is affected by regulation.

Table 3. 1 Summary of methods and variables used in assessing the Impact of regulatory reforms on bank efficiency.

Variable List	Definition	Source
Stage 1 (DEA Score Estimation)		
Inputs		
Wages and salaries		Capital IQ Pro
Total Capital	Tier 1 + Tier 2 capital	Capital IQ Pro
Total Deposits	From other Banks and Customers	Capital IQ Pro
HQLA	If L 1 + L 2 not given use only Leve 1 Assets that are available = Cash + central Bank reserves + certain marketable securities backed by sovereigns and central banks	Capital IQ Pro
Loan Loss Provisions		Capital IQ Pro
Risk-weighted assets		Capital IQ Pro
Outputs		
Total Loans	To businesses/ banks + retail customers	Capital IQ Pro
Operating income/ Revenue		Capital IQ Pro
Stage 2 (Panel Regression Analysis)		
Dependent Variable:		
DEA Scores		STATA DEA Estimation Output
Independent Variables:		
Wages and salaries		Capital IQ Pro
Total Capital		Capital IQ Pro
Total Deposits		Capital IQ Pro
HQLA		Capital IQ Pro
Loan Loss Provisions		Capital IQ Pro
Risk-weighted assets		Capital IQ Pro
Total Loans		Capital IQ Pro
Operating income/ Revenue		Capital IQ Pro
Control Variables:		
UK -Inflation		Capital IQ Pro
UK Bank Base Rates		Capital IQ Pro
UK GDP Growth		Capital IQ Pro

3.8.2 Banking Regulation and Bank Market Value

This section discusses in detail the specific methods and variables used in assessing the impact of regulatory reforms on the market value of the sampled banks. The Event Study Methodology (ESM) is the main method employed. As part of the ESM key components including the studied events, events dates, estimation and event windows are defined to a great detail. Table 3.2 in the section presents a summary of the main event dates and their corresponding description as well as event IDs. Further in this section, Figure 3.6 outlines the event study timeline model applied to all 6 events examined by the study.

This section divided as follows. Sub section 3.8.2.a discusses the origins of ESM, its relevance in finance studies and its application in this particular study. The enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023) being the two main events examined by this aspect of the study are discussed in sub section 3.8.2.b. The three key events under each main event including (i) Third Reading in the House of Commons; (ii) Third Reading in the House of Lords; and (ii) the Royal Assent are also detailed in this sub section. The dates on which the defined events occurred are stated in subsection 3.8.2.c. The rationale for stating event dates in ESM is also presented in this sub section. The estimation window and event window are outlined and justified in subsection 3.8.2.d. The subsection 3.8.2.d presents the daily stock prices and stock market index value as the sole variables employed in this analysis.

a. Event Study Methodology

The Event Study Methodology (ESM) has its roots in the early 1930s with the work of James Dolley (1933). Dolley's research investigated the behaviour of securities prices following corporate announcements, specifically focusing on stock splits. Over the subsequent decades, ESM gained traction among scholars and underwent continuous refinement. Notably, MacKinlay (1997) emphasizes the increasing sophistication of the technique. Other key contributors to ESM's development include Myers and Bakay (1948), Barker (1956, 1957, 1958), Ashley (1962), Ball and Brown (1968), and Fama et al. (1969) (MacKinlay, 1997; Corrado, 2011).

The classical ESM is a rigorous econometric approach rooted in finance. It draws upon the efficient market hypothesis, which suggests that capital markets quickly and accurately incorporate publicly available information into firms' stock prices. The ESM seeks to measure the effects of specific events (in the case of this study regulatory announcements) on a firm's prospects and resulting stock price movements by calculating abnormal returns. The ESM remains widely applied accounting and finance discipline (Ullah, Akhtar and Zaefarian, 2018; Ullah, Zaefarian, and Ullah, 2020; and Lim, Ahmed, and Ali, 2019). The successful application of this method in the fields of accounting, economics, and finance can attributed to the easy of accessing financial data from databases. In line with prominent studies such as Ball and Brown (1968); Fama et al. (1969); and MacKinlay (1997), the study employ the ESM in assessing the impact of regulatory reforms on the market value of the study's sampled banks.

The ESM is not without limitations, and these are highlighted and addressed is this study as follows. One obvious limitation is the potential for confounding events occurring around the same time as the event under study. These events can contaminate the observed abnormal returns, making it difficult to isolate the true impact of the event of interest. To mitigate this issue, the study carefully examined news reports and market data to identify and potentially control for other events happening within the estimation window (Lyon, Barber and Tsai, 1999). Additionally, the study used the FTSE 100 as a broader market benchmark to help adjust for general market movements unrelated to the specific events (See section 3.8.2.b) being examined. The second limitation of ESM is the assumption of market efficiency. If markets are not perfectly efficient, stock prices may not immediately and fully reflect the information conveyed by the event. This can lead to biased or inaccurate estimates of abnormal returns. The study addressed this by extending the event window (See section 3.8.2.d) to capture delayed or gradual market reactions (Brown and Warner, 1985).

Similarly, markets may partially anticipate the event before its announcement, resulting in abnormal returns being diluted or spread out over a longer period. In addition to adjusting the event window, the study examined pre-event trading patterns to rule out any potential anticipation effects (Kothari and Warner, 2007). Furthermore, Corrado (1989) identified that depending on sample size and event characteristics, the ESM may have limited statistical power to detect smaller effects. Given the study's sample size, this limitation is mitigated by using the Wilcoxon Generalized Sign test. Wilcoxon Generalized Sign test is a non-parametric test statistics that is more robust in smaller samples. Additionally, the study's statistical power is enhanced due to careful attention to event selection, focusing on key events likely to have a discernible market impact as discussed in section 3.8.2.b.

b. Studied Events Defined

As highlighted in the previous discussions, the Event Study Methodology (ESM) is employed to evaluate the effects of regulatory reforms, which include new information or announcements. This section outlines the main events and sub-events necessary for conducting an event study focused on two significant pieces of UK financial legislation: the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). Understanding the timeline of these legislative milestones is crucial for subsequently defining the event windows and isolating the impact of these regulatory shifts on UK banks. The Banking Reform Act (2013) emerged as a critical legislative response to the 2008 global financial crisis. Its core aim was to strengthen the UK banking sector, prevent future taxpayer-funded bailouts, and protect consumers from the risks posed by large, interconnected financial institutions (MacKinlay, 1997).

Key provisions under the Act include the structural separation of retail banking operations (taking deposits, providing everyday services) from riskier investment banking activities. This ring-fence aimed to insulate core banking functions from the volatility of trading floors. The Act also established the Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA) responsible for the safety/soundness of financial firms and ensuring fair treatment of consumers, as well as promoting market competition respectively. Banks are also required to hold substantially higher levels of capital reserves to act as a buffer during economic downturns under the Act. There was also an introduction of a "bail-in" mechanism, allowing failing banks to restructure their liabilities (e.g., by converting debt into equity) rather than relying on taxpayer bailouts. The potential for personal liability if the decisions of senior banking executives resulted in the failure of their institutions was also made possible by the Act.

The three main sub events considered under the enactment of the Banking Reform Act (2013) are: (i) Third Reading in the House of Commons; (ii) Third Reading in the House of Lords; and (ii) the Royal Assent. The first event, the Third Reading in the House of Commons is the date the then bill passed its final vote in the House of Commons, indicating substantial legislative progress. This also confirms the bill's approval by the lower house of Parliament. The second event, the Third Reading in the House of Lords, is when the bill passes its final vote in the House of Lords, often after the bill has been debated and revised. The third event, the receipt of Royal Assent is when the bill receives assent from the monarch and becomes law (ref).

Similarly, the three main sub events considered under the enactment of the Financial Services and Markets Act (2023) mirror those considered under the Banking Reform Act (2013). The Financial Services and Markets Act (2023) sets out the post-Brexit framework for financial services industry in the UK. It represents the most substantial piece of legislation since the Banking Reforms Act (2013), affecting a broad range of areas including UK MiFID, the financial promotions regime, and the regulation of crypto assets and stable coins used as payments. Some key provisions include the revocation of retained EU law following Brexit and the granting of HM Treasury new regulatory powers as well as changing the objectives and accountability mechanisms of UK regulators. The Act is designed to support government's ambitions to maintain the UK's financial services sector as a hub for global financing and a place that encourages innovation without sacrificing financial stability. The three main sub events considered under this act include: (i) Third Reading in the House of Commons, which marks the final debate on the bill in the Common; (ii) Third Reading in the House of Lords which allowed for final revisions affecting the regulatory landscape for banks, particularly concerning accountability mechanisms and regulatory objectives to be included before the final vote; and (iii) The royal assent of the Financial Services and Markets Act (2023) which formerly marked a significant shift in the UK's regulatory framework, empowering regulators with enhanced rule-making authority and consumer protection measures.

c. Event Dates

After the defining of appropriate events in section 3.3.2.b, the next step in ESM involves stating the dates the defined events occurred (Brown and Warner, 1985). These event dates are an important feature of the ESM, as they form the basis for evaluating the impact of the observed regulatory events on the market value/returns of the sampled banks (MacKinlay, 1997). The event date allows the study to compare the stock returns of the banks before an event with returns subsequent (estimation window) to the news reaching the market. This allows for the abnormal returns earned due to the analysed event to be measured statistically (Armitage, 1995; and Binder, 1998).

These abnormal returns refer to the actual ex-post return of a security (stock) over the event window minus the normal return of the firm over the event window (MacKinlay, 1997). This highlights the importance of ensuring that the precise date of the analysed events are identified to avoid flawed estimations of the associated abnormal returns. The event dates used in this study along with their corresponding defined events and assigned event IDs are presented in table 3.1. It is common in the application of ESM for some events to exhibit multiple dates, which is the case in this study, unlike the classic ESM events where a firm formally issues a statement on a set date (Sorescu et al., 2017). McWilliams and Siegel (1997) highlight the potential presence of information leakages in such events as limitation, making it relatively more challenging to determine when traders became aware of the new information. To overcome this limitation, the study uses multiple event windows to capture any information leakages (Fama et al., 1969; McWilliams and Siegel, 1997; and Sorescu et al., 2017).

Table 3. 2 A summary of event dates and event ID’s

Main Defined Events	Event ID	Event Description (Sub Events)	Event Date
Banking Reform Act (2013)	A	The key events associated with the passing of the Banking Reform Act (2013)	
	A1	Third reading House of Commons	9th July 2013
	A2	Third reading House of Lords	9th December 2013
	A3	Royal Assent	18th December 2013
Financial Services and Markets Act (2023)	B	The key events associated with the passing of the Financial Services and Markets Act (2023)	
	B1	Third reading House of Commons	7th December 2022
	B2	Third reading House of Lords	19th June 2023
	B3	Royal Assent	29th June 2023

d. Estimation Window and Event Window

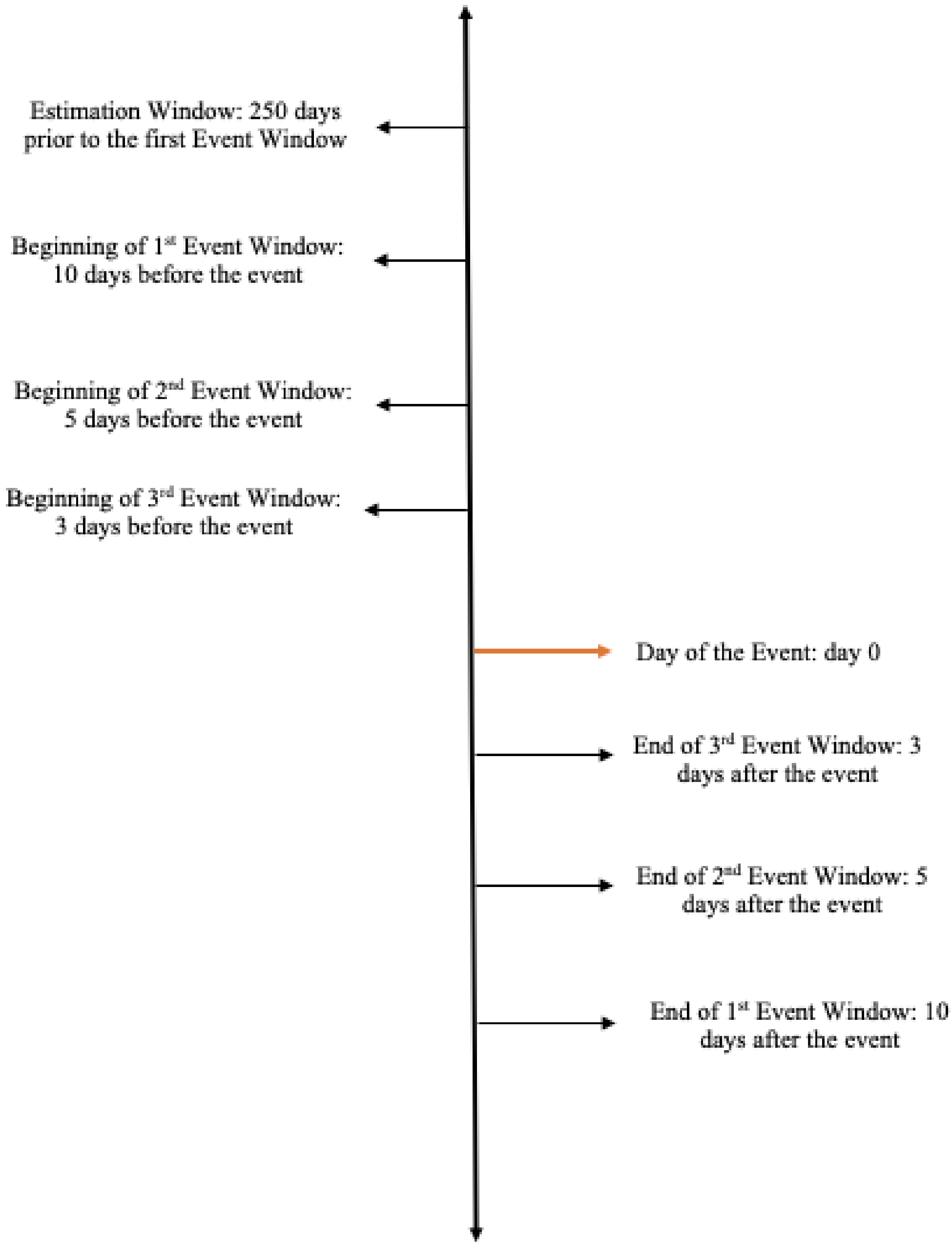
After defining the sample size and the length of the event timeline, the definition of the estimation window is the next in the ESM. This is a crucial period in event studies that is used to establish a baseline of "normal" or expected returns for a security or group of securities. It serves as a reference point to isolate the abnormal returns that may be directly caused by the specific event being analysed. The length of the estimation window varies depending on the nature of the study and the expected duration of the event's impact. A review of literature suggests that robust statistical analysis is ensured when an estimation window ranges from 100 to 250 trading days (Brown and Warner, 1985; Lubatkin and Shrieves, 1986; and MacKinlay, 1997). In line with more recent literature such as (ref) this study applies an estimation window of 250 days which ends 30 days before the start of the first event window. This is illustrated in figure 3.6. The event window could also presented as a lower-bound event window of 280 days and an upper bound event window of 30 days.

Similarly, event window may comprise a few days, weeks, or months before and after the event date. The size of the window is adjusted to capture both the immediate impact of the event and any potentially delayed or evolving effects. This makes the event window an important feature of the ESM, as it permits the study to measure the impact of the analysed event on firm returns. Although, there are no fixed number of days, weeks, or months that should form the length of an event window, the ideal length depends on the specific event and the market being studied (Armitage, 1995; McWilliams and Siegel, 1997). An ideal event windows should be relatively short so as to avoid the impact of unrelated events on the post-event returns while still allowing sufficient time to observe the event's full consequences (Delattre, 2007). Accordingly, this study has chosen three suitable event windows namely: a 3-day event windows; 5-day event windows; and 10-day event windows. These event windows comprise of the observed stock returns 3 days before and after the event (-3, 3); 5 days before and after the event (-5, 5); and 10 days before and after the event (-10, 10) respectively.

e. Daily Stock Prices and Stock Market Index Value: Main Variables in the Event Study

The quantitative data applied in this event study are the daily historical share prices of the sampled banks over the 23-year period obtained from Yahoo Finance and Eikon Thomson Reuters. The ticker symbols of the four sampled banks as listed on the London Stock Exchange (LSE) are: HSBAL (HSBC Bank Plc.), LLOYL (Lloyds Banking Group Plc.), BARCL (Barclays Bank Plc.), and NWGL (Natwest Group Plc). The study also used the iShares Core FTSE 100 UCITS ETF FTSE 100 Exchange Traded Fund (ETF) by BlackRock as a proxy for the FTSE 100 index. The ticker symbol for this ETF as listed on the LSE is ISF. This fund seeks to track the performance of the index composed of the 100 largest UK companies, which includes all sampled banks. This makes the fund better suited to represent the market in the study’s event study model.

Figure 3 6 Event Study Timeline Model Applied to all 6 Events in this Study.



As seen in the timeline above, it is typical for the estimation window and the event window not to overlap. This design originally proposed by MacKinlay, (1997) provides estimators for the parameters of the normal return model which are not inferenced by the returns around the event. The event returns may have a significant influence on the normal return measure if the event window and estimation are not separated. This would result in the unintended situation of both the normal returns and the abnormal returns capturing fragments of the impact of the event.

This will render the ESM ineffective in such a situation because of the methodology's fundamental assumption that the event impact is solely captured by the abnormal returns.

3.8.3. Bank regulation and Bank Profitability

The purpose of this section of the study is to expand on the panel regression analysis as a method applied in this aspect of the study. Context is given to the suitability of using this method to investigate the relationship that may exist between the bank regulation and bank profits. The description of the variables used is categorised based on their assessed relevance to this aspect of the study. Variables included due to their ability to measure bank profitability are discussed in sub section 3.8.3.b. Variables that are known in literature to be influenced by liquidity and capital regulation are discussed in sub section 3.8.3.c. Sub section 3.8.3.c presents the macroeconomic variables employed in the analysis to control for the impact of external macroeconomic forces on the profitability of banks.

a. Panel Regression Method

This aspect of the study also applies the panel regression methods described in section 3.8.1.d. This section further contextualises this method to highlight its suitability in the examination of the relationship between bank regulation and bank profits. The manner in which this method is applied in this aspect of the study is similar to that of Ahmed and Bhuyan (2020). This study run panel regressions for three dependent variables (i.e. ROA, ROE and NIM), eight independent variables (i.e. Level 1 Assets to Total Assets, Total Capital, Tier 1 Capital, Tier 2 Capital Ratio, Gross Loans to Total Deposits ratio, Annual Common Equity Growth, loan loss provisions to total loan, and Staff Cost to Income ratio) and three control variables (i.e. UK - Inflation rate, Bank of England Base Rate and UK GDP Growth Rate)

Additionally, multiple panel regressions are run along with two independent diagnostic tests using Stata. The data sets used in this study are strongly balanced panels, implying that each variable in the data set was observed the same number of times. The analysis is conducted in this manner to determine the suitability of either a fixed or random effects panel regression model for this study. The panel regression models along with the tests conducted are presented in sections 3.9.3.a through to 3.9.3.b. The outputs of both the fixed and random effects panel regression models are presented for each dependent variable, as was done in similar studies including, Suntraruk and Liu (2017); Dalci (2018); Sivalingam and Kengatharan (2018); and Mayuri and Kengatharan (2019). However, the appropriate model for each dependent variable is arrived at by using Hausman tests. The study subsequently uses the Breausch Pagan test (Breausch Pagan Lagrange Multiplier) to validate the outputs of the Hausman test used in selecting the appropriate model as similarly seen in Ghasemi, Nazrul and Komeli (2018); Khan, Mohd and Jatin (2018); and Dalci (2018). All panel regressions and tests were conducted using Stata.

b. Profitability Variables

The definition of profitability varies among banking literature. In line with previous studies such as by Sufian and Habibullah, (2009); Naceur and Omran, (2011) and Menicucci and Paolucci (2016), the study rely on the three most commonly used ratio measures of bank profitability. These are: Return on Assets (ROA), Return on Equity (ROE) and Net Interest Margin (NIM). Moreover, Lee and Hsieh, (2013) argue against the use of a single profitability variable in studies as this may produce misleading results. Although there are there are several other ratios used to measure the profitability of banks in literature, these mentioned dependent variables are three measures of profitability used in this study. It is worth mentioning that because the study's study only focuses on ROA, ROE and NIM, it does not exhaustively account for all aspects of bank profitability. Furthermore, ratios are the preferred measure of profitability because they are relatively unaffected by inflation as they are not affected by general price changes (Menicucci and Paolucci, 2016).

The first profitability variable, ROA, is particularly suitable for banks that report a lower ROE due to a lower leverage ratio (higher equity). This ratio is a measure that allows for easy comparison of the operating performance of banks. This study examines the ROA by first defining it as the ratio of net profits to total assets. This is the first dependent variable in the study's fixed and random effect regression models similar to what has been done in other studies such as Abbasoglu et al. (2007); Naceur and Goaied (2008); and Kosmidou (2008). Golin (2001); and Hassan and Bashir (2005) assert that ROA reflects the ability of a bank's management to generate profits from the assets, and it indicates how effectively the bank's resources are managed to produce such profits. This further validates the increased popularity of ROA as the key functional indicator of bank profitability in the literature (Menicucci and Paolucci, 2016). Earlier literature such as Rivard and Thomas (1997) describes ROA as a fundamental indicator of a bank manager's ability to generate profit from a bank's financial and real assets. This assertion is based on the premise that the measure is not influenced by high equity and it also assesses the return-generating capacity of entire assets of a bank.

The second measure of profitability used in this study is the ROE, which is a measure of the return attributable to shareholders for the equity they hold. This measure is defined as the ratio of net profits to total equity. This ratio further indicates the returns to shareholders expressed as the book value of their equity, and additionally reveals how well a bank's management uses its shareholders' funds. In addition to the above, this dependent variable has been included in this study as it gives some measure of a firm's efficiency when generating profits from each unit of shareholders' funds. This further gives an indication of how a bank is able to successfully leverage invested funds to propel earnings growth (Menicucci and Paolucci, 2016).

The NIM is used in this study as the last measure of profitability. This measure is defined as the ratio of the net interest income to total assets. This may also be considered to be the difference between the interest income generated by a bank and the amount of interest the bank must pay to its depositors and creditors, all divided by the average amount of their interest-earning assets. Here, interest-earning assets are the sum of all the assets of a bank that earns interest, including loans and investments in fixed-income securities (Berger, 1995). The NIM is further suitable because it aptly quantifies the profitability bank's interest-earning business, unlike ROA and ROE. NIM fundamentally represents a bank's efficiency and the rate of success of its investments (Berger, 1995; Naceur and Goaied, 2001).

c. Variables Influenced by Capital and Liquidity Regulation

According to Bonner, Lelyveld and Zymek (2015), quantitative liquidity requirements such as Liquidity Coverage Ratio (LCR) aim to ensure that banks hold enough liquid assets to sustain funding liquidity needs over a pre-defined stress period. The LCR is obtained by High Quality Liquid Assets by Net cash out flows within 30 days and should be greater than 100%. However, due to limitations around access to data on the net cash outflows within 30 days for each bank in the study's sample, the study focus on High Quality Liquid Assets as one of the proxies for liquidity requirements. Furthermore, liquidity requirements in the United Kingdom also ensure that maturity mismatches are limited. This is accomplished by requiring banks to hold a minimum amount of High Quality Liquid Assets (HQLA), including cash, central bank reserves and gilts. High Quality Liquid Assets (HQLA) are composed of Level 1 and Level 2 assets. Level 1 assets are considered to be highly liquid money market assets and consist of cash, central bank reserves and debt securities issued or guaranteed by high credit rated governments as well as corresponding central bank and Public Sector Entities (PSE). Level 2 assets on the other hand are of relatively lower market liquidity and are therefore discounted between 15% and 50%. These assets may also include certain qualifying non-financial corporate and covered bonds, as well as some securitizations. These liquidity requirements are aimed at capturing the liquidity needs of banks over a 30 day stress period. These are required to meet the difference between assumed drawdowns of liabilities (including off-balance sheet commitments) and contractual inflows (Banerjee and Mio, 2018). Similarly, Veeramoothoo and Hammoudeh (2022), use LCR and HQLA as variables in assessing the impact of Basel III liquidity regulation on the performance of US banks.

Again, this study uses only level 1 assets to total assets ratio as a proxy for High Quality Liquid Assets due to the subjective nature of the computation for level 2 assets. Additionally, banks are required to have a minimum of 60% of Level 1 assets among their reported High Quality Liquid Assets for the calculation of their LCRs. Whereas Level 2 assets are allowed to make up 40% or less of the High Quality Liquid Assets of banks. Moreover, the classification of certain assets as liquid and quantifying the liquidity risk of banks' liabilities, is likely to affect banks' decision on how to solve the trade-off between self-insurance against liquidity risk and the opportunity costs from holding liquid, lower-yielding assets. As the behaviour of banks may differ across individual institutions, this study may reveal that liquidity regulation may nullify their internal incentives to hold liquid assets. Other bank specific variables that may be influenced by capital and liquidity regulation are presented in the subsequent paragraphs below and summarised in Table 1.

First is the Level 1 Assets to Total Assets Ratio. As alluded to in the paragraph above, it measures the proportion of a bank's Level 1 assets, which are highly liquid and easily marketable securities, to its total assets. Liquidity regulations may impact the composition of a bank's assets. Higher liquidity requirements might lead to an increase in Level 1 assets, influencing this ratio positively. Total capital has been included as a variable because it represents the sum of a bank's Tier 1 and Tier 2 capital. It also serves as a measure of the overall financial health and capacity of a bank to absorb losses. Moreover, capital regulations aim to ensure that banks maintain an adequate level of capital. Therefore, monitoring total capital is essential in assessing a bank's ability to make profits while absorbing losses as it adheres to these regulatory requirements. Tier 1 capital ratio is rather more targeted in its aim as it represents the proportion of a bank's Tier 1 capital to its risk-weighted assets. In other words, it measures the core equity capital adequacy of a bank. Because capital regulations often specify a minimum Tier 1 capital ratio, its inclusion in this study helps us gauge the extent to which a bank's compliance with regulatory capital requirements impacts its profitability. Similar to the Tier 1 capital ratio, the Tier 2 capital ratio assesses the proportion of a bank's Tier 2 capital to its risk-weighted assets. As the Tier 2 capital is supplementary to Tier 1 capital and can absorb losses in situations where Tier 1 capital is insufficient, its inclusion in the study is relevant to painting a clearer picture of the impact capital requirements have on banks.

Gross loans to total deposits ratio is a variable included in the study for its ability to indicate the level of loans a bank has issued in relation to its total deposits, thereby providing insight into the bank's lending and deposit-taking activities which are of course influenced by the forms of regulation being studied. The rationale is that liquidity regulations influence a bank's lending and deposit strategies. Changes in this ratio could indicate how banks are adjusting their activities in response to liquidity requirements. The variable is relevant because a significant proportion of a bank's revenue comes from its lending activities. The annual common Equity growth variable on the other hand measures the annual percentage change in a bank's common equity over a specific period, usually a year. Given that capital regulations aim to enhance the quality and quantity of a bank's capital, monitoring common equity growth provides insights into how well a bank is adapting to capital requirements.

Loan loss provisions to total loan ratio is a variable included for its ability to measure the proportion of a bank's loan loss provisions to its total loans outstanding. It reflects the bank's assessment of potential credit losses. Regulators often require banks to maintain adequate provisions for potential loan losses. This ratio also provides insight into a bank's risk management practices. Similarly, literature such as Barth, et al. (2013) include loan loss provisions as a variable in their study to capture the risk and potential costs in making loan decisions. They further argue its importance in the study of bank profitability and efficiency (Drake, Hall and Simper, 2006).

Regulatory compliance by banks requires increasing the skilled and qualified personnel which come at additional cost to banks. To help assess this, the study have included the staff cost to income ratio to assess the efficiency of a bank by measuring the proportion of staff costs to total income. The study believe that this will help capture the increased cost of personnel associated with regulatory changes over the years. Moreover, regulatory pressures, especially those related to liquidity and capital adequacy, may influence the cost structures of banks. A higher ratio may indicate challenges in maintaining profitability while adhering to regulatory requirements. The relevance of this variable can be seen further highlighted in the annual cost of compliance report produced by Thomson Reuters (2023). This report identified the availability of skilled resources, retaining skilled resources, volume and implementation of regulatory change, and balancing associated cost pressures as part of the top five challenges of compliance for both individuals and boards of financial institutions.

Each of these variables is essential for understanding different facets of a bank's performance and compliance with liquidity and capital regulations. Studying these variables over the period considered in this study can provide valuable insights into how the regulatory landscape affects the financial health of banks. It is important to note that these variables have been used slightly differently in recent banking regulation literature. For instance, Ahamed et al. (2021) accounted for liquidity risk, capital risk, and loan portfolio risk by using total loans to deposits (LIQ), the ratio of shareholder's equity to total assets (EQA), and the ratio of loan loss provision to total loans (LLP) respectively.

Table 3. 3 Variable Summary and Panel Data Sources

Variables	Description	Measure	Source	Expected Impact on Profitability
Profitability Variables				
ROA	Return On Assets	Net income/Average total assets (%)	Capital IQ Pro	
ROE	Return On Equity	Net income/Average total equity (%)	Capital IQ Pro	
NIM	Net Interest Margin	Net interest income/Average earning assets (%)	Capital IQ Pro	
Variables Influenced by Capital and Liquidity regulation				
HQLAs	Level 1 Assets to Total Assets	(cash +Central bank reserves + certain marketable securities backed by sovereigns and central banks) / Total assets	Capital IQ Pro	-
Capital	Total Capital	Tier 1 capital + Tier 2 Capital	Capital IQ Pro	-
Tier1	Tier 1 Capital	(Core capital / Risk-weighted assets) * 100	Capital IQ Pro	-
Tier2	Tier 2 Capital Ratio	Tier 2 capital / Risk-weighted assets	Capital IQ Pro	-
Loans	Gross Loans to Total Deposits ratio	Gross Loans / Total Deposits * 100	Capital IQ Pro	+
Equity Growth	Annual Common Equity Growth	(Common equity (Year n) - Common equity (Year n-1)) / Common equity (Year n-1)	Capital IQ Pro	-
LLP	loan loss provisions to total loan	Loan loss provisions / Total loan * 100	Capital IQ Pro	-
Staff	Staff Cost to Income ratio	Staff cost / Income	Capital IQ Pro	-
Control Variables				
Inflation	UK -Inflation	Consumer Price Index (CPI) inflation data from the Office for National Statistics	BoE/ ONS	
Interest	Bank of England Base Rate	Set by the Monetary Policy Committee (MPC)	BoE	
GDP	UK GDP Growth Rate	(GDP (Year n) - GDP (Year n-1)) / GDP (Year n-1)	World Bank Database	

d. Macroeconomic Control Variables

There are numerous examples of the use of macroeconomic variables in banking regulation literature. These include Demirgüç-Kunt and Huizinga (1999); Barth, et al. (2003, 2013); Bonner and Eijffinger (2016); Ananou, et al. (2021); and Veeramoothoo and Hammoudeh (2022) among others. To control for the overall macroeconomic environment in which banks operate in different countries, Demirgüç-Kunt and Huizinga (1999); and Barth, et al. (2003, 2013) included the following three macroeconomic control variables real GDP per capita (GNPP); the growth rate of real GDP per capita (GRO); and the percentage change in the GDP deflator (INF). Whereas, Bonner and Eijffinger (2016); Ananou, et al. (2021); and Veeramoothoo and Hammoudeh (2022) ensure their results are robust by adding more macroeconomic variables namely Year-to-year growth rate of real GDP, inflation and the European Central Bank (ECB) interest rate.

This study found it essential to include macroeconomic variables as control variables in observed relationships between main variables associated with bank profitability (dependent variables) and the selected bank-specific variables (independent variables). The main purpose of this was to ensure that the observed relationships are not confounded by these macroeconomic external factors. The macroeconomic variables included in this study are discussed in subsequent paragraphs below. The study first included the UK rate of inflation as a macroeconomic variable. Inflation tends to have a significant impact on a bank's operations as it is known to affect the real value of money, interest rates, and the overall economic environment. The rate of inflation in a country may also influence interest income, loan demand, and the purchasing power of consumers and businesses, all of which can, in turn, impact a bank's profitability. Including UK inflation as a control variable, allows us to account for its potential effects on the dependent variables and hence isolate the impact of liquidity and capital regulations more accurately.

This study also includes the Bank of England's base rate as a second control variable. The bank base rates are a critical factor influencing the cost of funds and interest income for banks. This is due to the significant influence it has on the interest rates at which banks borrow and lend money. Changes in the base rate may affect a bank's profitability, particularly when considering Net Interest Margin as a measure, as well as the lending decisions of the bank. The inclusion of the base rate as a control variable allows for the differentiation between the effects of regulatory changes and those stemming from monetary policy decisions. This study included the UK GDP growth rate as the final control variable. This variable is included to help account for the general economic growth of the UK as a fundamental factor influencing the banking industry. Banks are highly dependent on the economic health of the country in which they operate.

The existing economic conditions of a country may affect loan demand, credit quality, and the overall business activities of banks operating within that country. Broadly speaking, a growing economy generally leads to increased business activities, lending opportunities, and higher profitability for banks. Therefore, including UK GDP growth as a control variable helps capture the broader economic context in which banks operate. This allows for a distinction between the impact of liquidity and capital regulations on bank profitability, from the impact of general economic conditions prevailing in the UK.

Including these control variables in this study aims to strengthen the robustness of the study's results by considering external factors that could influence the variables that may explain how bank profits are affected by regulation. Therefore, controlling for these factors allows us to more accurately isolate and attribute changes in the study's selected bank-specific variables to liquidity and capital regulations.

3.9 Model Estimation

This section delves into the empirical estimation strategies employed to investigate the impact of banking regulations on bank efficiency, market value, and profitability. Recognizing the ongoing debate around efficiency score estimation biases, this study combines non-parametric Data Envelopment Analysis (DEA) with parametric panel regressions to provide a robust analysis. The research acknowledges potential influences on results, such as Minimum Efficient Scale (MES) and external factors and employs the Malmquist index to account for efficiency changes over time. In examining the relationship between regulations and bank market value, this study utilizes an event study methodology with the market model. Cumulative Average Abnormal Returns (CAAR) are used to assess the overall impact of regulatory events, and the Wilcoxon signed-rank test is applied to determine the statistical significance of results. Additionally, the research investigates the link between banking regulations and profitability by employing fixed and random effects models. The Hausman test is used to select the most appropriate model, while Breusch-Pagan tests check for random effects and heteroskedasticity.

The remainder of this section is divided into three subsections. Subsection 3.9.1 details the DEA models and panel regression analysis used to examine bank efficiency. Subsection 3.9.2 outlines the event study market model and statistical tests employed to assess the impact on bank market value. Finally, subsection 3.9.3 presents the fixed and random effects models and statistical tests used to investigate the relationship between bank regulation and profitability.

3.9.1 Banking Regulations and Bank Efficiency

The assessment of efficiency in banking has been considered widely in the literature, utilising both non-parametric and parametric techniques (Hall, 2001). Yet there still remains a debate over whether the estimated efficiency scores are biased, not only due to the techniques utilised to estimate them, but also due to other endogenous and exogenous factors that may be affecting the bank sample. To further highlight the flaws in technique in estimating efficiency, McAllister and McManus (1993) argued that the Minimum Efficient Scale (MES) for banks can change as the total asset size of the banks in the sample increases or decrease over time, due to possible differences in the asset portfolios between the smaller and larger banks. Additionally, it has long been recognised that external factors can have a significant impact on relative efficiency scores (Drake, Hall and Simper, 2006).

In light of this, this sub section looks at the specific models applied under the implemented nonparametric DEA and DEA based Malmquist index in examining the effect of banking regulation on bank efficiency. These models are stated in a manner that mitigates the flaws previously identified. This section also looks at the specific fixed and random effects panel regression models applied in the second stage of the analysis.

a. DEA Models

A prominent strength of the DEA lies in its capability to relatively evaluate the individual efficiency or performance of a Decision-Making Unit (DMU) within a target group of interest that operates in a certain application domain such as the banking industry (Liu, et al. 2013). Golany and Roll (1989) cite the identification of sources of inefficiency, the ranking of DMUs, evaluating the effectiveness of policies, and the creation of a quantitative basis for reallocation of resources as some of the key reasons for applying DEA in the banking industry. Another advantage of applying the DEA approach relative to a parametric technique, such as stochastic frontier analysis is the absence of the problem of functional form dependency (Drake, Hall and Simper, 2006). Unlike the stochastic frontier analysis, DEA does not assume a particular functional form which characterises the relevant economic production function, cost function, or distance function. As a result, efficiency scores estimated with DEA are not partially dependent on how accurately the chosen functional form represents the true production relationship (Drake and Simper, 2003; and Ferrier and Lovell, 1990).

There are two standard DEA models namely, CCR (Charnes, Cooper, and Rhodes) and BCC (Banker, Charnes, and Cooper) models (Charnes, Cooper and Rhodes. 1978; and Banker, Chames and Cooper, 1984). The CCR DEA model is a model of constant returns to scale. The BCC DEA model is a model of variable returns of scale. The CCR model is a radial model in which efficiency scores are derived from the extent to which all inputs can be reduced and/or outputs increased, where this reduction or increase occurs proportionately. In other words, this assumes that the production technology, also called the production possibility set, exhibited constant returns to scale (CRS). This model is given in both input and output-orientations. The orientation corresponds to the viewpoint taken in improving the inefficient units, whether the goal would be to reduce excess inputs consumed or expand shortfalls in outputs produced, respectively, to make the inefficient DMUs efficient (Paradi, Sherman, and Tam 2018). This model is unsuitable for this study due to an inability of the UK banking industry to conform to the assumptions of the model.

The BCC on the other hand is better suited and applied in this study. The resulting efficiency from this model is always at least equal to the one given by the CCR model, and those DMUs with the lowest input or highest output levels are rated efficient. Unlike the CCR model, the BCC model allows for variable returns to scale, which is also applied in this model (Banker, Chames and Cooper, 1984). This models ability to add a convexity constraint that ensures that the composite unit used to measure efficiency is of similar scale size as the unit being evaluated. The BCC model is therefore suitable for situations where the production technology exhibits increasing, decreasing, or constant returns to scale.

The measure of bank efficiency in this aspect of the study is therefore obtained using DEA with a model that is primarily based on the financial intermediation approach. Originally developed by Sealey and Lindley (1977), this approach posits that total loans and securities are outputs, whereas deposits along with labour and physical capital are inputs. This approach to modelling financial intermediation has been widely adopted and used in the literature such as Drake and Weyman-Jones (1996), Bauer et al. (1998), Tortosa-Ausina (2002), Drake and Hall (2003); and Maudos and Pastor (2003).

In line with the following applications of the approach Casu et al., (2004); Drake et al., (2006); Barth, et al (2013); and Sharma and Sharma, (2015) the study construct an intermediation model that has six inputs and two outputs to obtain bank efficiency scores of sampled UK banks. The study also obtain efficiency scores for US banks and compare both sets of scores solely on the basis of their estimated efficiency score.

The chosen BCC DEA model for a study could either be input and output oriented. An input-oriented BCC model aims to minimise the input consumption for a given level of output. In other words, it focuses on how much a DMU can reduce its inputs without affecting its outputs. On the other hand, output orientation maximises the output production for a given level of input. The choice of orientation depends on the objective and the control of the DMU's examined (Paradi, Sherman, and Tam 2018). In this study where the study's DMUs are sampled retail banks, it is evident that they have more control over their inputs than their outputs. For instance, banks have better control over their wages and salary cost, total capital, and HQLA compared to the revenues. This coupled with the aim of the study to examine the primary impact of liquidity and capital specific regulation on the inputs of banks indicate that an input-oriented BCC DEA model is better suited for this aspect of the study.

This study applies the Ji and Lee, (2010) user written DEA command in STATA. The command is used to apply the study's BCC DEA model. The syntax of this DEA command is given as follows.

dea ivars = ovars [if] [in] [using/filename], [rts (string) ort (string) stage (#) trace saving(filename)] --- STATA Command 1

Where:
dea: is the Ji and Lee, (2010) is the DEA command prompt in STATA
$ivars$: List of input variables
$ovars$: List of output variables
$rts\ (string)$: Specifies the returns to scale. The default is rts (crs), specifies constant returns to scale. rts (vrs), rts(drs), and rts(nirs) mean the variable returns to scale, decreasing returns to scale and the nonincreasing returns to scale, respectively.
$ort(string)$: Specifies the orientation. The default is ort (i) or ort (in), meaning the input oriented DEA. Ort (o) or ort (out) means the output oriented DEA.

$stage$ $(\#)$: Specifies the way to identify all efficiency slacks. The default is stage (2), meaning the two-stage DEA. Stage (1) means the single-stage DEA.
$Trace$: Allows all the sequences to be display in the result window and also saved in the "dea.log" file. The default is to save the final results in the "dea.log" file.
$saving(filename)$: Specifies that the results be saved in filename.dta.

After incorporating the study's chosen model as well as all input and output variables, the DEA command executed in STATA is presented as follows. This is done to estimate and compare the efficiency scores of the sampled UK and US banks.

dea WS TC TD HQLA LLP RWA = TL OIR, RTS (VRS) ORT (IN) STAGE (2) ------------ STATA Command 2

Where everything else is as defined under the stated STATA command (1), except for the following:

WS TC TD HQLA LLP RWA: are the input variables previously defined in Section 3.3.1.e, namely wages and salaries; total capital; total deposits; High Quality Liquid Assets; Loan Loss Provision; and Risk Weighted Assets respectively.
TL OIR: are the output variables previously defined in Section 3.3.1.e, namely Total Loans; and Operating Income/Revenue respectively.

To account for the effect of time on the estimated efficiency scores, the study proceed to apply the DEA based Malmquist index (malmq) described in section … by executing the Lee et al., (2011) user contributed command in STATA. The syntax of this user contributed malmq command is given as follows.

malmq ivars = ovars [if] [in] [using/filename], [ort (string) period (string) trace saving(filename)] -- STATA Command 3

Where:

malmq: is the Lee et. al., (2011) Malmquist index command prompt.
ivars: List of input variables

ovars: List of output variables
Ort (string): specifies the orientation. This could be either ort (i) or ort (in), meaning the input oriented MI. ort (o) or ort (out) means the output oriented MI
Period: identifies the time variable.

The version of "STATA Command 3" that is executed in STATA to estimate the Malmquist index efficiency scores is presented as follows.

malmq WS TC TD HQLA LLP RWA = TL OIR, ort (in) period (Year) ------------ STATA Command 4

Where everything else is same as defined in "STATA Command 2" and "STATA Command 3".

The BCC model is therefore suitable for situations where the production technology exhibits increasing, decreasing, or constant returns to scale. Given the diversity in size and business models among the sampled UK banks, the assumption of variable returns to scale is more realistic. In this study, where the study's DMUs are sampled retail banks, it is evident that they have more control over their inputs than their outputs. For instance, banks have better control over their wages and salary cost, total capital, and HQLA compared to their revenues. This, coupled with the study's aim to examine the primary impact of liquidity and capital-specific regulation on the inputs of banks, indicates that an input-oriented BCC DEA model is better suited for this aspect of the study.

b. Panel Regression Analysis

Banker and Natarajan (2008); and Barth et al., (2013) show that a two-stage DEA based approach comprising a DEA model followed by further empirical analysis such as a panel regression analysis enhances estimation of the impact of the contextual variables on the efficiency scores. Since operational efficiency score for a bank has only been estimated as the fraction of actual inputs, a second stage fixed and random effects panel regression allows the study to examine the relationship between bank regulation and bank efficiency (Beck et al., 2006. Simar and Wilson, 2007; Barth et al., 2013).

The study extend equation (2) and (3) to reflect the variables used in this study to assess the impact of liquidity and capital regulation on bank efficiency. The bank efficiency incorporated in this model is the estimated DEA based Malmquist index (malmq) efficiency scores. The fixed effect regression model used in the study is as follows:

$$y_{it} = a_i + \beta \mathrm{WS}_{it} + \beta \mathrm{TC}_{it} + \beta \mathrm{TD}_{it} + \beta \mathrm{HQLA}_{it} + \beta \mathrm{LLP}_{it} + \beta \mathrm{RWA}_{it} + \beta \mathrm{LLP}_{it} + \beta \mathrm{TL}_{it} + \beta \mathrm{OIR}_{it} + \beta \mathrm{Inflation}_{it} + \beta Interest + \beta \mathrm{GDP}_{it} + \delta_t + u_i + \varepsilon_{it} \text{ ---------------------} \quad (3)$$

Similar to the fixed effects model the random effects model is presented as follows:

$$y_{it} = \alpha + \beta \mathrm{WS}_{it} + \beta \mathrm{TC}_{it} + \beta \mathrm{TD}_{it} + \beta \mathrm{HQLA}_{it} + \beta \mathrm{LLP}_{it} + \beta \mathrm{RWA}_{it} + \beta \mathrm{LLP}_{it} + \beta \mathrm{TL}_{it} + \beta \mathrm{OIR}_{it} + \beta \mathrm{Inflation}_{it} + \beta Interest + \beta \mathrm{GDP}_{it} + u_i + \varepsilon_{it} \text{ -------------------------} \quad (4)$$

Where the description of all components remain the same as in equation (2) and (3) except y_{it} and the independent variables. y_{it} is the efficiency score i at time t. The description of the independent variables is given in Section 3.8.1.e (and Table 3.1) above.

3.9.2 Banking Regulations and Bank Market Value

This section presents the main model applied under the ESM in assessing the impact of regulatory reforms on the market value of the sampled banks. This underscores the empirical importance of model estimation by highlighting the several key steps and considerations involved in applying the market model in this event study. The application of this model in this aspect of the study allows for the study to control for market movements, conduct precise measurements and ensure statistical rigor of the finding through significance testing. This model adjusts for the UK stock market wide movements, in order to isolate the specific impact of the two main examined regulatory events on the stock returns of banks. This control is essential in attributing observed changes to the regulation rather than general market trends. Furthermore, in estimating the normal return relationship using historical data, the market model allows for precise measurement of abnormal returns. This quantification is critical for understanding the extent of the impact of the said regulatory events. Rigorous evidence on whether the regulatory events had significant impacts on stock prices is obtained through the statistical tests on cumulative abnormal returns permitted by the model.

The remainder of this section is divided into the following subsections. Sub section 3.9.2.a presents and discusses the basic for the market model. Sub section 3.9.2.b outlines the use of the market model ibn measuring the Cumulative Average Abnormal Return (CAAR) of the sampled banks following the examined events. Sub section 3.9.2.c presents the Wilcoxon signed-rank test (1945) as the statistical test used to assess the significance of the impact of the regulatory events on the abnormal returns of the sampled banks.

a. Event Study: Market Model

There are a number of approaches available to a researcher conducting an event study. These approaches are generally either grouped as statistical or economic models. The models under the statistical approach rely on statistical assumptions of asset returns and do not draw upon economic arguments–whereas the reverse is true for models under the economic approach (MacKinlay, 1997). This aspect of the study applies the market model in the examination of the impact of regulatory events on the returns of the sampled banks. The market model of the ESM is a statistical model which relates the return of any given security to the return of the market portfolio. The model achieves this by presenting a linear specification which depends on the joint normality of asset returns. The basic form of the market model is given by MacKinlay, (1997) in equation (5).

$$R_{it} = a_i + \beta_i R_{mt} + \varepsilon_{it} \quad \text{--} \ (5)$$

$$\mathrm{E}\ (\varepsilon_{it} = 0) \qquad\qquad var\ (\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

Where R_{it} and R_{mt} are the returns on security i and the market portfolio at time period t, ε_{it} is the zero mean disturbance term, with α_i, β_i and $\sigma^2_{\varepsilon_i}$ being the parameters of the market model. In applications of this model a broad stock market index such as S&P 500 Index, or the FTSE 100 index is used as the market portfolio. The FTSE 100 index is used in this study. The market model is improvement over the initial constant mean return model because it takes away a portion of the aspect of return that is related to variations in the return of the market, thereby reducing the variation of the estimated abnormal return (Sharpe, 1964; and MacKinlay, 1997). This then suggests an increased ability to capture the effects of an event on the returns of a security over a given time.

Statistical Models may also be either classed as single or multi factor model. As they are typically portfolios of traded securities, factor models are driven by the advantage of reduced variations in the abnormal returns by having a greater proportion of variations explained in the normal return estimation. There are generally single factor model and multifactor models. Multifactor models tend to include industry indexes in addition to the market indexes in the estimation of abnormal returns. However, Sharpe, Alexander and Bailey (1999) highlight that the benefits of employing multifactor models tend to be limited. This is due to the observation that only a small marginal explanatory power is obtained from the addition of that additional industry index, hence little reduction is observed in the variance of the abnormal return. The market model is an example of a single factor model also known as a Single Index Model (SIM).

Additionally, markets may partially anticipate the event before its announcement, resulting in abnormal returns being diluted or spread out over a longer period. In addition to adjusting the event window, the study examined pre-event trading patterns, specifically looking for unusual trading volumes or price movements that might suggest information leakage. While no definitive evidence of leakage was found, the possibility of some anticipation cannot be entirely ruled out, and this is acknowledged as a potential limitation of the study.

b. Measuring the Cumulative Average Abnormal Return (CAAR) with the Market Model.

The application of the ESM in finance typically requires the estimation of the abnormal return of a sampled set of stocks following the occurrence of an event. This aspect of the study applies the market model developing framework measuring and analysing abnormal returns of the sampled banks, following the two major events defined in Section 3.8.2.b. All things being equal, the Ordinary Least Squares (OLS) is a consistent estimation procedure for the market model parameters estimated over the estimation window and applied in estimating the Abnormal Return (AR). MacKinlay, (1997) presents the equation for the estimation of these paremeter as follows.

$$\hat{\beta} = \frac{\sum_{t=T_0+1}^{T_1}(R_{it} - \widehat{\mu_i})(R_{mt} - \widehat{\mu_m})}{\sum_{t=T_0+1}^{T_1}(R_{mt} - \widehat{\mu_m})^2} \text{ ---------------------------- } (6)$$

$$\hat{\alpha} = \widehat{\mu_i} - \widehat{\beta_i}\widehat{\mu_m} \text{ -- } (7)$$

Where all else remains the same as in equation (5) except for T_1 and $t = T_0 + 1$ which constitutes the estimation windows. As seen in literature such as Brown and Warner (1985);

MacKinlay (1997); and Kolari and Pynnonen (2011) events are unexpected and are bound to ARs over then period of the event. The ESM allows for these ARs to be measured in order to arrive at a concussion as to whether a given event influenced firms' securities' market value. Further applying the market model described by MacKinlay (1997), the study present an equation proposed by Pacicco, Vena and Venegoni (2018) for estimating AR of a given firm.

$$AR_{it} = R_{it} - E(R_{it}|X_t) \text{--------------------------- (8)}$$

Where $R_{i,t}$ is the actual return following the event and $E(R_{it}|X_t)$ is the expected return conditioned to the information X for the period t, unrelated to the event. The estimation of AR is further rewritten by Pacicco, Vena and Venegoni (2018) as single index model (SIM) orientation of the market model as.

$$AR_{i,t} = R_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \text{--------------------------- (8)}$$

Where else remains the same except for $E(R_{it}|X_t) = \hat{\alpha}_i + \hat{\beta}_i R_{m,t}$. These equations thus far highlight the relative ease with which the ARs can be estimated once the normal returns are computed, if the aim is to ascertain impact of an event for each single security on a single day event. However, this study focuses on assessing the impact of multiple sub events over a multiday period and as such highlights the need to apply a time-series aggregation of the AR's by obtaining Cumulative Average Abnormal Returns (CAAR). The CAAR allows this study focus on the average effect of the examined events over multiple days and is obtained by summing Average Abnormal Returns (AAR) over time as suggested by Pacicco, Vena and Venegoni (2018) and shown in equation (9) below.

$$CAAR(t_1 t_2) = \sum_{i=t_1}^{t_2} AAR_t \text{------------------------ (9)}$$

The $estudy$ user contributed command by Pacicco, Vena and Venegoni (2018) is applied in STATA for the estimation of the CAAR needed to assess the impact of regulatory changes on sampled UK banks. The $estudy$ command performs the event study in STATA by computing the ARs and properly running the chosen diagnostic to determine their statistical significance. Unlike other commands, the $estudy$ is able to use daily stock prices instead of calculated returns, although returns are preferred. The $estudy$ command provides CAAR and statistical hypothesis testing results (significance levels) by event firms. The command also allows for graphical display of cumulative average abnormal returns Kaspereit, (2021). The syntax for the $estudy$ as presented by Pacicco, Vena and Venegoni (2018)

$$estudy\ varlist1\ [(varlist\ 2) \ldots\ (varlist\ N)], datevar(varname) evdate(date) dateformat(string)$$
$$lb1(\#)\ ub1(\#) [lb2(\#)\ ub2(\#)\ \ldots\ lb6(\#)\ ub6(\#) eswlbound(\#)\ eswubound(\#)\ modtype(string)$$
$$indexlist(varlist)\ diagnosticstat(string) sdecimal(\#)\ showpvalues$$

Where:

$datevar(varname)$ specifies the date variable in the dataset.

$evdate(date)$ specifies the date of the event.

$dateformat\ (string)$ specifies the date format of the event date (evdate()).

$lb1(\#), ub1(\#), lb2(\#), ub2(\#), \ldots, lb6(\#), and\ ub6(\#)$ specify up to six event windows around the event date (lb1() and ub1()are required). lb and ub represent the lower and upper bounds respectively.

$eswlbound(\#)$specifies the lower bound of the estimation window.

$eswubound(\#)$specifies the upper bound of the estimation window. By default, it corresponds to the 30th trading day prior to the event, thus avoiding an overlap between the estimation and the event windows.

$modtype(string)$ specifies which model must be used to compute the normal or abnormal returns. String may be one of the following: SIM (SIM), the default, requires to specify only one variable (factor) index list ().

$indexlist(varlist)$specifies the varlist useful to compute a normal or an abnormal component of securities' returns and is conditional to the modtype()option.

$diagnosticstat$ $(string)$specifies which test must be used to analyse whether ARs statistically differ from zero (parametric and nonparametric tests are available).

c. Statistical Tests: Wilcoxon Signed-Rank Test

Literature offers two broad types of statistical significance tests, namely parametric and non-parametric. The group of parametric tests largely assume a normal distribution of returns, whereas the latter is not anchored to any a priori assumption (Kolari and Pynnonen, 2011; Kothari and Warner 2007). However, these parametric tests generally suffer from the cross-sectional correlation of ARs that may heavily affect their outcome in the case of event-day clustering that verifies when a single event simultaneously affects all securities included in the analysis (Pacicco, Vena and Venegoni, 2018). Therefore, the parametric tests may generally underperform when securities' return distributions are not normal. This highlights the importance of applying non parametric tests such as Wilcoxon signed-rank test proposed by Wilcoxon (1945) and the generalized rank test proposed by Kolari and Pynnonen (2011). The Wilcoxon signed-rank test checks for the statistical significance of AARs by considering both the signs and the magnitude of ARs. Whereas the generalized rank test only tends to outperform both all other rank tests and the parametric ones without suffering either from the serial correlation of ARs or from the event-induced volatility.

This study finds the Wilcoxon signed-rank test proposed by Wilcoxon (1945) to be better suited for testing the statistical significance of the estimated AARs and applies it. This test is more effective compared to other simple sign test since it incorporates information about the scale of abnormal returns. This test is also robust to outliers and can handle non-normal distributions. The Wilcoxon Generalized Sign Test is particularly suitable when the study intends to mitigate against the likelihood that distributions of abnormal returns might be skewed or have outliers (Pancotto, ap Gwilym and Williams, 2020). This test is known to stand as a good middle ground between the basic Sign Test and Rank Tests as it offers more sophistication than the basic sign test by utilizing return magnitudes yet remains robust to distributional assumptions compared to rank-based tests. The null and alternate hypothesis of this test are presented as follows.

Null Hypothesis (H_0): The median of the differences in abnormal returns is zero (the event has no effect on stock prices).

Alternative Hypothesis (H_1): The median of the differences in abnormal returns is not zero (the event affects stock prices).

The Wilcoxon signed-rank test helps to determine if there is a statistically significant change in stock returns due to the event, without assuming normality of returns by rejecting or accepting the null hypothesis. This makes it a robust tool for event studies such as this study, especially given the use of financial data from a relatively small sample size that may not meet all parametric test assumptions. This test is executed in STATA by including "Wilcoxon" option as part of the $estudy$ command in STATA. This command assesses the significance of the CAARs and provides results with p-values shown in parentheses, allowing for the determination the statistical significance of the each corresponding CAAR at a given confidence level. These confidence levels can either be at 1%, 5% or 10%.

3.9.3 Bank regulation and profitability

The empirical estimation presented in this section enables the quantification of the relationship between banking regulations, specifically liquidity and capital requirements, and bank profitability. This involves estimating the parameters of this aspect of the study's econometric model, which helps in understanding the magnitude and direction of the impact. There is a particular focus on whether stricter regulatory requirements–as captured by the carefully selected bank liquidity and capital variables–significantly impact profitability. The applied fixed and random effects models are particularly useful in panel data analysis as they address unobserved heterogeneity. Using these econometric models provide distinct insights through their findings. For instance, fixed effects model estimations output indicates how changes in regulation impact profitability within the same bank over time. Whereas, random effects output indicates the overall impact of regulations, assuming unobserved effects are random. Furthermore, fixed effects models control for time-invariant bank-specific characteristics, while random effects models are efficient if the random effect assumption holds. The Hausman test is subsequently used to guide the choice between these models, ensuring appropriate handling of unobserved heterogeneity and yielding reliable and interpretable results for policy evaluation and decision-making. The remainder of this section is divided into the following subsections. Sub section 3.9.3.a presents the applied fixed and random effects models. Sub section 3.9.3.b presents all the statistical tests executed to ensure robust results.

a. Fixed Effect and Random Effects Regression Model Estimation

In this section the study extend equation (2) to reflect the variables used in this study to assess the impact of liquidity and capital regulation on bank profitability. The fixed effect regression model used in the study is as follows:

$$y_{it} = a_i + \beta \text{HQLAs}_{it} + \beta \text{Capital}_{it} + \beta \text{Tier1}_{it} + \beta \text{Tier2}_{it} + \beta \text{Loans}_{it} + \beta \text{EquityGrowth}_{it} + \beta \text{LLP}_{it} + \beta \text{Staff}_{it} + \beta \text{Inflation}_{it} + \beta Interest + \beta \text{GDP}_{it} + \delta_t + u_i + \varepsilon_{it} \text{ ----------------------- (10)}$$

Where the description of all components remains the same as in equation (2) except y_{it} and the independent variables. y_{it} is the profitability of bank i at time t. The three measures of bank profitability presented in Section 3.3.3 namely ROA, ROE and NIM are tested in three consecutive models where each measure of profitability includes a different measure respectively. The description of the independent variables is given in Sections 3.3.3 (and Table 3.3) above.

Similarly, the study apply equation (3) to present the used random effects model as follows:

$$y_{it} = \beta \text{HQLAs}_{it} + \beta \text{Capital}_{it} + \beta \text{Tier1}_{it} + \beta \text{Tier2}_{it} + \beta \text{Loans}_{it} + \beta \text{EquityGrowth}_{it} + \beta \text{LLP}_{it} + \beta \text{Staff}_{it} + \beta \text{Inflation}_{it} + \beta Interest + \beta \text{GDP}_{it} + \alpha + u_i + \varepsilon_{it} \text{ ------------------------ (11)}$$

Where the description of all components remain the same as in equation (4) with the exception of y_{it} and the independent variables. y_{it} is the measure of profitability of bank i at time t. The three measures of bank profitability presented in Section 3.3.3 namely ROA, ROE and NIM are tested in three consecutive models where each measure of profitability includes a different measure respectively. The description of the independent variables is given in Sections 3.8.3 and 3.8.3 (and Table 3.3) above.

b. Statistical Tests

<u>Hausman Test</u>

This is a specification test conceived by Hausman (1978) and originally used to test for the orthogonality of the common effects and regressors. This test also tests whether the individual characteristics are correlated with the regressors (Greene, 2018). Under the null hypothesis of the test, the two estimates being tested must not systematically differ and if they do, other tests may be based on the difference. In essence, the Hausman test evaluates the significance of an estimator against an alternative estimator. This test allows for a model specification test in which one proposed estimator of a parameter is both consistent and efficient under the null hypothesis and inconsistent under the alternate hypothesis. Whereas, the second proposed estimator of the same parameter is consistent both under the null hypothesis and under the alternate hypotheses but inefficient under the null hypothesis.

H_0: The random effects model is the most appropriate model.

H_a: The fixed effects model is the most appropriate model.

This study employs the Hausman test to decide the most appropriate model to choose between fixed and random effects models. The decision rule for this test is to choose the random effects model if the null hypothesis holds true (if the p-value is not significant i.e. Prob > chi2 is > 0.05) and choose the fixed effects model if the alternate hypothesis (if the p-value is significant i.e. Prob > chi2 is < 0.05) is proven true. This test essentially, tests whether the unique errors are correlated with the regressors, accepting the null hypothesis means they are not (Baltagi, 2001). This test is performed using the Stata software statistical package.

Breusch Pagan test (Breusch Pagan Lagrange Multiplier)

The Lagrange Multiplier test for random effects was developed by Breusch and Pagan (1980). The Breusch Pagan method of testing for Random Effects is a significance test which is based on the residual value of the OLS method. The Lagrange Multiplier helps in deciding which model is better suited for a study when considering a random effects regression model and a simple OLS regression model. The null Lagrange Multiplier test states that the variances across entities are equal to zero. This implies no significant difference across units (i.e. the variance of the random effect is zero and there is no panel effect).

H_0: The random effects are not significant, and the use of the random effects model is not appropriate.

H_a: The random effects are significant, and the use of the random effects model is appropriate.

This test is performed using the STATA software statistical package. The output of this test is based on the distribution of Chi-Squares with a degree of freedom for the number of independent variables. Therefore, if the value of Lagrange Multiplier statistic is greater than the critical value of chi-squares then the study reject the null hypothesis (i.e. ‘Prob > chibar2’ or p-value > 0.05). This implies that the random effect method of estimation is a more precise estimation for the panel data regression model based on the data presented. On the other hand, if the value of the Lagrange Multiplier statistic is less than the critical value of chi-squares, the study accept the null hypothesis (i.e. ‘Prob > chibar2’ or p-value < 0.05). This implies that the random effect method of estimation is not appropriate for the panel data regression model based on the data provided (Greene, 2000).

Breusch Pagan test for Heteroscedasticity

The study subsequently used the Breusch-Pagan test to test for the presence of heteroscedasticity in the selected model following the Hausman test. The rationale behind this test is that if heteroskedasticity is present, then the variance of the error term should be related to the predictor variables in the model. Conducted using STATA, the test involves regressing the squared residuals of the original regression model on the predictor variables and testing the significance of the resulting coefficients. If the coefficients exhibit a significant difference from zero, it indicates the presence of heteroskedasticity (Baltagi, 2001).

H_o: There is constant variance among the residuals i.e. homoskedasticity is present.

H_a: There is evidence of unequal variance i.e. heteroskedasticity is present

In other words, if the p-value of the test is less than the significance level (for instance 0.05) then the study reject the null hypothesis and conclude that heteroscedasticity is present in the regression model. However, if this is greater than the significance level, then the study fail to reject the null hypothesis and conclude that Homoscedasticity is present, implying the residuals are distributed with unequal variance (Greene, 2018). This test is performed using the STATA software statistical package.

3.10 Chapter Summary

This chapter details the methodology used to examine the impact of bank regulation on banks in the UK. It is conducted within a positivist paradigm, utilizing a deductive research approach and a longitudinal design. The positivist paradigm assumes an objective reality that can be studied through empirical research, while the deductive approach involves testing hypotheses derived from existing theories. The longitudinal design allows for the examination of changes over time, specifically from 2000 to 2023. The study emphasizes reliability, validity, and the potential for generalization of findings, although it acknowledges limitations due to the specific context of UK banking regulations. The sample selection includes the top 4 UK banks based on market capitalization and total assets, ensuring relevance to both domestic and international banking contexts.

The chapter outlines the methods used to analyse the impact of banking regulation on bank efficiency, market value, and profitability. These methods include Data Envelopment Analysis (DEA), Event Study Methodology, and Fixed and Random Effects Panel Regression Analysis. The variables used in these analyses are carefully defined and sourced from reputable databases like Capital IQ Pro and Yahoo Finance. The chapter concludes by detailing the model estimation process, including the specific DEA models, ESM models, panel regression specifications, and statistical tests employed to ensure robust and reliable results.

Specifically, the study uses a two-stage DEA model to assess bank efficiency. The first stage employs a DEA-based Malmquist index to measure changes in efficiency over time, while the second stage uses fixed and random effects panel regression to identify the factors influencing efficiency. The study also employs an event study methodology to assess the impact of regulatory events on bank market value, using the market model to estimate abnormal returns and the Wilcoxon signed-rank test to determine statistical significance. Additionally, the study investigates the relationship between banking regulations and profitability using fixed and random effects models, with the Hausman test used to select the appropriate model and the Breusch-Pagan test used to check for heteroskedasticity.

Chapter 4: Findings

4.1 Chapter Introduction

This chapter delves into the intricate relationship between regulatory reforms and the performance of major UK retail banks. It examines how these reforms, particularly those concerning liquidity and capital adequacy, influence three key aspects of bank performance: efficiency, market value, and profitability. The analysis commences by grounding itself in the financial intermediation theory, recognizing the pivotal role banks play in converting deposits into loans and other profitable assets. This theoretical foundation informs the investigation into how regulatory changes, impacting key balance sheet items, shape the efficiency landscape of the UK's top four retail banks. To provide a comparative perspective, the study extends its scope to include their US counterparts, offering insights into potential divergences in efficiency trends across different regulatory environments.

A two-stage analytical approach is employed to dissect the complexities of this relationship. The first stage harnesses Data Envelopment Analysis (DEA) to quantify the efficiency with which banks transform inputs, such as labour and capital, into outputs like loans and revenue. Both the traditional Variable Returns to Scale (VRS) DEA model and the dynamic Malmquist Index are employed to capture both static and time-varying efficiency dynamics. The second stage utilizes panel regression analysis to pinpoint the specific input and output variables that exert the most significant influence on bank efficiency, thereby providing a granular understanding of the regulatory impact.

The chapter then shifts its focus to the impact of regulatory reforms on bank market value, employing an Event Study Methodology (ESM). This approach allows for the isolation and quantification of the effects of specific regulatory events, such as the enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023), on the stock returns of the sampled banks. By analysing the Cumulative Abnormal Returns (CAARs) around these events, the study discerns the market's perception of these regulatory changes and their implications for bank valuation.

Finally, the chapter probes the nexus between regulatory reforms and bank profitability. It employs a battery of profitability measures, including Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM), to capture the intricate nature of bank profitability. Panel regression models are then deployed to disentangle the effects of regulatory variables, such as capital adequacy and liquidity requirements, from other factors influencing bank profitability. This analysis sheds light on how regulatory reforms shape the profitability landscape of the UK banking sector. In sum, this chapter provides a comprehensive examination of the interplay between regulatory reforms and the performance of UK retail banks. By employing a robust methodological framework and drawing on both theoretical and empirical insights, it contributes to a deeper understanding of the far-reaching consequences of regulatory changes in the banking industry.

This chapter is structured as follows. Section 4.2 employs Data Envelopment Analysis and panel regressions to assess bank efficiency, comparing UK banks to their US counterparts and analysing the influence of regulatory changes. In Section 4.3, an Event Study Methodology is utilised to examine the market value effects of key regulatory events, capturing investor reactions to reforms. In Section 4.4, the chapter investigates the relationship between regulatory reforms and bank profitability, employing panel regressions to analyse the impact of capital and liquidity regulations on various profitability measures. The chapter concludes by synthesizing these findings, offering a comprehensive understanding of how regulatory reforms shape the landscape of UK retail banking.

4.1.1 Key Findings

In investigating the relationship between bank efficiency and regulatory reforms, it was observed that US banks are slightly more efficient than UK banks, but UK banks are more responsive to regulatory changes. This may suggest that UK regulations, while stringent, encourage adaptation and efficiency. The findings also revealed that global financial crisis significantly impacted bank efficiency in both countries, but UK banks recovered quickly. This highlights the resilience of the UK banking system. Capital regulation positively impacts efficiency, while liquidity regulation has a slightly negative effect. This indicates a potential trade-off between bank safety and efficiency. Additionally, increasing loan portfolios significantly improves bank efficiency. This suggests that regulations restricting lending activities might hinder efficiency.

An examination of the association between regulation and market value of banks revealed that regulatory events significantly impact bank stock prices. This aligns with the efficient market hypothesis, where markets quickly incorporate new information into valuations. The Banking Reform Act (2013) had a negative impact on bank stock prices, while the Financial Services and Markets Act (2023) had a positive impact. This shows how market sentiment is influenced by the perceived effects of specific regulations. The Banking Reform Act (2013) successfully reduced the inherent risk associated with bank shares. This may indicate the effectiveness of the Act in promoting financial stability.

The findings from the investigation of the impact of regulatory reforms on bank profitability revealed that liquidity regulation positively impacts bank profitability across all measures. This suggests that higher liquidity requirements can lead to increased profits. The impact of capital regulation is mixed. Increased total capital is positively associated with profitability, but stricter Tier 1 capital requirements have a negative impact. This highlights the need for a balanced approach to capital regulation. In essence, the study found that regulatory reforms have a significant and varied impact on UK retail banks. While these reforms generally aim to enhance financial stability, they can have varying effects on bank efficiency, market value, and profitability. These findings underscore the importance of carefully designed regulations that balance prudential concerns with the need to support a thriving and efficient banking sector.

4.2 The Impact of Liquidity and Capital Regulatory Reforms on the Efficiency of Retail Banks

This section draws heavily on the principles of financial intermediation originally introduced by Sealey and Lindley, (1977) discussed in Section 2.2.1 of this thesis. The fundamental concept of this theory maintains that after banks secure deposits from customers they transform them into loans and other income generating assets, primarily through the application of the required amount of labour as well as capital. In line with other studies such as Berger and Humphrey, (1997); and Dell'Atti, Pacelli, and Mazzarelli, (2015), the intermediation approach is believed to be most appropriate in the analysis of the efficiency of banks as they engage in this process. In this section however, the study examine the efficiency of the top four retail banks in the UK considered under this study as discussed in Section 3.7. The top four banks considered are Lloyds Banking Group, Barclays Bank Plc, NATWEST Plc, and HSBC Bank Plc. This study also found it compelling to present results which included a comparison of the efficiency scores of top 4 UK banks with the scores of their US counterparts. The US counterparts considered for this analysis are Bank of America, Citigroup, Wells Fargo and US Bancorp. The sample selection process for these banks is presented in Appendix A.4.9.

Drawing on this theory this section specifically investigates the impact of liquidity and capital regulatory reforms on the efficiency of banks. The study particularly focus on the financial statement items of banks that are most affected by liquidity and capital regulation. The relevant financial statement items (including Wages and salaries, Total Capital, Total Deposits, HQLA, Loan Loss Provisions, Risk-weighted assets, Total Loans, Revenue) are the variables used in the chosen methods of investigation. To appropriately investigate this phenomenon, the study employed a two stage data analysis approach using two main methods: the Data Envelopment Analysis (DEA) and panel regression methods. Under the Data Envelopment Analysis method, the study first categorise these affected bank balance sheet items (variables) into inputs and outputs variables, with inputs including Wages and Salaries, Total Capital, Total Deposits, HQLA, Loan Loss Provisions, and Risk-weighted assets; and outputs including Total Loans and Revenue. The study then test for how efficiently each bank is able to convert the inputs into outputs. These tests are conducted in STATA using the DEA command to estimate two distinct sets of efficiency scores for each bank. The study estimate the basic Variable Returns to Scales (VRS) DEA scores using the BCC DEA model (Banker, Charnes and Cooper, 1984). The study also goes a step further to estimate Malmquist Index to account for the effect of time on the efficiency of the banks studied.

The panel regression analysis is subsequently used in the second stage to determine the variables (input and output) with the most significant impact on the efficiency of banks. This is done by using the estimated DEA efficiency scores in the first stage as dependent variables. The study estimated both fixed and random effects after which the Hausman Test was used to test for and select the most appropriate effects model. This section is further divided into three sub sections as follows: the BCC DEA model VRS DEA scores are presented in Section 4.2.1, results from the Malmquist Index estimation are presented in Section 4.2.2, and the fixed panel regression analysis results are presented in Section 4.2.3. The last two sections of this chapter house the discussion and the conclusion respectively. The relevant hypothesis is addressed in Section 4.2.4.

4.2.1 Data Analysis Results: Stage 1a VRS DEA Results

The bank efficiency scores of the top UK banks considered in this study are summarized in Table 4.1. In the first row of this table houses the description of the data presented in the table. The first item the study present is the 'Period' which describes the 23-year period considered by this study which is from the year 2000 to 2023. The next 4 items in the first row are the

‘Decision Making Units (DMU’s)’ as discussed in section …. of this study. Finally, the ‘Average_UK_Banks_DEA_VRS_Scores’ describes the annual average bank efficiency scores of the top UK banks considered by the study as calculated using the Variable Returns to Scale (VRS) DEA approach. On the other hand, Table 4.2 contains similar results from top banks in the US used for comparative purposes by this study. Although both countries are similarly developed, banks in the US tend to have higher efficiency scores on an average, compared with their counterparts in the UK.

Table 4. 1 DEA Efficiency Scores for UK Banks

Period	DMU1	DMU2	DMU3	DMU4	Average_UK_Banks_DEA_VRS_Scores
2000	0.815	.	1.000	1.000	0.938
2001	0.912	0.952	1.000	1.000	0.966
2002	0.905	0.974	0.982	1.000	0.965
2003	0.928	1.000	1.000	1.000	0.982
2004	1.000	1.000	0.968	1.000	0.992
2005	0.923	1.000	1.000	1.000	0.981
2006	0.908	1.000	1.000	1.000	0.977
2007	1.000	1.000	0.934	0.830	0.941
2008	1.000	1.000	0.945	1.000	0.986
2009	1.000	1.000	1.000	0.836	0.959
2010	0.993	1.000	1.000	0.684	0.919
2011	0.899	1.000	1.000	0.495	0.849
2012	0.857	0.941	1.000	0.748	0.886
2013	0.976	1.000	1.000	0.745	0.930
2014	0.874	1.000	1.000	1.000	0.969
2015	0.931	1.000	1.000	1.000	0.983
2016	0.969	1.000	0.978	1.000	0.987
2017	1.000	0.872	1.000	1.000	0.968
2018	1.000	1.000	1.000	0.875	0.969
2019	0.974	1.000	1.000	0.911	0.971
2020	0.866	0.955	0.996	0.914	0.933
2021	0.816	0.933	1.000	1.000	0.937
2022	1.000	1.000	1.000	1.000	1.000
Mean					0.96
Standard Deviation					0.04

Note: missing value indicates infeasible problem.

For instance, the mean of the annual average DEA scores for UK banks was only 0.96 whereas that of their US counterparts was 1.00. This is reflected in the annual average efficiency scores of the banks operating in both countries. The annual average efficiency scores of US banks far exceeded the annual average efficiency scores of UK banks in 15 out of the 22 years studied.

The mean and standard deviations of the annual average efficiency scores of UK banks were 0.96 and 0.04 whereas that of the annual average efficiency scores of US banks were 1.00 and 0.15 respectively. This implies that although US banks recorded significantly higher levels of efficiency over the period, the higher levels of efficiency varied significantly from the mean. On the other hand, the relatively lower levels of efficiency recorded by the UK banks had little to no variation from their mean, indicating more consistent levels of efficiency among these banks over the studied period. The level of variation in the annual average efficiency scores is also evident in Figure 4.1.

It can be further seen from Table 4.1 that out of all 4 UK banks sampled for the 23 year period, DMU4 (NATWEST Plc.) had the lowest efficiency score of 0.495 in 2011. Conversely, as seen among their US counterparts in Table 4.2, DMU2 (Barclays Bank Plc.) recorded the lowest efficiency score of 0.771 in 2020. Whereas there were no efficiency scores greater than 1 recorded among all 4 UK banks for the period considered, 3 out of the 4 US banks sampled recorded super efficiency scores of above 1, with DMU1 (HSBC Bank Plc.) recording the highest super efficiency score of 3.518 in 2015. A DMU is said to be supper efficient for a particular period if it has a DEA score greater than 1.

Table 4. 2 DEA Efficiency Scores for US Banks

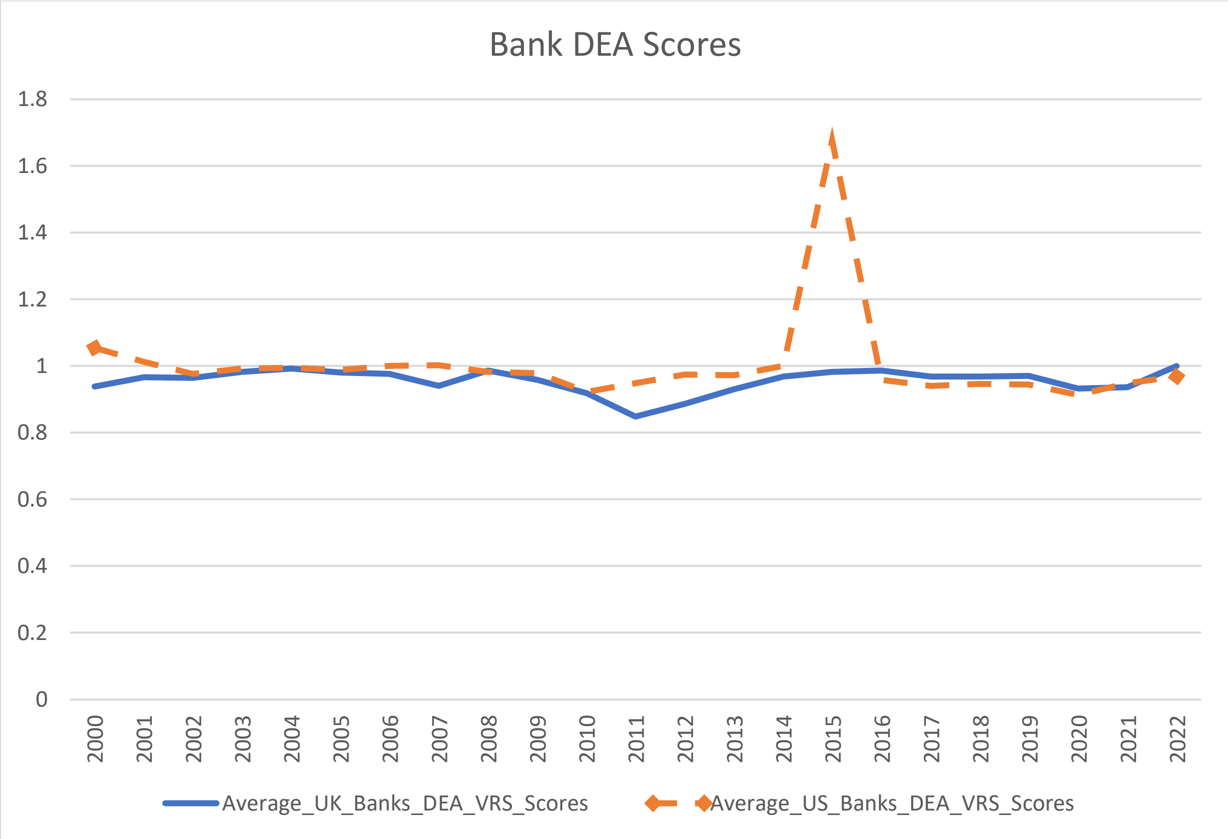
Period	DMU1	DMU2	DMU3	DMU4	Average_US_Banks_DEA_VRS_Scores
2000	1.000	1.221	1.000	1.000	1.055
2001	0.968	0.998	1.084	1.000	1.012
2002	0.925	1.000	0.982	1.000	0.977
2003	0.996	0.987	1.000	0.991	0.993
2004	0.980	1.000	1.000	1.000	0.995
2005	1.000	0.957	1.000	1.000	0.989
2006	1.000	1.000	1.000	1.000	1.000
2007	1.000	1.011	1.000	1.000	1.003
2008	1.000	0.970	0.958	1.000	0.982
2009	1.000	0.815	1.100	1.000	0.979
2010	0.948	0.793	1.000	0.953	0.923
2011	0.949	0.903	1.000	0.943	0.949
2012	0.983	0.915	1.000	1.000	0.974
2013	1.000	0.889	1.000	1.000	0.972
2014	1.000	.	1.000	1.000	1.000
2015	3.518	0.970	1.216	1.000	1.676
2016	0.966	0.892	1.000	0.978	0.959
2017	1.000	0.816	0.995	0.954	0.941
2018	1.000	0.845	1.000	0.938	0.946
2019	1.000	0.835	1.000	0.947	0.946

2020	0.962	0.771	1.004	0.916	0.913
2021	1.000	0.795	1.000	1.000	0.949
2022	1.000	0.974	0.984	0.919	0.969
Mean					1.00
Standard Deviation					0.15

Note: missing value indicates infeasible problem.

As alluded to in the paragraph above and depicted in Figure 4.1 below, the sampled US banks were relatively super-efficient compared to their UK counterparts. The plotted annual average efficiency scores in Figure 4.1 indicates that super efficiency was never attained by UK banks at any point during the period studied. However, the annual average efficiency scores of UK banks remained reasonably close to their mean score of 0.96 with a negligible standard deviation of 0.04. The lowest annual average efficiency score of 0.848 for UK banks was recorded in 2011 as can be seen from Figure 4.1. This can be attributed to the significantly low efficiency score of 0.495 recorded by DMU4 (NATWEST Plc.) in the same year. On the other hand, there is a sharp contrast in the observed annual average efficiency scores of US banks. Although a greater proportion of efficiency scores where slightly below the annual average efficiency mean score of 1.00 for US banks sampled, there were a few years where the annual score far exceeded the mean. For instance, the average efficiency score was 1.676 in 2015. This can be attributed to the highest super efficiency score of 3.518 recorded by DMU1 (HSBC Bank Plc.) in 2015.

Figure 4 1 UK and US DEA Efficiency Scores



4.2.2 Stage 1b: DEA Based Malmquist Index Results

The effects of time on the efficiency of banks are also considered by estimating the Malmquist Indices (MI) for the sampled banks operating in both countries. As detailed in section ….. the Malmquist Index accounts for the effect of time on the efficiency of DMUs by estimating the Total Factor Productivity Change (TFPCH) of those DMUs. In other words, Malmquist (i.e. Productivity Growth) Index measures the productivity changes along with time variations and can be decomposed into changes in efficiency and technology. Using the user contributed 'malmq' command STATA statistical package, Malmquist indices are calculated from DEA efficiency scores with the results presented in Table 4.3 and Table 4.4 for UK and US banks respectively.

Unlike the DEA efficiency scores that are estimated on a scale of 0 to 1 and interpreted accordingly, the interpretation of the Malmquist indices relies on its two main components. As detailed in Section 3.9.1 the two main components are TECCH (Technical Efficiency Change) and TECH (Technological Change). TECCH also referred to as the catch-up or recovery effect discloses the level of efficiency of a DMU relative to the DEA frontier, or the most optimal frontier. TECCH score of greater than 1 indicates improved efficiency whereas a score of less than 1 implies a decline in efficiency over the examined period. On the other hand, TECH gives a measure of a shift in the most optimal frontier itself to highlight advancements and declines in technology. For a given DMU, a TECH score of greater than 1 signifies technological advancements whereas a score less than 1 indicates technological deterioration (Casu, Girardone and Molyneux, 2004).

In this study however, focus is placed on the estimated Total Factor Productivity Change (TFPCH) also referred to in some literature as the Malmquist Indices (MI) to assess the effect of time on the efficiency of the sampled banks as was done in Cummins, Weiss and Zi, (1999); and Sharma and Sharma, (2015). If the TFPCH value is greater than 1 it implies productivity growth over time. A TFPCH value of less than 1 suggests deterioration in the productivity whereas a TFPCH value equal to 1 indicates the stagnation in productivity of DMUs. Most importantly, to determine whether TFPCH was as a result of changes in efficiency over a given period, the study compares its value to the values of TECCH and TECH. As detailed in equation (1.3) under Section 3.8.1, the STATA statistical package calculates TFPCH for a given period by multiplying both estimated TECCH and TECH for that period.

In essence if the efficiency change (TECCH) is greater than the technological change (TECH) in the components of TFPCH, the study attributes the improvements in productivity to increases in the efficiency of DMUs and conclude presence of the catching–up effect. On the other hand, a situation in which the technological change (TECH) is greater than the efficiency change (TECCH) component the study concludes that improvements in productivity is attributable to innovation/improvements in technology and the presence of innovation effect (Cummins, Weiss and Zi, 1999; Casu, Girardone and Molyneux, 2004; and Sharma and Sharma, 2015).

Table 4. 3 Malmquist Indices - UK Banks

Period	Average TECH	Average TECCH	Average TFPCH (TECH x TECCH)
2000~2001	1.000	0.990	0.990
2001~2002	1.000	0.974	0.974
2002~2003	1.000	1.072	1.072
2003~2004	1.000	0.989	0.989
2004~2005	1.000	0.888	0.888
2005~2006	1.000	0.979	0.979
2006~2007	1.000	0.854	0.854
2007~2008	1.000	0.871	0.871
2008~2009	1.000	0.958	0.958
2009~2010	1.000	0.963	0.963
2010~2011	0.988	0.863	0.854
2011~2012	1.012	1.111	1.127
2012~2013	1.000	1.140	1.140
2013~2014	1.000	1.234	1.234
2014~2015	1.000	1.032	1.032
2015~2016	1.000	0.845	0.845
2016~2017	1.000	1.207	1.207
2017~2018	1.000	0.804	0.804
2018~2019	1.000	0.986	0.986
2019~2020	1.000	0.628	0.629
2020~2021	1.000	1.335	1.335
2021~2022	1.000	1.125	1.125
Mean	1.000	0.993	0.993
Standard Deviation	0.004	0.160	0.161

As presented in Table 4.3 and 4.4, the results from the Malmquist Index estimation tell a similar story to the efficiency scores from this study's DEA analysis presented in Section 4.2.1 above. The respective means of the average annual MI (TFPCH) for the sample UK banks and US banks presented in Tables 4.3 and 4.4 indicate that US banks on an average were considerably more productive than their UK counterparts over the studied period. The MI mean for UK banks is 0.993 whilst that of the US banks is 1.05, as seen in Tables 4.3 and 4.4 respectively. The results also indicate that the greater productivity recorded by US banks over the period is attributable to a 5% increase in the Efficiency Change (TECCH) component of the TFPCH. This can be seen in Table 4.4 where the study observed a mean for the average annual TECCH of 1.05 against an average annual TECH mean of 1.

The decline in the productivity of the sampled UK banks over the same period reflected by the mean of the annual average TFPCH 0.993 can be attributed to a 0.7% decline in the Efficiency Change (TECCH) component. This is seen in Table 4.3. However, the variations in the efficiency component for the sampled UK banks are considerably lower than the variations seen in the efficiency component of their US counterparts. This implies that although the sampled UK banks were less efficient, their changes in technical efficiency year on year remained relatively more consistent than that of their US counterparts. This can also be seen illustrated in Figure 4.2. Furthermore, as presented in Tables 4.3 and 4.4 as well as Appendices 4.1 and 4.2, a significant 50% of the increases in productivity of the sampled US banks were as a result of improved efficiency (TECCH). Whereas only 36% of the increases in productivity from the sampled UK banks are a result of improved efficiency (TECCH). These results are thus far consistent with the results of the study's Data Envelopment Analysis presented in Section 4.2.1 above. These results highlight the fact that the sampled US banks are more efficient than their sampled UK counterparts.

Table 4. 4 Malmquist Indices - US Banks

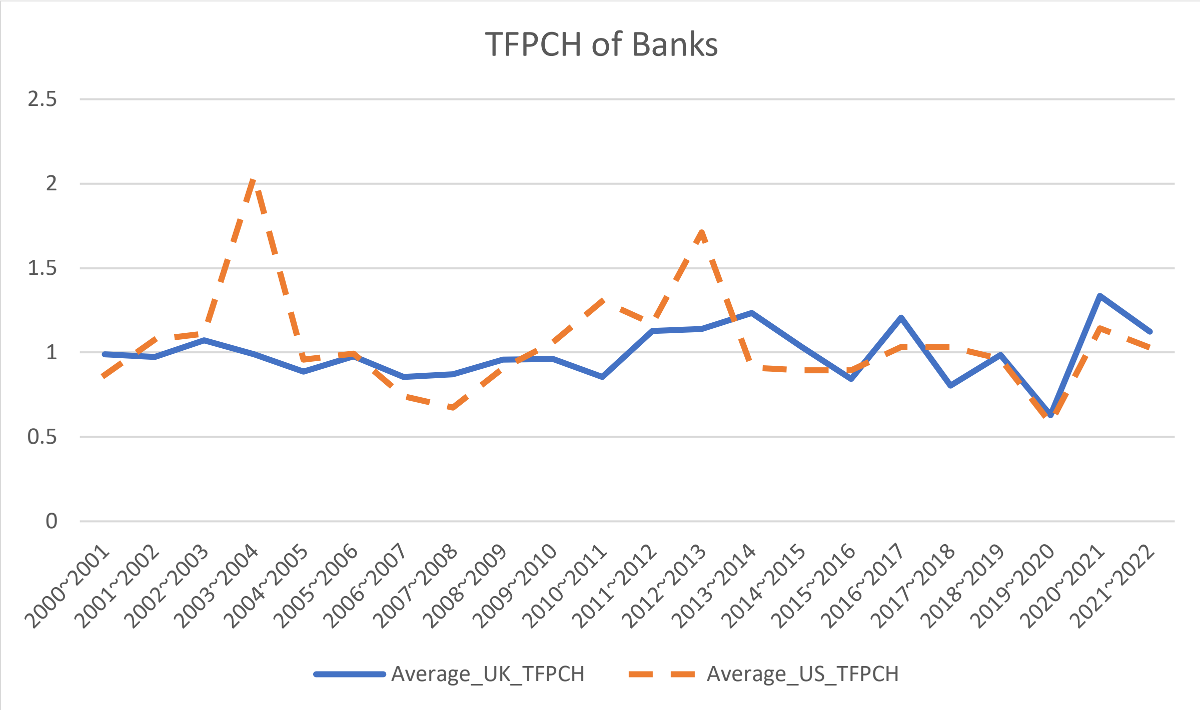
Period	Average TECH	Average TECCH	Average TFPCH (TECH x TECCH)
2000~2001	1	0.865	0.8652
2001~2002	1	1.078	1.0776
2002~2003	0.998	1.116	1.1134
2003~2004	1.002	2.041	2.0436
2004~2005	0.99	0.969	0.9565
2005~2006	1.01	0.981	0.9949
2006~2007	0.99	0.75	0.7397
2007~2008	0.964	0.694	0.6746
2008~2009	0.969	0.937	0.9054
2009~2010	1.069	0.989	1.0612
2010~2011	1.002	1.307	1.3066
2011~2012	0.999	1.169	1.1717
2012~2013	1.021	1.691	1.712
2013~2014	1	0.912	0.9118
2014~2015	1	0.895	0.895
2015~2016	1	0.893	0.8928
2016~2017	0.979	1.053	1.032
2017~2018	1	1.035	1.0341
2018~2019	0.997	0.963	0.9601
2019~2020	1.003	0.579	0.5819
2020~2021	1.021	1.055	1.144
2021~2022	1.001	1.023	1.0274
Mean	1.00	1.05	1.05
Standard Deviation	0.02	0.31	0.32

Note: missing value indicates infeasible problem.

The variations in the TFPCH of UK and US Banks sample are made more prominent in Figure 4.2. It can be observed from the figure that the productivity changes of sampled UK banks have seen relative minimal and more stable variations. The reverse can however be observed concerning the productivity changes of sampled US banks from the figure. It also important to note that neither of the sampled banks from either country are observed to have experienced a stagnation in productivity. On the contrary, the significant impact of the efficiency component of the TFPCH can be seen in Figure 4.2. These are particularly pronounced in years 2003-2004, 2012-2013, 2019-2020, and 2020-2021. It is observed that the sampled US banks recorded exceptionally high TFPCH of 2.04 and 1.71 in the years 2003-2004 and 2012-2013 respectively.

These were clearly influenced by the significant improvements in efficiency of 2.041 and 1.691 for both years respectively as seen in Table 4.4. Interesting is the significant decline in TFPCH for the year 2019-2020 among sampled banks in both countries. The average TFPCH for that year for the sampled US banks and UK banks were 0.5819 and 0.629 respectively, further signalling a corresponding decline in productivity of 41.8% and 37.1% over the period. This decline in productivity is solely attributed to the analogous declines in the efficiency component of the TFPCH of 42.1% and 37.2% for the respective sampled US and UK banks over that period. These declines observed in 2019-2020 can be further explained by a slowing down of the economic activity in both countries as a result of the lockdowns that followed the Covid-19 global pandemic. The pandemic affected the efficiency of banks by slowing down the credit creation activities, alongside a decreased demand for consumer credit.

Figure 4 2 The Total Factor Productivity Change of UK and US Banks



4.2.3 Stage 2: Regression Analysis Results

In this section the study attempts to investigate the phenomenon identified in the two immediately preceding sections of this chapter, essentially looking to explain the lower efficiency scores of UK banks as identified in the previous sections. Taking the input and output variables used in the study's DEA analysis in the previous section, the study tries to identify which variables had a significant impact on the efficiency of banks. Recall from the discussion presented in section 3.6.3 that these variables have specifically been selected because they are most impacted by liquidity and capital bank regulations. The study also included the same macroeconomic variables to control for the effects of the wider UK economy, on the efficiency of the sampled banks and for consistency. This allowed the study to answer the question of whether these regulatory reforms have an impact on the efficiency of banks, as well as the nature of the said impact.

This section achieves this by running and testing both fixed and random effects regression analysis using the STATA statistical package. The section ultimately settled for the fixed effects regression model after using the Hausman Test to test both modules for suitability given the dataset. The study tests the fixed effects model for cross-sectional correlation using the Breusch-Pagan LM test, testing for heteroscedasticity using the Modified-Wald test for groupwise heteroscedasticity. The results of the Modified-Wald test for groupwise heteroscedasticity are presented in Appendix A.4.7. The results of this test revealed the presence of groupwise heteroscedasticity in the study's fixed effects model. The results for the Breusch-Pagan LM test is presented in Figure 4.3. They reveal no significant correlation between the residuals of the fixed effects regression model. This implies the independence of the model's independent variables.

Finally, a robust fixed effects panel regression was run in STATA to control for heteroskedasticity and collinearity, with results presented in Table 4.6. These variables were first converted into ratios before carrying out the regression analysis to allow for a more balanced dataset given the range of the bank efficiency variable (UKBanks_DEA~scores). The results for the random effects regression analysis, random effects panel regression analysis and Hausman Test are presented in Appendices A.4.3, A.4.4 and A.4.5 respectively.

Table 4. 5 Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
UKBanks_DEA~scores	92	0.928	0.091	0.495	1
WS %	92	0.006	0.003	0.002	0.014
TC %	92	0.050	0.025	0.029	0.266
TD %	92	0.550	0.083	0.374	0.872
HQLA %	92	0.101	0.078	0.003	0.260
LLP %	92	0.003	0.002	-0.002	0.011
RWA %	92	0.301	0.083	0.158	0.443
TL %	92	0.956	0.011	0.934	0.981
OIR %	92	0.044	0.011	0.019	0.066
UK Inflation	92	0.022	0.014	0.004	0.079
UK Bank Base Rate	92	0.022	0.020	0.002	0.059
UK GDP Growth	92	0.017	0.035	-0.110	0.085

Table 4.5 describes the characteristics of the data used in this in accordance with the methodological framework outlined in Chapter 3. It is vital to present these statistics in a study as it enables us to describe, compare and contrast the study variables mathematically. These kinds of statistics are also relevant for identifying basic features of the data used in this study. These features include simple summaries regarding the sample and the data structure of variables included in the study. Saunders, Lewis and Thornhill (2023) argue that descriptive statistics coupled with sound graphical representation is the foundation of sound econometric data analysis. The remainder of this section focuses on the interpretation of the fixed effects regression analysis presented in Table 4.6.

Figure 4 3 Test for Breusch-Pagan LM test for cross-sectional correlation in fixed effects model

```
. xttest2

Correlation matrix of residuals:

         __e1      __e2      __e3      __e4
__e1   1.0000
__e2   0.1163    1.0000
__e3  -0.3903    0.3431    1.0000
__e4   0.3077   -0.2750   -0.3687    1.0000

Breusch-Pagan LM test of independence: chi2(6) =     13.566, Pr = 0.0349
Based on 23 complete observations
```

Table 4.6 presents the study's main regression results. The dependent variable is the DEA bank efficiency measure or score. The first column presents the independent input and output variables most affected by the kinds of changes regulation considered by this study, as well as the control variables. These variables are Wages and Salaries, Total Capital, Total Deposits, High Quality Liquid Assets (HQLA), Loan Loss Provision (LLP), Risk Weighted Assets (RWA), Total Loans (TL), Operating Income (OI), UK Bank Base Rates, UK Inflation and UK GDP Growth rate. The second column through the estimated coefficients summarises the regression of the efficiency scores on the independent variables. The third column presents the robust deviations from the means of the variables. The last column presents the p values relied on in determining whether the relationship between the dependent variable and a particular independent variable is significant.

Table 4. 6 Robust Fixed Effects Regression Results

Variables	Coefficients	Robust Standard Errors	P Values
WS	2.172	2.78	0.492
TC	0.407	0.231	-0.176
TD	0.232**	0.0534	-0.0225
HQLA	-0.119	0.317	-0.733
LLP	-16.68	9.935	-0.192
RWA	0.384**	0.097	-0.0287
TL	2.376**	0.703	-0.0431
OIR	OIR omitted because of collinearity.		
UKBaseRates	0.0481	0.7	-0.95
UKInflation	0.58	0.387	-0.231
UKGDPGrowth	-0.428	0.226	-0.154
Constant	-1.569*	0.65	-0.0948
Observations	92		
R-squared	0.36		
sigma_u	0.0659		
sigma_e	0.0699		
rho	0.4707		

Robust pval in parentheses: *** p<0.01, ** p<0.05, * p<0.1

It is immediately clear from Table 4.6 that only Total Deposits, Risk Weighted Assets, and Total Loans are significantly associated with the efficiency scores. It is clear that an increase in Total Deposits is associated with improved bank efficiency as indicated by its positive coefficient of 0.232 at a 5% significancy level. This implies that a single standard deviation increase in Total Deposits would result in a 0.232 in efficiency score, holding all else constant at a confidence level of 95%. This result suggests that less restrictive regulation or the removal of activity restricting regulation will enhance the efficiency of banks. For instance, the removal of the Ring Fencing requirement under the Banking Reform Act (2013) will allow banks consolidate larger deposits from multiple areas of business and in turn contribute to improved efficiency.

Total capital as can be seen from Table 4.6 has a positive but insignificant association with bank efficiency scores. This result suggests that more stringent capital regulation has a weak relationship with bank efficiency. A possible reason for the insignificant result, as suggested by Barth et al (2013), could be due to the inclusion of actual capital figures in the analysis. The rationale is that the actual capital has a dominant effect on bank efficiency rather than the stringency of the capital regulations. However, the results from the second proxy for capital regulation, Risk Weighted Assets appear to be significant. This is because Risk Weighted Assets is one of the key components relied on in calculating main bank capital ratios such as the Tier 1 and 2 Capital Ratios. The results in Table 4.6 suggests that there is also a positive relationship between Risk Weighted Assets and bank efficiency at a 5% significance level. The coefficient of Risk Weighted Assets of 0.384 implies that where all else is held constant, a one standard deviation increase in Risk Weighted Assets will result in a 0.384 increase in bank efficiency at a 95% confidence level. Based on these results, the study conclude that capital regulation has a substantially positive relationship with bank efficiency.

High Quality Liquid Assets on the other hand have a relative weaker insignificant negative association with bank efficiency. This implies that increases in liquidity regulation such as an increase in the required proportion of High Quality Liquid Assets to be held by banks will overall have marginally negative effect on their efficiency, although insignificant. Therefore, as the main proxy for liquidity regulation in this study, the study conclude based on these results that liquidity regulation insignificantly reduces bank efficiency. Having a significant relationship nonetheless is Total Loans. The results in Table 4.6 show a relatively substantial positive coefficient of 2.376 for Total Loans at a 5% significance level. This suggests that as banks increase the assets by growing their loan portfolios, so does their level efficiency.

Table 4.6 also highlights the important role bank risk plays in bank efficiency. The study includes Loan Loss Provision (LLP) as a measure of the bank's own perceived risk as done in literature such as Barth et al. (2013). The LLP coefficient of -16.68 indicates a substantial inverse relationship with bank efficiency. Although this association is not statistically significant, it highlights the magnitude and direction of change cause to bank efficiency. That is, all things being equal, a one standard deviation increase in LLP, bank efficiency will decline by a factor of 16.68. Additionally, the study revealed that out of the three macroeconomic control variables included, only GDP growth rate has a negative association with bank efficiency. Finally, the fixed effects regression results present an R squared above 0.3, suggesting satisfactory explanatory power of the study's regressors.

4.2.4 Testing the First Hypothesis (H_1)

DEA was used to assess the efficiency of UK retail banks in converting inputs (e.g., wages, capital, deposits) into outputs (e.g., loans, revenue) under regulatory constraints. The study used the Banker, Charnes, and Cooper (BCC) model with variable returns to scale (VRS) to account for the diverse nature of the UK banking industry, where banks may experience varying levels of efficiency at different scales of operation. The analysis aimed to understand how well banks transform inputs into outputs under changing regulatory regimes.

The Malmquist Index was applied to measure changes in efficiency over time. This index decomposes efficiency changes into two components: technical efficiency change, which reflects improvements in a bank's ability to utilize its existing resources, and technological change, which represents shifts in the overall production frontier due to technological advancements or other external factors. By analysing the Malmquist Index, the study aimed to discern whether changes in efficiency were primarily driven by internal improvements or external shifts in the operating environment.

In the second stage, panel regression analysis with both fixed and random effects models was employed to identify the specific factors that influence bank efficiency. This approach allowed for the identification of specific regulatory factors that significantly influence bank efficiency while controlling for unobserved heterogeneity across banks and time. The fixed effects model accounted for time-invariant bank-specific characteristics that might affect efficiency but were not explicitly included in the model, while the random effects model assumed that these unobserved effects were random and uncorrelated with the included explanatory variables. The analysis revealed that H_1 may only be accepted in the case capital regulatory reforms since the P value for RWA is significant at 5% level. The significant p value in this context indicates that an increase in capital requirement ratios will result in a corresponding increase in bank efficiency.

Research Question 1: Do liquidity and capital regulatory reforms affect the efficiency (technical) of retail banks?

The DEA and Malmquist Index findings revealed that US banks were slightly more efficient than UK banks, but UK banks were more responsive to regulatory changes. The Panel Regression Analysis showed that factors such as total deposits, risk-weighted assets, and total loans were significantly associated with efficiency scores. These findings suggest that regulatory reforms do affect the technical efficiency of retail banks.

4.3 The Impact of regulatory reforms on market value of retail banks Employing an Event Study Methodology

The UK financial services industry, specifically the banking sector is one of the most heavily regulated industries in the world. The copious literature on bank regulatory practices have highlighted the need for financial regulation and supervision in protecting the banking and financial system. There are a number of studies that have attempted to examine the relationship between regulatory reforms and the stock markets. As existing literature predominantly focuses on U.S. markets, this results in a clear lack of studies focusing specifically on this area in the United Kingdom. This chapter attempts to fill this gap in literature by examining the effect of the Financial Services (Banking Reform) Act (2013) on the stock returns of the top four banks high street banks in the UK. The study also examine the effect of the Financial Services and Markets Act (2023) enacted 10 years after Banking Reform Act (2013) and compare the results. As the other studies briefly reviewed the rationale for conducting this empirical analysis, in this section emanates from notion that the stock market is the best evaluator of the efficacy of financial reforms and their impact of the risk as well as return for financial institutions. This notion is further supported by the Efficient Market Hypothesis theory detailed in Section 2.2.3. It is important to note that the semi-strong form of this theory particularly dictates that information such as regulatory changes are immediately incorporated into a stock's price as soon as that information becomes available publicly This section employs the Event Study Methodology (EMS) presented in detail in Section 3.8.2 to examine these effects.

The Banking Reforms Act (2013) aimed to implement a practical definition of the concept of ring-fencing that promotes the idea of ring-fencing of certain banking activities. The Act requires all household and small and medium-sized enterprises (SME's) deposits and current accounts to be held within a UK ring-fenced bank. Those ring-fenced banks are prohibited from operating a range of wholesale and investment banking activities (Korotana, 2016). The Financial Services and Markets Act (2023) on the other hand is a ground-breaking piece of UK legislation that introduces significant reforms to the financial services industry, affecting almost all financial services firms, including banks and their customers. This Act will primarily repeal retained EU law on financial services and give broader powers to HM Treasury to make regulations as well as to define additional activities for regulation within the UK.

The structure of the ESM used in the chapter is extensively presented in Sections 3.9.2. However, the study find it necessary to briefly state the two main events and the collective six sub events of interest. the study's two main events are The Banking Reforms Act (2013) and the more recent Financial Services and Markets Act (2023). As detailed in Table 3.2 the sub events are the third readings in the UK House of Commons and Lords, and their respective royal accent dates. The study first calculate the daily stock returns for the study's sampled banks spanning the period 2000 to 2023. Following MacKinlay, (1997) the study use an estimation window of 252 trading days. Using the market model detailed in Section 3.9.2 estimate the CAAR for 3 event windows for each of the six sub events. These are (-3, 3), (-5, 5), and (-10, 10) trading days respectively. This allowed for the capture of information slippages in the study's assessment of the effects of the study's defined events on the stock prices of the sampled banks. It is also usual to define the event window to be larger than the specific period of interest. This permits examination of periods surrounding the event.

4.3.1 Descriptive Statistics

This section presents a summary of the data used in the analysis carried out in this chapter. As presented in table 5.1 the study used the daily price data from the four sampled banks and iShares plc. core FTSE 100 UCITS ETF (ISFL) to calculate the daily returns used to conduct the study. The total number of daily returns for each security used for the study exceeded 4,000 for the period 2000 to 2023. The lowest performing securities for the period as measured by their returns were LLOYL and NWGL. However, BARCL appeared to have the highest return of 2.49% as well as the highest as represented by a standard deviation of 1.59.

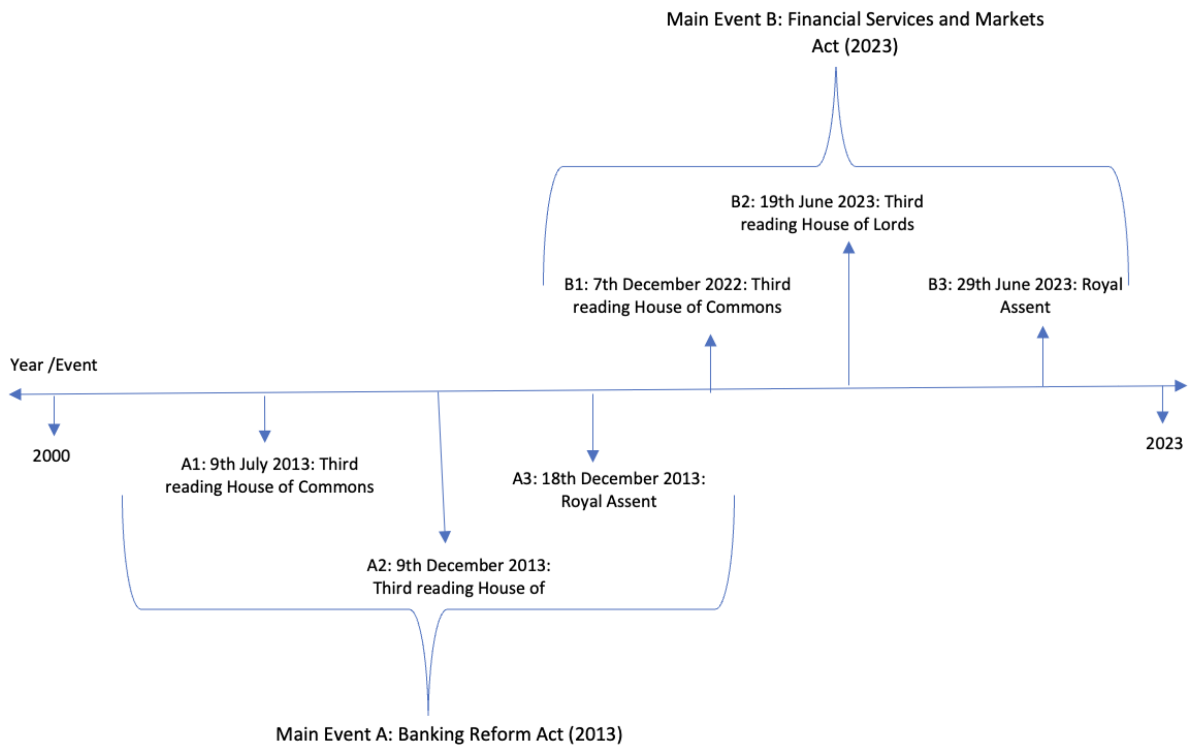
Table 5. 1 Event Study Analysis Summary Statistics

Variable	Obs	Mean	Std.dev.	Min. Return	Max. Return
LLOYL	4,040	-0.00032	0.038642	-1	0.5037252
BARCL	4,040	0.024945	1.598369	-1	101.5516
NWGL	4,040	-2.1E-05	0.033055	-0.6657063	0.3566883
HSBAL	4,040	0.000327	0.017781	-0.187786	0.1551506
ISFL	4,040	0.000111	0.011803	-0.1150979	0.0984779

Source: Data obtained from Yahoo finance and calculation carried out in Excel and STATA by the researcher.

A summary of the regulatory reforms and corresponding events are presented in figure 5.1. This figure details the order in which the impact of these events are assessed. As seen in the figure, the two main events are assigned alphabetic codes A and B respectively. Alpha-numeric codes are assigned to each corresponding sub event including A1 to A3 and B1 to B3 respectively. It is also worth noting that a summary of the estimated CAAR's of the sampled banks for both main events and their corresponding sub events are presented in Appendix B5.1.

Figure 5. 1 Regulatory Reforms and Event Dates



4.3.2 Empirical Results: Event A Banking Reforms Act (2013)

In this section the study attempt to specifically investigate the impact that the passing of the Banking reforms Act (2013) had on the study's sampled banks and present the results of the study's investigation. The study identified the three key stages a bill needs to go through before it officially becomes an Act of parliament in the UK and test for the stock reaction of the study's sampled banks using the ESM. the study's results are presented as follows: the study present results from the study's analysis of the main stages in sections 5.1.1 through to 5.1.3. These sections contain tables of the CAARs observed for each security over the three event windows ((-3, +3), (-5, +5), and (-10, +10) trading days respectively). The study also present graphical illustrations for each of the three event windows under each respective event. These illustrations allow for a deeper appreciation of the stock's reaction for as far as 10 days before and 10 days after each event.

4.3.2.1 Event A1: Third reading House of Commons 9th July 2013

The results presented in this section is associated with the first event (Event A1) over the three identified window periods. Table 5.1.1 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented under each column. Table 5.1.1 below shows that the CAAR were positive in all three event windows. NWGL (Natwest Group) recorded the highest returns of 7.7%, 9.1% and 9.5% over the 3-day, 5-day and 10-day event windows respectively. Whereas HSBAL (HSBC Bank) recorded the lowest returns of 1.42%, 0.68% and 2.13% over the same event windows respectively. However, none of the single security CAARs are significant in either event window. These returns suggests that the stock price of banks cumulatively reacted to Event A1 although none was significant. The table also shows that aggregate CAARs computed using the portfolio technique and the ones estimated averaging the single firms' CAARs are the same throughout. However, the aggregate CAARs computed using the estimated averaging the single firms' CAARs are significant. In other words, the reported group CAARs of 3.88%, 4.45% and 5.26% ones for each of the three respective event windows are all significant at a 0.01 significance level.

The results from this application as presented in table 5.1.1 show that in all three specified event windows, 'Event A1' did not lead to a significant reaction from the individual stock returns of all sampled banks except when they are grouped. As can be seen from the table, when the sampled banks are grouped, 'Event A1' is seen to have a significant positive impact on the group. This suggests that the event registered on that given date had a significant positive influence on groups' stock returns.

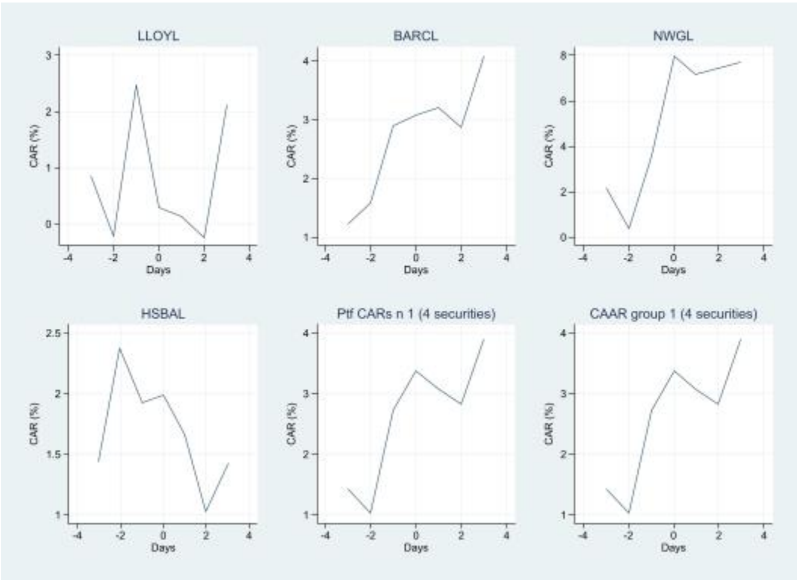
Table 5.1. 1 Event Date A1 Third Reading by the House of Commons: 9th July 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	3-day Event Window			5-day Event Window			10-day Event Window		
Security	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	2.1361%	0.6277	0.0440	3.4809%	0.5284	0.0551	3.3374%	0.6617	0.0762
BARCL	4.0959%	0.4454	0.0536	4.2502%	0.5275	0.0672	5.5209%	0.5525	0.0928
NWGL	7.7042%	0.2014	0.0601	9.1014%	0.2285	0.0754	9.5857%	0.3584	0.1042
HSBAL	1.4238%	0.4637	0.0194	0.6899%	0.7769	0.0243	2.1398%	0.5248	0.0336
Ptf CARs n 1 (4 securities)	3.8899%	0.2802	0.0359	4.4550%	0.3237	0.0451	5.2628%	0.3987	0.0623
CAAR group 1 (4 securities)	3.8899%***	0.0000	2.7386	4.4550%***	0.0000	2.7386	5.2628%***	0.0000	2.7386

*** p-value < .01, ** p-value <.05, * p-value <.1

The daily Cumulative Abnormal Returns (CAR) and CAAR over a ‘3-day Event Window’ for ‘Event A1’ is presented in Figure 5.1.1. From the figure, the returns of LLOYL and HSBAL unlike that of BARCL and NWGL appeared to be on a downward trajectory until the 2 days after the event when they begin to rise. It can be seen that the returns in the figure generally appear to be fluctuating positively up until the second trading day after the event, where they begin to rise sharply.

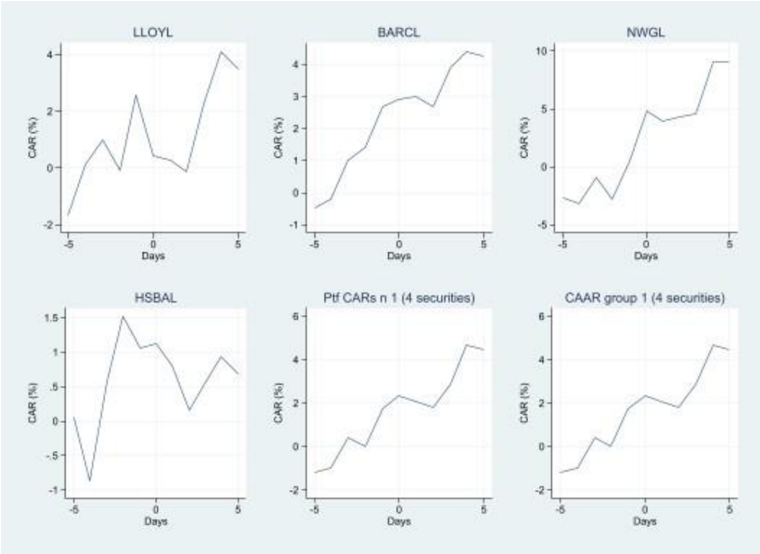
Figure 5.1. 1 Event Window A1.1 (3-day Event Window)



Source: STATA data analysis output

The returns over a ‘5-day Event Window’ as presented in Figure 5.1.2 appeared to be moving in a similar direction, with the exception of a sharp dip in return after the 4 days following the event. The figure shows a generally positive fluctuation of returns over the specified ‘5-day Event Window’.

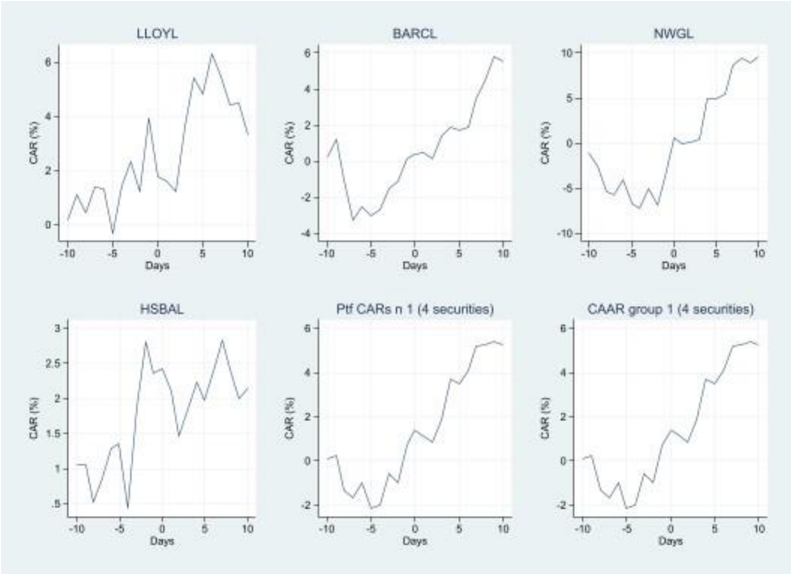
Figure 5.1. 2 Event Window A1.2 (5-day Event Window)



Source: STATA data analysis output

A much broader view of the reaction of the returns of sampled banks to the event is presented in Figure 5.1.3. The figure presents the returns over a '10-day Event Window'. As can be seen, the LLOYL and HSBAL had the most volatile returns over the period. However, the impact of the event on the returns of the sampled banks observed over a 10-day period is seen to be positive. The returns are seen to be consistently increasing from the 5th day before the event to the 10th day after the event. This may be a sign of the impact of positive speculation by market participants or information spillages in the market, resulting in the positive market reaction to the event prior to its occurrence.

Figure 5.1. 3 Event Window A1.3 (10-day Event Window)



Source: STATA data analysis output

4.3.2.2 Event A2: Third Reading by the House of Lords: 9th December 2013

The results presented in this section are associated with the first event (Event A2) over the three identified window periods. Table 5.1.2 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented under each column. The table shows that the CAARs for the 3-day Event Window are all negative with only the group CAAR being significant. This implies that when examined over a 3-day Event Window, Event A2 has a non-significant negative effect on the returns of all sampled banks. However, when the banks are examined as a group, the effect is still negative with a group CAAR of -2.38% but becomes significant at a significance level 0.1. Furthermore, when the impact of the event is examined over a 5-day Event Window, the effect largely remains negative with the exception of the returns of LLOYL which now becomes positive. The event is also seen to have a slightly less negative effect on the group with a group CAAR of -1.525% at a 0.01 significance level. On the other hand, when same event is examined over a 10-day Event Window its effects are largely positive, with the exception of HSBAL which remains negative with a CAAR of -3.194%. The effect of the event on the group is seen to be significantly positive from the group CAAR of 1.7030% at significance level of 0.01.

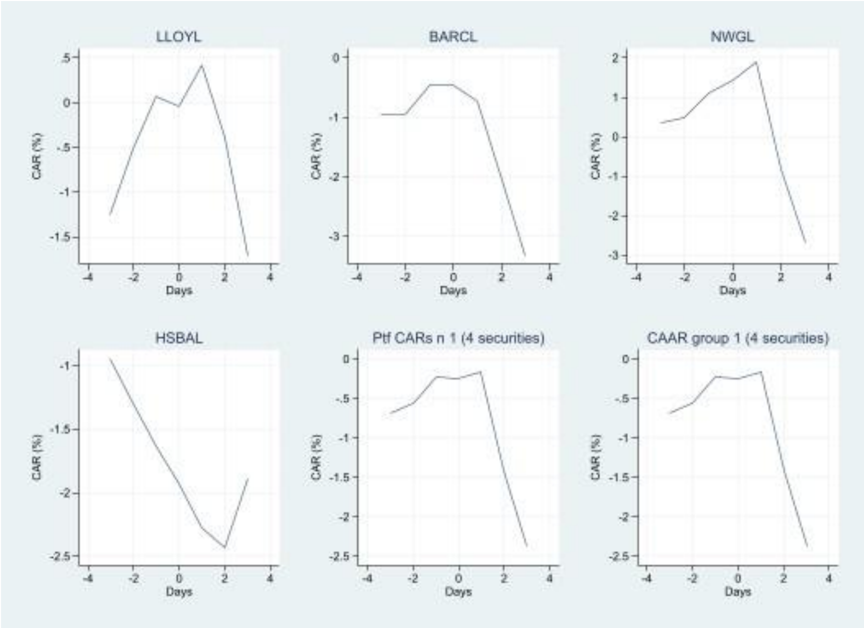
The results as presented in table 5.1.2 shows that in all three specified event windows, ‘Event A2’ did not lead to a significant reaction from the individual stock returns of all sampled banks except when they are grouped. As can be seen from the table, when the sampled banks are grouped, ‘Event A2’ is seen to have a significant effect overall, but the direction of the effect is seen to vary depending on the event window. The event registered on that given date had a significant positive influence on groups’ stock returns only when examined over a 10-day Event Window. Whereas over a 3-day and 5-day Event Window this influence is negative.

Table 5.1. 2 Event Date A2 Third Reading by the House of Lords: 9th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

Security	A 3-day Event Window			A 5-day Event Window			A 10-day Event Window		
	CAAR(-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-1.7049%	0.6678	0.0397	0.8627%	0.8625	0.0497	5.6455%	0.4122	0.0687
BARCL	-3.3156%	0.3989	0.0392	-4.4601%	0.3654	0.0492	3.5607%	0.6008	0.0680
NWGL	-2.6681%	0.6036	0.0513	-0.1434%	0.9822	0.0643	0.6071%	0.9456	0.0889
HSBAL	-1.8835%	0.3414	0.0198	-2.4415%	0.3253	0.0248	-3.1914%	0.3520	0.0342
Ptf CARs (4 securities)	-2.3800%	0.3930	0.0278	-1.5252%	0.6622	0.0349	1.7030%	0.7240	0.0482
CAAR (4 securities)	-2.3800%*	0.0679	2.7386	-1.5252%***	0.0000	2.7386	1.7030%***	0.0000	2.7386

*** p-value < .01, ** p-value <.05, * p-value <.1

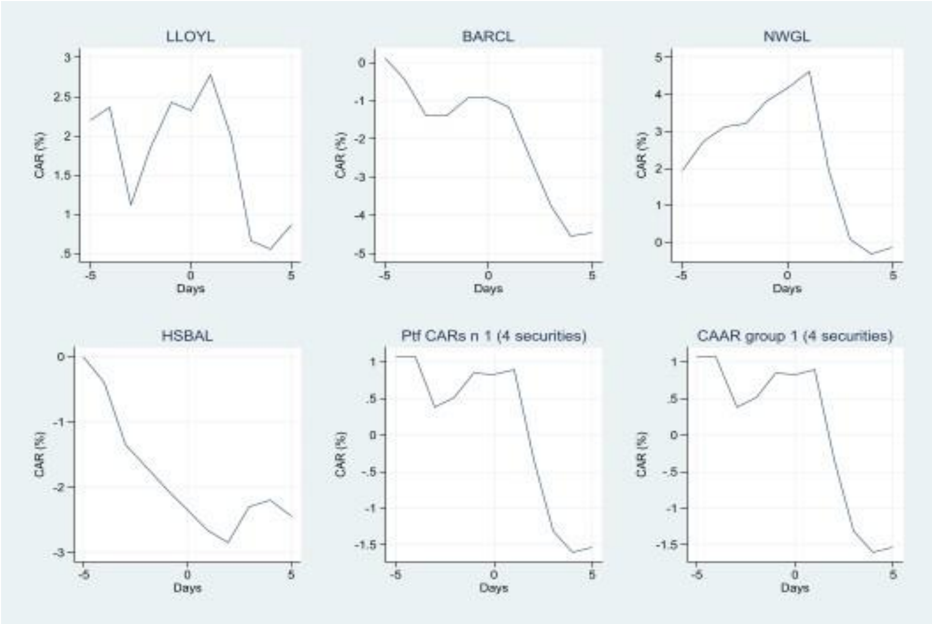
Figure 5.2. 1 Event Window A2.1 (3-day Event Window)



Source: STATA data analysis output

The daily Cumulative Abnormal Returns (CAR) and CAAR over a ‘3-day Event Window’ for ‘Event A2’ is presented in Figure 5.2.1. From the figure, the returns of LLOYL, BARCL and NWGL unlike that of HSBAL, appeared to be on an upward trajectory until the after the day of event when they begin to sharply decline. It can also be observed that the returns in the figure generally appear to be fluctuating negatively over the event window. This reaction appears radically different from the results observed for Event Window A1.1.

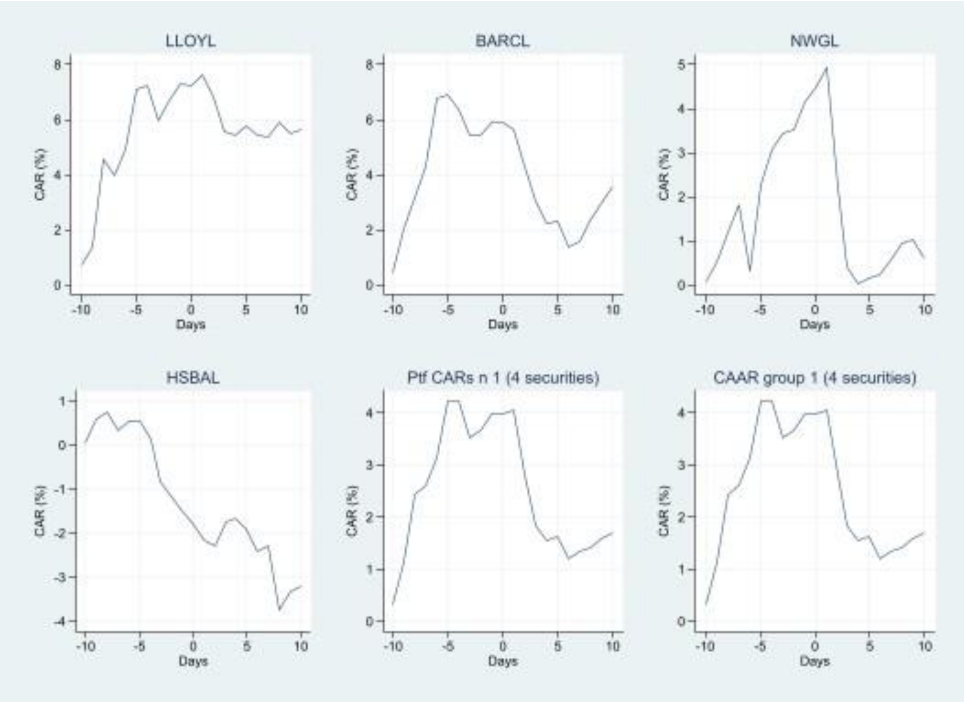
Figure 5.2. 2 Event Window A2.2 (5-day Event Window)



Source: STATA data analysis output

The returns over a '5-day Event Window' as presented in Figure 5.2.2 appeared to present a similar pattern with signs of a slight increase in returns after the 4th day following the event. The returns of HSBAL appear to be the exception to this observation. The figure maintains the illustration of a generally negative fluctuation of returns over the specified '5-day Event Window'. This reaction also appears radically different from the results observed for Event Window A1.2.

Figure 5.2. 3 Event Window A2.3 (10-day Event Window)



Source: STATA data analysis output

The much broader view of the reaction of the returns of sampled banks to the event is presented in Figure 5.2.3 tells a slightly different story as it presents the returns over a much longer '10-day Event Window'. As can be seen, only LLOYL had the most volatile returns over the period. Although the overall impact of the event on the returns of the sampled banks observed over a 10 period is seen to be positive with the exception of HSBAL, the returns first appear to be increasing until they reach their peak around the day of the event before they begin to decline. This may be a sign of the impact of positive speculation by market participants or information spillages in the market, resulting in the positive market reaction to the event prior to its occurrence.

4.3.2.3 Event Date A3: Royal Assent. 18th December 2013

The results presented in this section are associated with the first event (Event A3) over the three identified window periods. Table 5.1.3 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented under each column. The table shows that the individual security CAARs for the 3-day Event Window are all positive and insignificant, with exception of HSBAL. Only the group is negative and significant with a CAAR value of -0.1411% at 0.01 significant level. This implies that when examined over a 3-day Event Window, Event A3 has a non-significant negative effect on the returns of on most sampled banks. Conversely, when the banks are examined as a group the effect is still negative with a group CAAR of -0.1411% but becomes significant at a significance level of 0.01. However, when the impact of the event is examined over a 5-day Event Window, the effect is entirely negative. The event is also seen to have a significantly more negative effect on the group with a group CAAR of -2.0027% at a 0.1 significance level. Similar results are found when the event is examined over a 10-day Event Window, with the exception of BARCL and NWGL that become positive with respective CAARs of 1.3422% and 1.1317%. Consequently, the effect of the event on the group is seen to be significantly negative with a group CAAR of -0.4476% at significance level of 0.01.

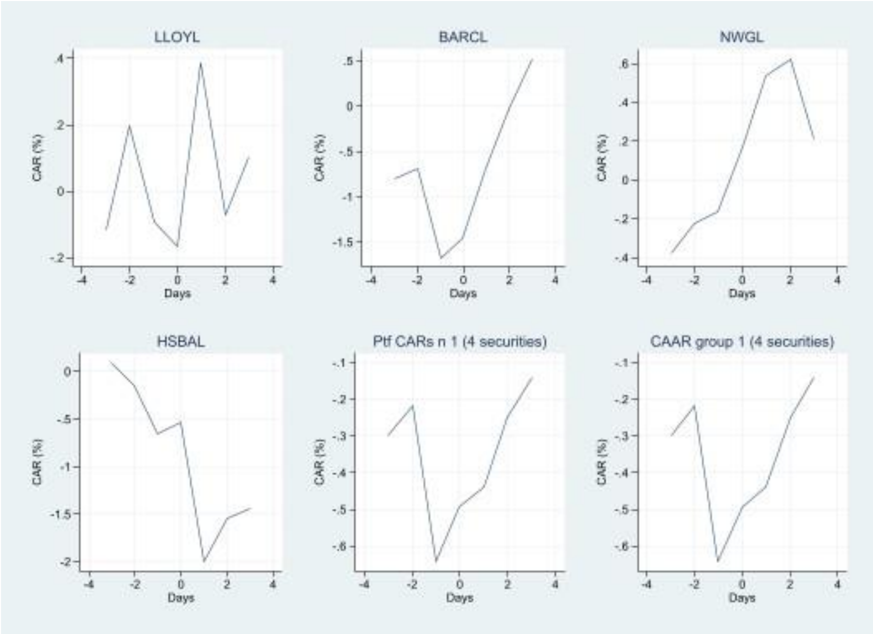
The results as presented in table 5.1.3 indicate that in all three specified event windows, 'Event A3' similar to the other two events examined did not lead to a significant reaction from the individual stock returns of all sampled banks except when they are grouped. However, as can be seen from the table, when the sampled banks are grouped, 'Event A3' is seen to have a significant and negative effect on the stock returns of the sampled banks overall. The event registered on that given date had a significant negative influence on grouped stock returns across all three event windows examined.

Table 5.1. 3 Event Date A3 Royal Assent: 18th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

Security	A 3-day Event Window			A 5-day Event Window			A 10-day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.1010%	0.9788	0.0380	-2.5780%	0.5891	0.0477	-0.1915%	0.9768	0.0659
BARCL	0.5275%	0.8922	0.0389	-1.1747%	0.8097	0.0487	1.3422%	0.8422	0.0673
NWGL	0.2164%	0.9674	0.0528	-2.4027%	0.7171	0.0662	1.1317%	0.9017	0.0915
HSBAL	-1.4374%	0.4686	0.0198	-1.9335%	0.4367	0.0248	-4.1926%	0.2227	0.0343
Ptf CARs (4 securities)	-0.1411%	0.9590	0.0274	-2.0027%	0.5606	0.0344	-0.4476%	0.9250	0.0475
CAAR (4 securities)	-0.1411%***	0.0000	2.7386	-2.0027%*	0.0679	2.7386	-0.4476%***	0.0000	2.7386

*** p-value < .01, ** p-value <.05, * p-value <.1

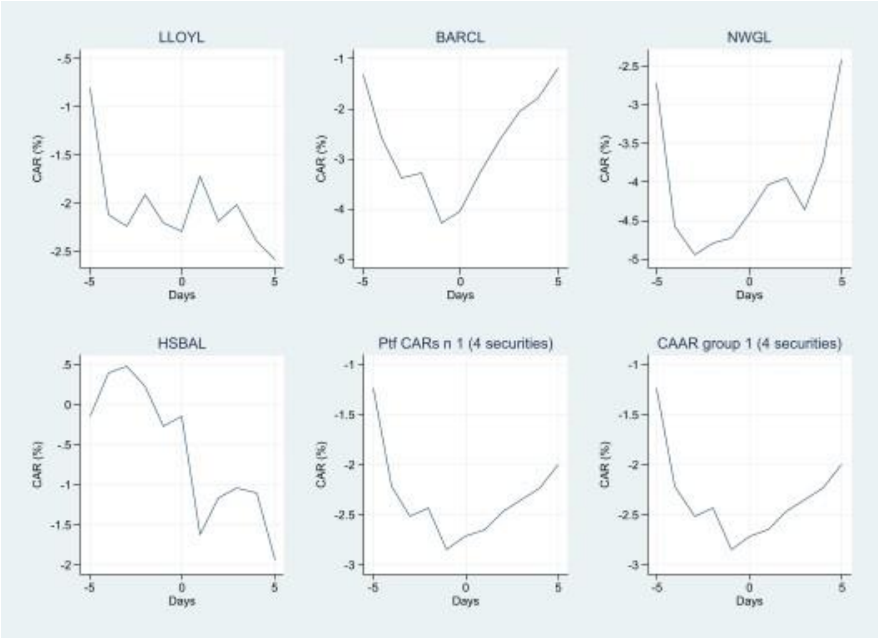
Figure 5.3. 1 Event Window A3.1 (3-day Event Window)



Source: STATA data analysis output

The daily Cumulative Abnormal Returns (CAR) and CAAR over a ‘3-day Event Window’ for ‘Event A3’ is presented in Figure 5.3.1. The figure indicates that unlike LLOYL and HSBAL the returns of BARCL and NWGL unlike that of HSBAL, appeared to be on an upward trajectory after the day of event. LLOYL appears to be the most volatile over the event window whereas HSBAL experienced a sharp decline in returns after the day of the event. It can also be observed that the returns in the figure generally appear to be negatively over the event window similar to the results observed for Event Window A2.1.

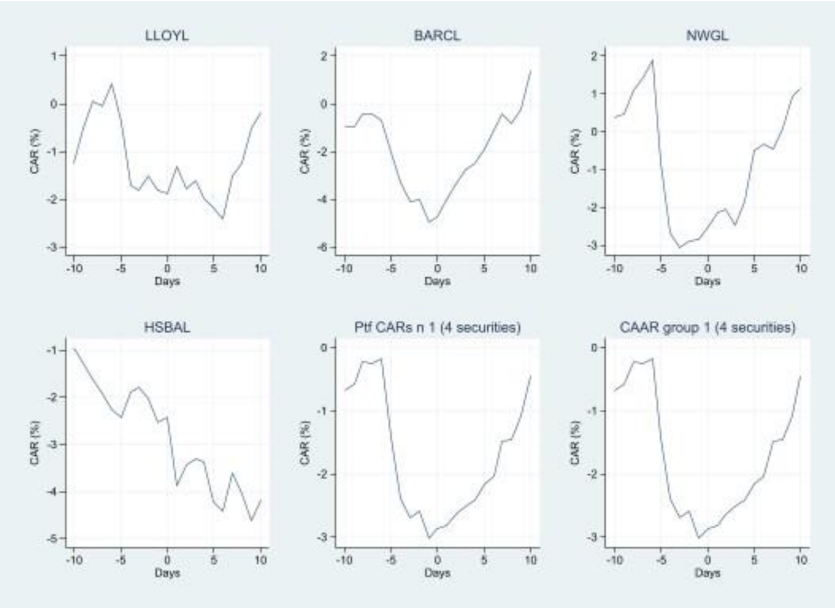
Figure 5.3. 2 Event Window A3.2 (5-day Event Window)



Source: STATA data analysis output

The returns over a '5-day Event Window' as presented in Figure 5.3.2 appeared to present a similar pattern with the curves appearing to slightly take the shape of an inverted bell curve, with the base of the bell nearing the event day. As in the previous event window LLOYL and HSBAL appear to be the exception to this observation. The figure maintains the illustration of a generally negative trend in the returns over the specified '5-day Event Window'. This reaction to the event also appears distinct from the results observed for Event Window A2.2.

Figure 5.3. 3 Event Window A3.3 (10-day Event Window)



Source: STATA data analysis output

The much broader view of the reaction of the returns of sampled banks to the event is presented in Figure 5.3.3, presenting a near perfectly formed inverted bell cure over the '10-day Event Window'. The figure suggests that the returns of LLOYL, BARCL and NWGL transitioned into to an upward trend from a downward trend prior to the event in question. This is the same observation for the portfolio and group returns. This may be a sign of the impact of positive speculation by market participants or information spillages in the market, resulting in the positive market reaction to the event prior to its occurrence. However, the overall impact of the event on the returns of the sampled banks observed over a 10-day period is seen to be positive with no exceptions.

4.3.3 Empirical Results: Event B Financial Services and Markets Act (2023)

In this section the study attempt to examine the impact that the passing of the Financial Services and Markets Act (2023) had on the stock returns of the study's sampled banks and present the results of the study's investigation. The study identified the three key stages a bill needs to go through before it officially becomes an Act of parliament in the UK and test for the stock reaction of the study's sampled banks using the ESM. These are the third reading by the House of Commons; third reading by the House of Lords; and receiving royal assent. the study's results are presented as follows. The study present results from the study's analysis of the main stages in sections 5.2.1 through to 5.2.3. These sections contain tables of the CAARs observed for each security over the three event windows ((-3, +3), (-5, +5), and (-10, +10) trading days respectively). The study also present graphical illustrations for each of the three event windows under each respective event. These illustrations allow for a deeper appreciation of the stock's reaction for as far as 10 days before and 10 days after each event.

4.3.3.1 Event Date B1: Third reading House of Commons 7th December 2022

The results presented in this section are associated with the first event (Event B1) over the three identified window periods. Table 5.2.1 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks and the portfolio as well as group security roles. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented appropriately under each column. The table shows that the individual security CAARs for the 3-day Event Window are all positive and insignificant. The observed returns of the group are positive and significant with a group CAAR of 1.59% at 0.01 significance level. This implies that when examined over a 3-day Event Window, Event B1 had an insignificant positive effect on the returns of each individually sampled bank. Conversely, when the banks are examined as a group the effect is still positive with a group CAAR of 1.59% but at a significance level of 0.01. However, when the impact of the event is examined over a 5-day Event Window, the effect of the event on the study's sampled banks are almost entirely negative with the exception of NWGL which recorded an insignificant positive return of 1.83%. The examined event is also seen to have a significant marginal negative effect on the group with a group CAAR of -0.105% at a 0.01 significance level over the 5-day period. The results obtained when the effects of the event are examined over a 10-day event window are similar to that of results from the 3-day event windows. That is, the effect of the event on the group is seen to be significantly positive with a group CAAR of 2.69% at significance level of 0.01.

The results as presented in table 5.2.1 reveals that in all three specified event windows, ‘Event B1’ did not lead to a significant reaction from the individual stock returns of all sampled banks except when they are grouped. As can be further seen from the table, when the sampled banks are grouped, ‘Event B1’ has a significant effect overall but the direction of the effect is seen to vary depending on the event window. The event registered on that given date had a significant positive influence on groups’ stock returns only when examined over a 3-day and 10-day Event Window, whereas over a 5-day Event Window this influence is negative.

Table 5.2. 1 Event Date B1 Third Reading by the House of Commons: 7th December 2022 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

Security	A 3-day Event Window			A 5-day Event Window			A 10-day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR(-5,5)	PVALUES	StDev	CAAR(-10,10)	PVALUES	StDev
LLOYL	0.8251%	0.9726	0.2401	-0.0339%	0.9991	0.3010	1.4491%	0.9722	0.4159
BARCL	1.5090%	0.9993	16.9264	-0.0997%	1.0000	21.2184	0.1396%	1.0000	29.3174
NWGL	2.7256%	0.5204	0.0423	1.8315%	0.7304	0.0531	4.1025%	0.5764	0.0733
HSBAL	1.2523%	0.7384	0.0375	-2.1890%	0.6414	0.0469	4.9350%	0.4475	0.0649
Ptf CARs (4 securities)	1.5913%	0.8075	0.0653	-0.1051%	0.9898	0.0818	2.6929%	0.8119	0.1130
CAAR (4 securities)	1.5914%***	0.0000	2.7386	-.1051%***	0.0000	2.7386	2.6929%***	0.0000	2.7386

*** p-value < .01, ** p-value <.05, * p-value <.1

Figure 5.4. 1 Event Window B1.1 (3-day Event Window)

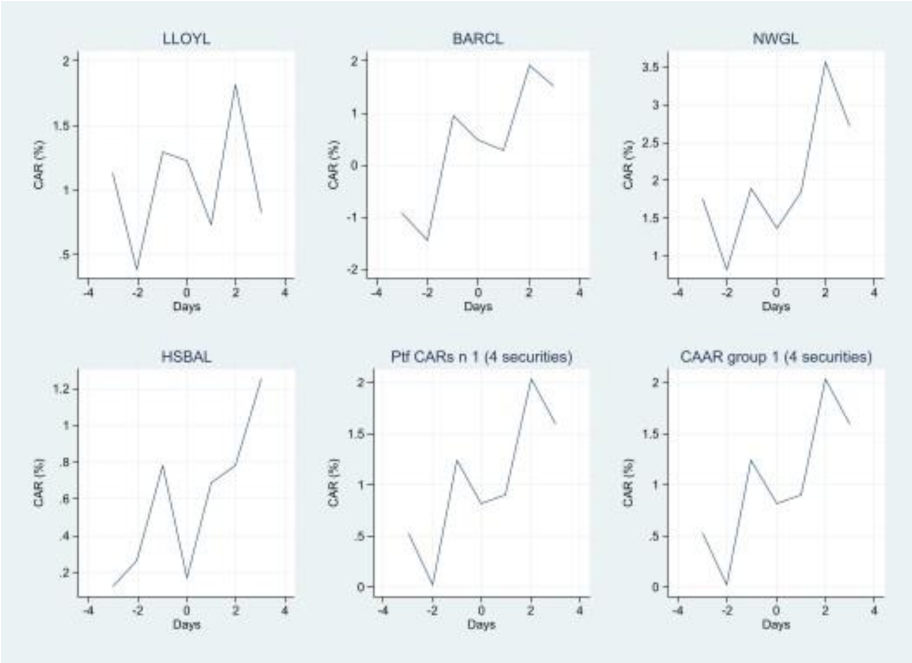
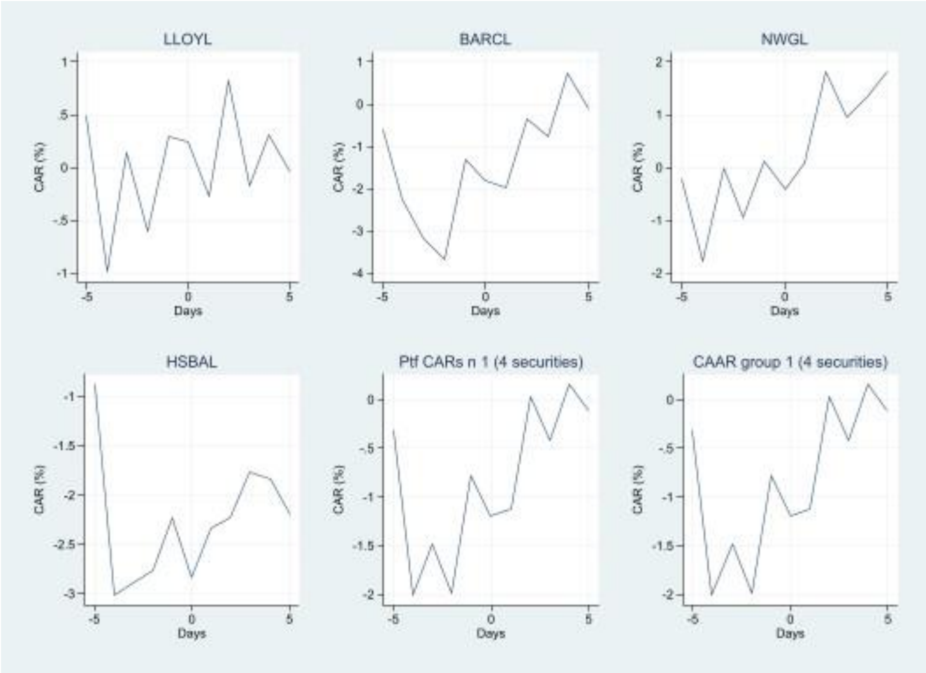


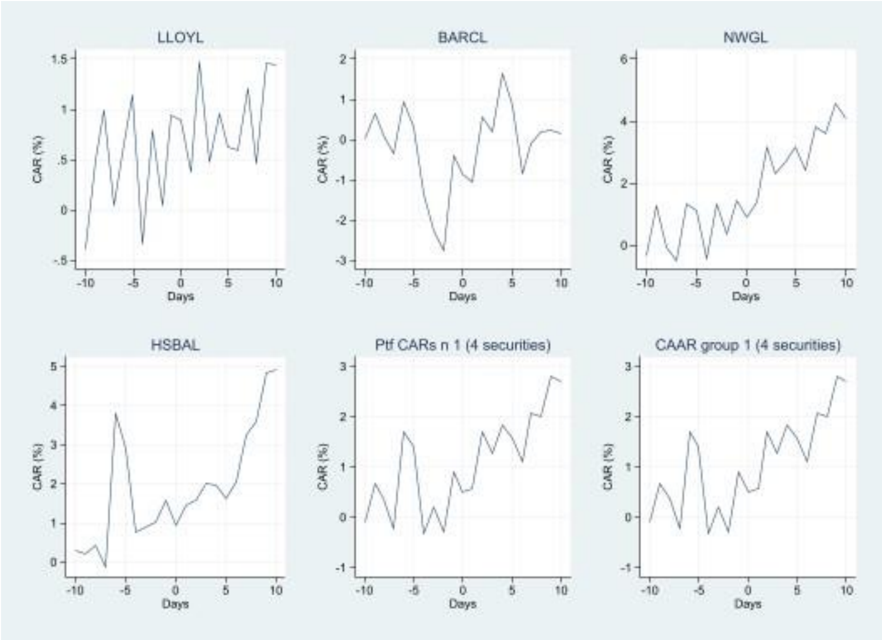
Figure 5.4.1 presents the daily Cumulative Abnormal Returns (CAR) and CAAR over a '3-day Event Window' for 'Event B1'. The figure indicates that LLOYL and BARCL experienced a slight decline in returns following the event, but began increase after the 1st day after the event. Whereas the returns of NWGL and HSBAL experienced sharp increases following the event. It can also be observed that the returns in the figure generally appear to be fluctuating on an upward trend before and after the event. These results appear to be similar to those observed in Event Window A1.1.

Figure 5.4. 2 Event Window B1.2 (5-day Event Window)



The returns over a '5-day Event Window' as presented in Figure 5.4.2 appeared to present a similar pattern to the returns in Figure 5.4.1. The distinction here is that there appears to be a decline in returns after the 3rd day following the event. The figure also illustrates a negative trend in the returns over the specified '5-day Event Window' especially as seen in the group CAAR curve. This reaction to the event also appears sharply distinct from the results observed for Event Window A2.2.

Figure 5.4. 3 Event Window B1.3 (10-day Event Window)



A '10-day Event Window' presents a much broader view of the reaction of the returns of sampled banks to the event which Figure 5.4.3 presents. The presents a picture of extreme volatility over the 10 day period. The volatility is especially pronounced in LLOYL, with the exception of HSBAL and BARCL who both appeared to have their returns peak at about 5 days before the event and then fall sharply before beginning to rise again as the date of the event approached. The returns of the remaining securities as well as the grouped returns appear to be on a sustained upward trend over the period although volatile. This may or may not be a sign of the impact of positive speculation by market participants or information spillages in the market, resulting in the positive market reaction to the event prior to its occurrence. However, the overall impact of the event on the returns of the sampled banks observed over a 10 period is seen to be positive. This appears to be consistent with the results from Event Window A1.3.

4.3.3.2 Event Date B2: Third reading House of Lords 19th June 2023

The effects of event (Event B2) are observed over the three identified event windows and results presented in this section. Table 5.2.2 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks and the portfolio as well as group security roles. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented appropriately under each column. The table shows that the individual security CAARs for the 3-day Event Window are all negative with the exception of HSBAL which is seen to be positive. Additionally, the effect of the event on all individual securities appears to be insignificant, except for NWGL which has a CAAR of -10.5437% at a significance level of 0.05. The observed returns of the group are also negative and significant with a group CAAR of -3.77% at 0.01 significance level. This implies that when examined over a 3-day Event Window, Event B2 had a largely negative effect on the returns of sampled banks with only marginally rate of significance. Similarly, when the banks are examined as a group the effect is still negative with a group CAAR of -3.77% at a significance level of 0.01. Furthermore, when the impact of the event is examined over a 5-day Event Window, the effect of the event on the study's sampled banks is also almost entirely negative with the same exception of HSBAL which recorded an insignificant positive return of 2.1806%. As was observed over a 3-day event window, NWGL a significant negative effect but at a higher level of significance with a CAAR of -9.0104% at a 0.1 significance level. The examined event is also seen to have a significant marginal higher negative effect on the group with a group CAAR of -4.0615% at a 0.01 significance level over the 5-day period. The results obtained when the effects of the event are examined over a 10-day event window appear mixed for the individual banks. A notable difference in the result observed over the 10-event window is the positive significant effect that the event had on group returns with a group CAAR of 0.6989% also at a 0.01 level of significance.

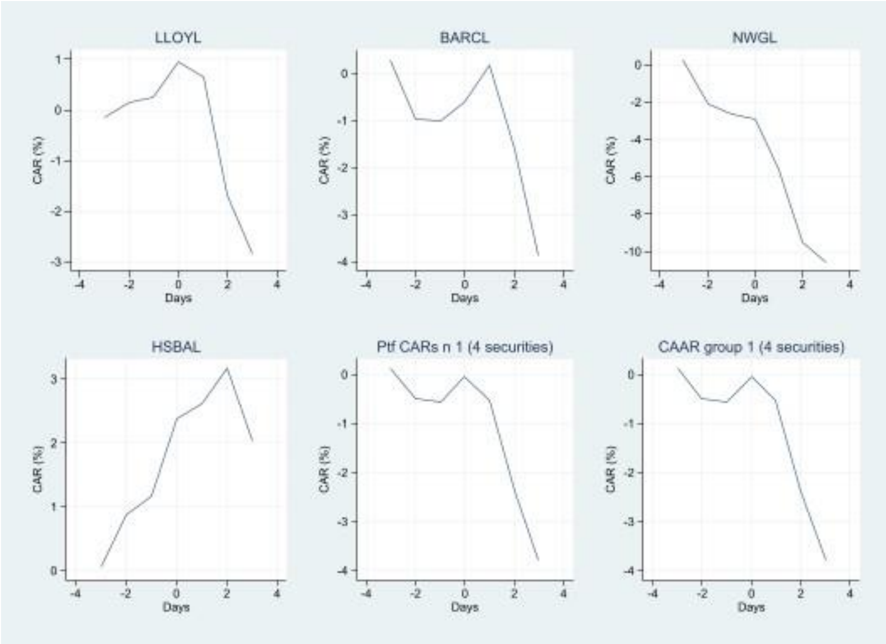
Summarily, the results presented in table 5.2.2 reveals that in all three specified event windows, 'Event B2' led to a very limited significant reactions from the individual stock returns of all sampled banks except when they are grouped. As can be further seen from the table, when the sampled banks are grouped, 'Event B2' has a significant effect overall but the direction of the effect is seen to vary depending on the event window. The event registered on that given date had a significant positive influence on groups' stock returns only when examined over a 10-day Event Window. Whereas over a 3-day and 5-day Event Window this influence is negative.

Table 5.2. 2 Event Date B2 Third Reading by the House of Commons: 19th June 2023 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

Security	A 3-day Event Window			A 5-day Event Window			A 10-day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-2.8579%	0.868	0.172	-4.7979%	0.824	0.215	-0.3777%	0.990	0.297
BARCL	-3.8632%	0.998	16.891	-4.7635%	0.998	21.174	1.6642%	1.000	29.257
NWGL	-0.5437%**	0.015	0.043	-9.0104%*	0.097	0.054	-5.0273%	0.501	0.075
HSBAL	2.0438%	0.578	0.037	2.1806%	0.636	0.046	6.3204%	0.321	0.064
Ptf CARs (4 securities)	-3.7722%	0.458	0.051	-4.0615%	0.524	0.064	0.6989%	0.937	0.088
CAAR (4 securities)	-3.7723%***	0.000	2.739	-4.0615%***	0.000	2.739	0.6989%***	0.000	2.739

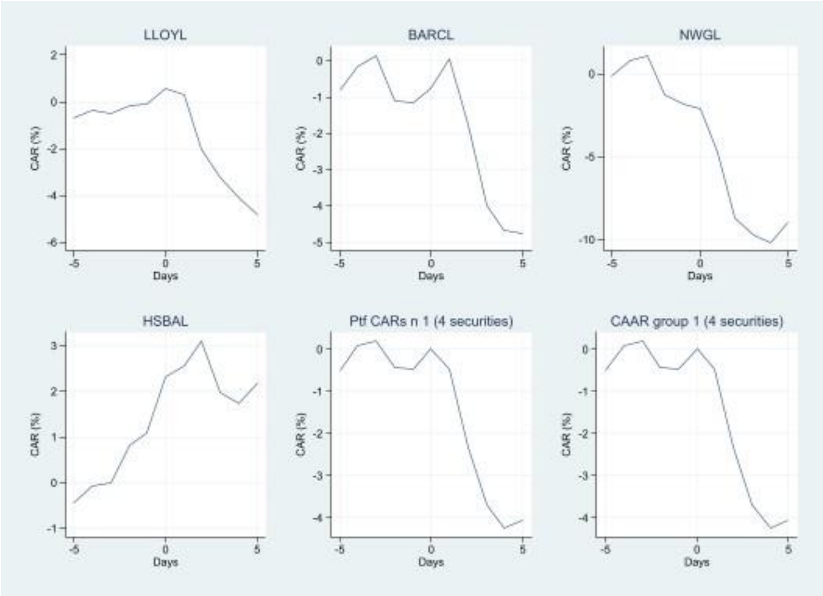
*** p-value < .01, ** p-value <.05, * p-value <.1

Figure 5.4. 4 Event Window B2.1 (3-day Event Window)



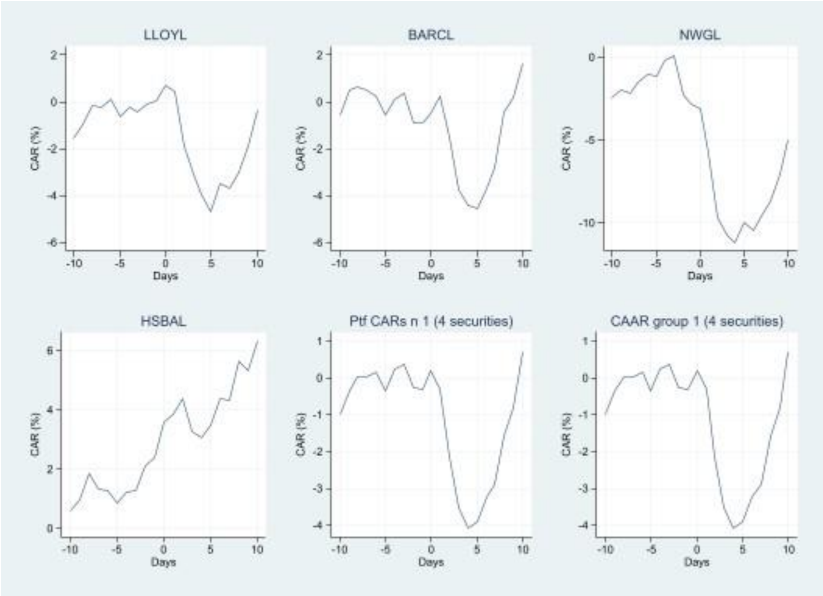
An illustration of the effect of 'Event B2' over a 3-day Event Window' is presented in Figure 5.4.4. The figure indicates that the returns appear to be on a straight downward trend after the day of the event except for the returns of HSBAL and BARCL which briefly ascend before following the trend. There appears to be little volatility over the event window for this particular event similar to what is observed in Event Window A2.1. It can also be observed that the returns in the figure generally appear to be negatively over the event window which is also consistent with the results observed for Event Window A2.1.

Figure 5.4. 5 Event Window B2.2 (5-day Event Window)



The returns over a ‘5-day Event Window’ as presented in Figure 5.2.5 appeared to generally present a similar pattern with the results described in Figure 5.4.4. Similar to what was observed in the previous event window the returns of HSBAL and BARCL are still exceptions to the trend. The distinction here however is that, the group CAAR returns appear to be on an upward trend after the 4th day following the event. The figure maintains the illustration of a generally negative trend in the returns over the specified ‘5-day Event Window’ following occurrence of the specified event. This reaction to the event also appears consistent with the results observed for Event Window A2.2.

Figure 5.4. 6 Event Window B2.3 (10-day Event Window)



A much broader view over a '10-day Event Window' of the reaction of the returns of sampled banks to the event is presented in Figure 5.4.6. The results presented in this figure similar to the other two event windows mostly indicates that returns begin to dip continuously until after the 4th day following the event when they experience a sustained upward trend until the 10th day. This observation is consistent for the portfolio and group returns. However, the overall impact of the event on the returns of the sampled banks observed over a 10 event window is inconclusive.

4.3.3.3 Event Date B3: Royal Assent 29th June 2023

The results presented in this section is associated with the event (Event B3) over the three identified event window periods. Table 5.2.3 presents the results in four broad columns. The first contains the ticker symbols of the sampled banks and the portfolio as well as group security roles. The results for the 3-day Event Window, 5-day Event Window and 10-day Event Window are presented in second, third and fourth columns respectively. Key results including CAARs, P values and standard deviation are presented appropriately under each column. The table shows that the individual security CAARs for the 3-day Event Window are all positive and insignificant. However, the observed returns of the group are positive and significant with a group CAAR of 3.6966% at 0.01 significance level. This implies that when examined over a 3-day Event Window, Event B3 had an insignificant positive effect on the returns of each individual sampled bank. On the other hand, when the banks are examined as a group, the effect is still positive with a group CAAR of 3.6966% at a significance level of 0.01. Moreover, when the impact of the event is examined over a 5-day Event Window, the effect of the event on the study's sampled banks is also positive. The examined event is also seen to have a significant marginally lower positive effect on the group, with a group CAAR of 2.1159% at a 0.01 significance level over the 5-day event window. Lastly, results obtained when the effects of the event are examined over a 10-day event window are similar to that of results from the 3-day event windows, except for the returns of NWGL which had a negative insignificant return of -4.121%. The effect of the event on the group of sampled banks is seen to be significantly positive with a substantially lower group CAAR of 1.1656% at significance level of 0.01.

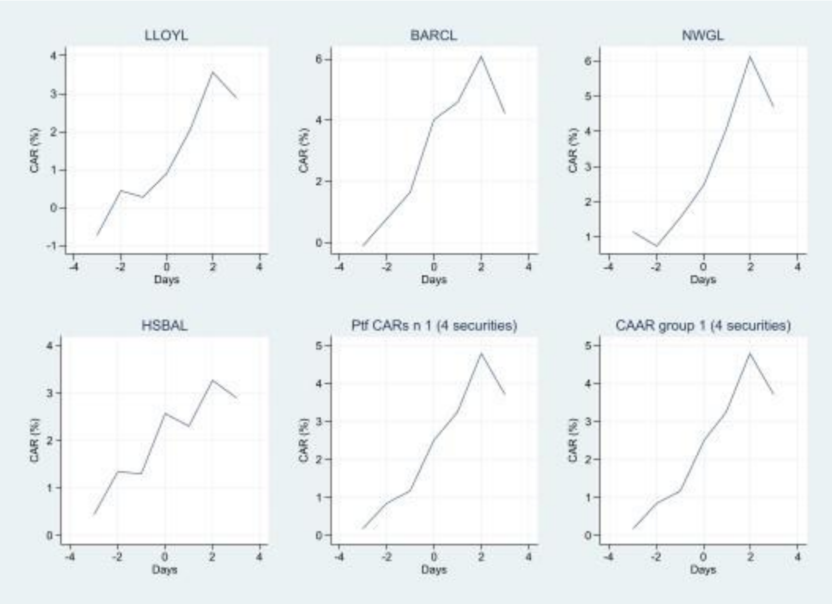
The results as presented in table 5.2.3 reveals that in all three specified event windows, 'Event B3' did not lead to a significant reaction from the individual stock returns of all sampled banks except when they are grouped. As can be further seen from the table, when the sampled banks are grouped, 'Event B3' has a significant positive effect overall.

Table 5.2. 3 Event Date B3 Royal Assent: 29th June 2023 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3-day Event Window			A 5-day Event Window			A 10-day Event Window		
Security	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	2.8926%	0.8663	0.1716	2.7242%	0.8993	0.2152	2.1857%	0.9414	0.2973
BARCL	4.2325%	0.9980	16.8913	0.6380%	0.9998	21.1743	2.4441%	0.9993	29.2565
NWGL	4.6969%	0.2671	0.0422	2.5638%	0.6286	0.0529	-4.1212%	0.5737	0.0732
HSBAL	2.9140%	0.4244	0.0364	2.4689%	0.5891	0.0457	3.9283%	0.5340	0.0631
Ptf CARs (4 securities)	3.6966%	0.4659	0.0506	2.1160%	0.7391	0.0635	1.1656%	0.8943	0.0877
CAAR (4 securities)	3.6966%***	0.0000	2.7386	2.1159%***	0.0000	2.7386	1.1656%***	0.0000	2.7386

*** p-value < .01, ** p-value <.05, * p-value <.1

Figure 5.4. 7 Event Window B3.1 (3-day Event Window)



The individual daily Cumulative Abnormal Returns (CAR) and group CAAR over a '3-day Event Window' for 'Event A3' is presented in Figure 5.2.7. The figure indicates that except for the returns of HSBAL which saw a brief dip immediately after the day of the event, all other returns appear to have experienced a sustain ascent until 2 days after the event where they begin to fall sharply. It can also be observed that the returns in the figure generally appear to be positive over the event window unlike the results observed for Event Window A3.1.

Figure 5.4. 8 Event Window B3.2 (5-day Event Window)

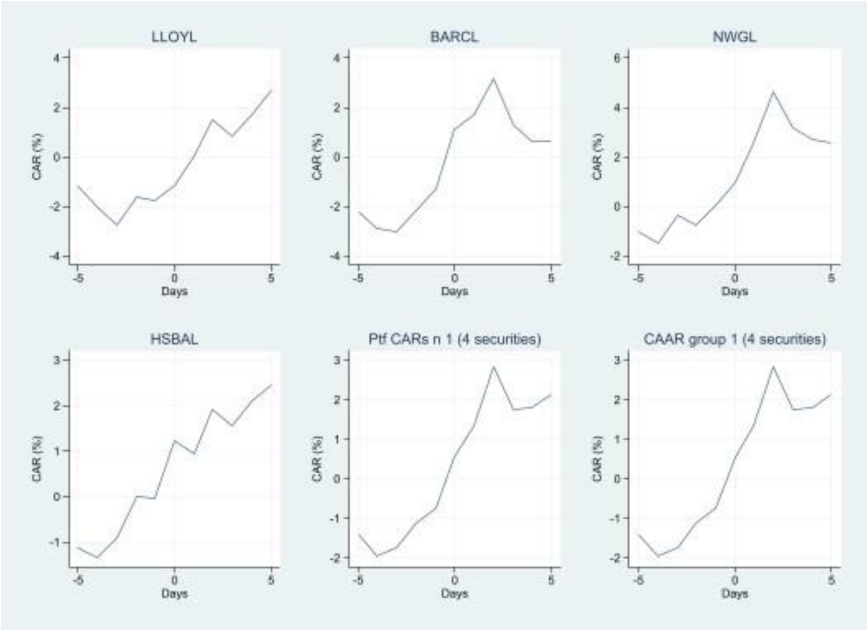
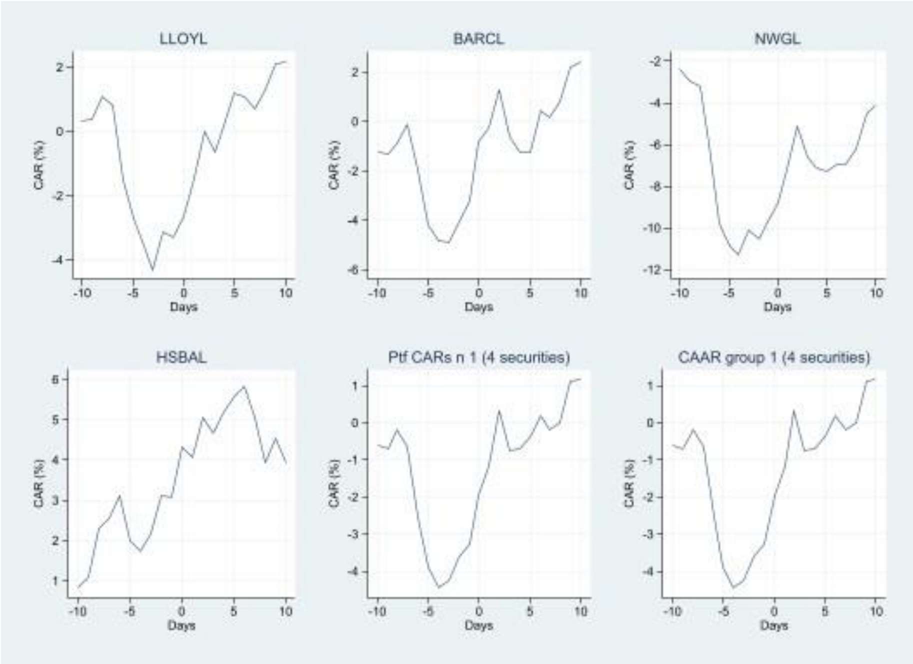


Figure 5.2.8 presents returns over a ‘5-day Event Window’ with similar pattern to Event Window B2.2. It is observed that the return from BARCL and NWGL sustain their decline after the second day following the event, whereas the returns from LLOYL and HSBAL appeared to be increasing after the 3rd day following the event after declining for only a day. The figure maintains the illustration of a generally positive fluctuation in returns over the specified ‘5-day Event Window’.

Figure 5.4. 9 Event Window B3.3 (10-day Event Window)



A clearer view of the relationship between the returns of sampled banks and ‘Event B3’ over a ‘10-day Event Window’ is presented in Figure 5.2.9. The figure indicates that returns of the sampled banks were positively affected when examined over a 10 day event window. The general trend observed is a lowest return seen 4 days before the date of the event and highest return seen after the 5th day following the event in all securities. This is also consistent for the grouped returns. This may be a sign of the impact of positive speculation by market participants or information spillages about the event, resulting in the largely positive market reaction to the event prior to its occurrence.

Table 5.3. 1 Summary of Empirical Results from the Event Study of the Enactment Banking Reform Act (2013)

Event ID	Event Description	Event Date	Event Window	Impact on Individual CAAR	Impact on Group CAAR	Significant Impact on Individual Securities	Significant impact on Group	Unsystematic Risk
A	Main Event - The key events associated with the passing of the Banking Reform Act (2013)	9th July 2013 – 18th December 2013		Mostly Positive	Negative	No	Yes	Low Risk Impact
A1	Third reading House of Commons	9th July 2013	3- Day Event Window	Positive	Positive	No	Yes	Low Risk
			5- Day Event Window	Positive	Positive	No	Yes	Low Risk
			10- Day Event Window	Positive	Positive	No	Yes	Low Risk
A2	Third reading House of Lords	9th December 2013	3- Day Event Window	Negative	Negative	No	Yes	Low Risk
			5- Day Event Window	Mostly Negative	Negative	No	Yes	Low Risk
			10- Day Event Window	Mostly Positive	Positive	No	Yes	Low Risk
A3	Royal Assent	18th December 2013	3- Day Event Window	Mostly Positive	Negative	No	Yes	Low Risk
			5- Day Event Window	Negative	Negative	No	Yes	Low Risk
			10- Day Event Window	Evenly Split	Negative	No	Yes	Low Risk

Table 5.3. 2 Summary of Empirical Results from the Event Study of the Enactment Financial Services and Markets Act (2023)

Event ID	Event Description	Event Date	Event Window	Impact on Individual CAAR	Impact on Group CAAR	Significant Impact Individual Securities	Significant impact on Group	Unsystematic Risk
B	The key events associated with the passing of the Financial Services and Markets Act (2023)	7th December 2022 to 29th June 2023		Mostly Positive	Positive	No	Yes	Low Risk Impact
B1	Third reading House of Commons	7th December 2022	3- Day Event Window	Positive	Positive	No	Yes	Low Risk
			5- Day Event Window	Mostly Negative	Negative	No	Yes	Low Risk
			10- Day Event Window	Positive	Positive	No	Yes	Low Risk
B2	Third reading House of Lords	19th June 2023	3- Day Event Window	Mostly Negative	Negative	1 out of 4	Yes	Low Risk
			5- Day Event Window	Mostly Negative	Negative	1 out of 4	Yes	Low Risk
			10- Day Event Window	Evenly Split	Positive	No	Yes	Low Risk
B3	Royal Assent	29th June 2023	3- Day Event Window	Positive	Positive	No	Yes	Low Risk
			5- Day Event Window	Positive	Positive	No	Yes	Low Risk
			10- Day Event Window	Mostly Positive	Positive	No	Yes	Low Risk

4.3.4 Testing the Second Hypothesis (H2)

The Event Study Methodology (ESM) is a statistical method used to study the impact of events on stock prices. In this study, ESM was used to examine the impact of regulatory events on bank stock prices. The study focused on the enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). The ESM is a valuable tool for researchers because it allows them to isolate the impact of an event on a stock's price. This is done by calculating the abnormal return, which is the difference between the actual return and the expected return. The expected return is calculated using a statistical model that takes into account the overall market movements and other factors that may affect the stock price.

The ESM was used to test the second hypothesis (H_2) by examining the impact of regulatory events on bank stock prices. The study focused on the enactment of the Banking Reform Act (2013) and the Financial Services and Markets Act (2023). The study found that these events had a significant impact on bank stock prices. Specifically, the study found that the Banking Reform Act (2013) had a negative impact on bank stock prices, while the Financial Services and Markets Act (2023) had a positive impact on bank stock prices. The results of the ESM analysis support the second hypothesis (H_2). The findings suggest that regulatory events can have a significant impact on the market value of retail banks. This information is important for investors and policymakers. Investors can use this information to make informed investment decisions. Policymakers can use this information to design regulations that promote financial stability

Research Question 2: How is the market value of retail banks affected by events associated with regulatory reforms?

The ESM findings showed that the Banking Reform Act (2013) was generally associated with negative but insignificant effects on individual bank returns, while the Financial Services and Markets Act (2023) was linked to positive and significant effects. These results suggest that regulatory reforms can significantly impact the market value of retail banks, with the direction of the impact depending on the specific reform.

4.4 The Impact of Regulatory Reforms on the Profitability of the Big Four Banks in the UK

4.4.1 Descriptive Statistics

This section describes the characteristics of the data used in this, in accordance with the methodological framework outlined in Section 3.8.3. This section also presents the characteristic associated with the data. It is vital to present these statistics in a study as it enables us to describe, compare and contrast the study variables mathematically. These kinds of statistics are also relevant for identifying basic features of the data used in this study. These features include simple summaries regarding the sample and the data structure of variables included in the study. Descriptive statistics coupled with sound graphical representation is argued to be the foundation of sound econometric data analysis (Saunders, Lewis and Thornhill, 2023).

The remaining aspects of this section are presented in the following order. A panel data summary statistic of the variables used in the models of this study are presented in Table 3 and discussed thereafter. This summary also allows for analysis of the datasets used in the study, including an assessment of the preliminary features of the bank profitability variables (dependent variables), the variables influenced by bank regulation (independent variables) and the control variables.

Table 6. 1 Panel Data Summary Statistics of Model Variables

Variable		Mean	Std. dev.	Min	Max	Observations
ROA1	overall	45.66304	26.46593	1	91	N = 92
	between		5.347458	42.34783	53.65217	n = 4
	within		26.05309	-4.98913	87.48913	T = 23
ROE1	overall	45.66304	26.46593	1	91	N = 92
	between		6.281806	40.34783	53.17391	n = 4
	within		25.89449	-4.51087	93.31522	T = 23
NIM	overall	.1515557	.2229379	-.963555	.555555	N = 91
	between		.0465718	.0958293	.209832	n = 4
	within		.2191769	-.9078285	.4972787	T-bar = 22.75
HQLAs1	overall	46.5	26.70206	1	92	N = 92
	between		11.60022	37.21739	63.04348	n = 4
	within		24.71775	-7.543478	98.58696	T = 23
Capital1	overall	29.73913	19.36115	1	64	N = 92
	between		3.215628	26.82609	34.26087	n = 4
	within		19.15761	-2.521739	63.43478	T = 23
Teir1 1	overall	28.77174	18.67896	1	62	N = 92
	between		3.612862	25.26087	33.69565	n = 4
	within		18.41212	.8152174	64.51087	T = 23
Teir2_1	overall	31.42857	23.04019	1	72	N = 84
	between		4.796297	26.08696	37.08696	n = 4
	within		22.63169	-2.658385	67.81988	T-bar = 21
Loans	overall	.8965204	.1948239	.323387	1.469814	N = 91
	between		.1614477	.7214327	1.107324	n = 4
	within		.1358723	.4984747	1.25901	T-bar = 22.75
Equity~h	overall	.1015175	.3649964	-.381575	2.494113	N = 90
	between		.0383268	.0452116	.1284949	n = 4
	within		.363455	-.399467	2.467136	T-bar = 22.5
LLP1	overall	44.94444	25.69587	1	89	N = 90
	between		6.349477	39.81818	53.13043	n = 4
	within		25.09162	-1.18599	88.03535	T-bar = 22.5
Staff	overall	.2724582	.0848494	0	.6189	N = 91
	between		.039954	.2162957	.3101391	n = 4
	within		.0773035	-.0376809	.6140355	T-bar = 22.75
Inflat~n	overall	.0224783	.0144309	.004	.079	N = 92
	between		0	.0224783	.0224783	n = 4
	within		.0144309	.004	.079	T = 23
Interest	overall	.0218504	.0204319	.00175	.05875	N = 92
	between		0	.0218504	.0218504	n = 4
	within		.0204319	.00175	.05875	T = 23
GDP	overall	.016663	.0345618	-.11025	.08525	N = 92
	between		0	.016663	.016663	n = 4
	within		.0345618	-.11025	.08525	T = 23

Source: STATA data analysis output for panel data summary Statistics.

The most useful measures presented in Table 3 above are the mean and standard deviation. The mean is the most frequently used measure of central tendency and includes all data values in its calculation. A drawback of the calculated mean value is the fact that it is unduly influenced by extreme data values or outliers. However, outliers are to be considered a fact of life and should be acknowledged but not altered since altering data for this purpose may produce results that do not truly reflect the research problem. The standard deviation on the other hand is the square root of the variance associated with the study's data. A large standard deviation relative to the mean suggests that the mean does not represent the data well.

The summary statistic output presented in Table 3 above indicates that among the three measures of profitability considered in this study, ROA and ROE on an average recorded the highest profitability values. This implies that over the period between 2000 and 2022, the sample banks which account for 91% of the total assets in the UK's banking sector (see Figure 2) realised an average profitability of 45.6% as measured by ROA and ROE. However, due to the nature of the study data, the standard deviation was calculated for overall, between and within effects to correspond with the respective panel data analysis effect model. Therefore, in assuming the fixed effects model, the study consider within the standard deviation of 26.1 and 25.9 calculated for ROA and ROE respectively and conclude that the means do not adequately represent the data. On the other hand, if the study is considering the random effects model, the study consider between standard deviations and conclude that the means adequately represent the data.

When considering variables directly influenced by bank regulation, the summary statistics in Table 3 include that high quality liquid assets, loan loss provisions and capital were the most influenced over the period studied. These variables showed average annual rates of 46.5%, 44.9% and 31.4% respectively. Whereas, staff costs, equity growth and loans presented the lowest annual rate of 0.27%, 0.1% and 0.89% respectively. This implies that regulatory reforms such as Basel II and III as well as the Bank reforms act (2013) concerning liquidity and capital requirements evidently affected the liquidity and capital positions of banks more strongly.

4.4.2 Graphical Representation of Key Variables Influenced by Bank Regulation

4.4.2.1 Measures of Profitability

In the graphs presented below, banks numbered 1, 2, 3 and 4 are HSBC Bank Plc, Barclays Bank Plc, Lloyds Banking Group PLC and NATWEST Group PLC respectively. As can be seen from Figures 3, 4 and 5, the profitability of the sampled Bank 1 has been on a consistent decline from the year 2000 to 2023. Whereas, the profitability of Banks 2, 3 and 4 appear to be on the rise following a decline during the global financial crisis. It can also be seen from Figures 3, 4 and 5, that changes in profitability are more pronounced in the profitability measures ROA and ROE compared to NIM. This may be attributed to a volatile interest rate regime in the UK over the period of study and a sharp increase in more recent times from December 2021. As can be seen in Appendix 5, high interest rates were present in the early 2000s up until after the financial crisis in April of 2009 and again in December 2021 as an effect of the economic downturn suffered as a result of covid-19. The performance of ROA and ROE may have been impacted by the increasing liquidity and regulatory requirements over the period considered.

Figure 6. 1 Return on Assets

Figure 6. 2 Return on Equity

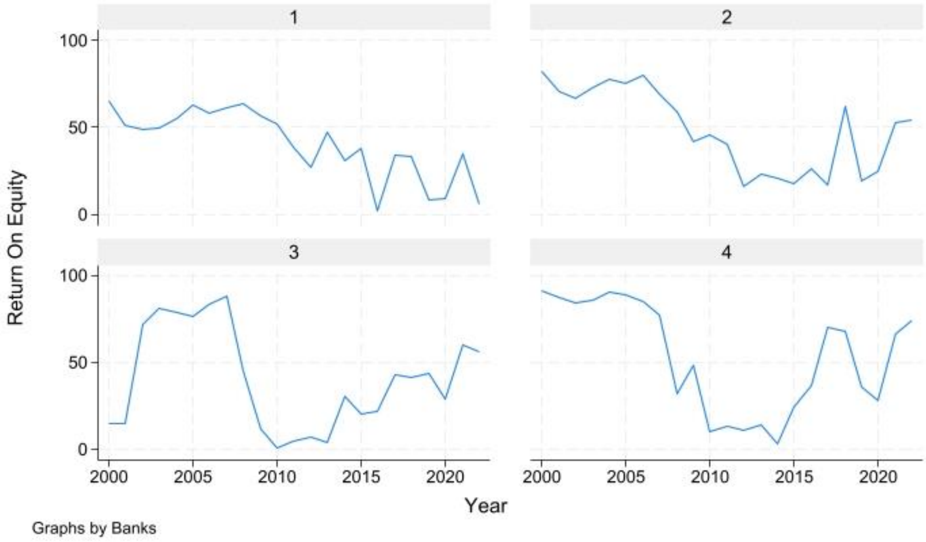
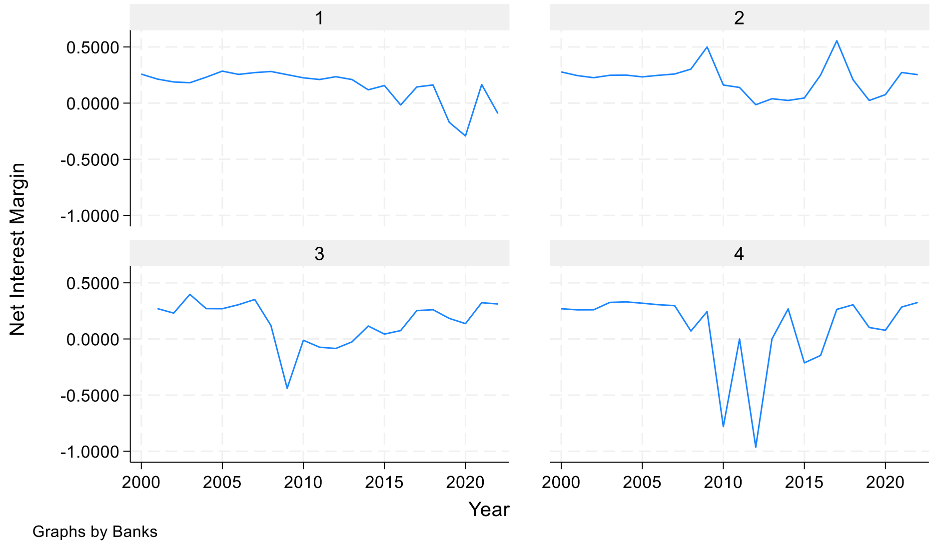


Figure 6. 3 Net Interest Margin



4.4.2.2 Variables Influenced by Capital and Liquidity Regulation

The main measures of bank liquidity and capital requirements presented in Figures 6 and 8 are seen to have increased systematically in accordance with regulatory requirements over the studied period. The graphical representation indicates a consistent increase in the amount of capital and liquidity held by banks over this period. To meet the liquidity requirement of 100% or more of HQLAs, it can be seen from Figure 6 that the sampled banks in the UK took on more and more level 1 assets in proportion to their total assets. This is because banks are required to have at least 60% of their HQLAs made up of level 1 assets, which is the highest quality assets a bank can hold. A similar picture is painted in Figure 8 regarding the effect of capital requirements on the tier 1 capital of the sampled banks. In the graphs presented below, banks numbered 1, 2, 3 and 4 are HSBC Bank Plc, Barclays Bank Plc, Lloyds Banking Group PLC and NATWEST Group PLC respectively.

Figure 6. 4 HQLAs

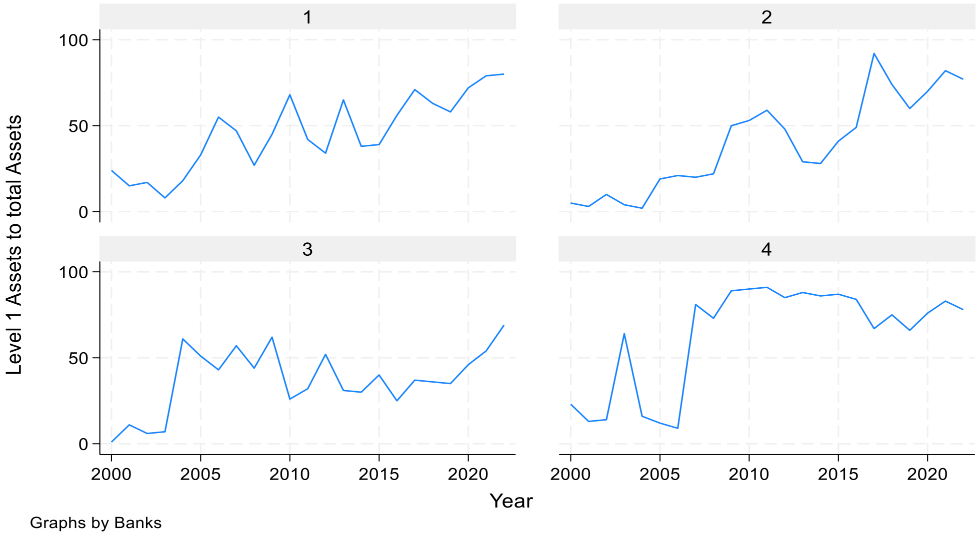


Figure 6. 5 Total Capital

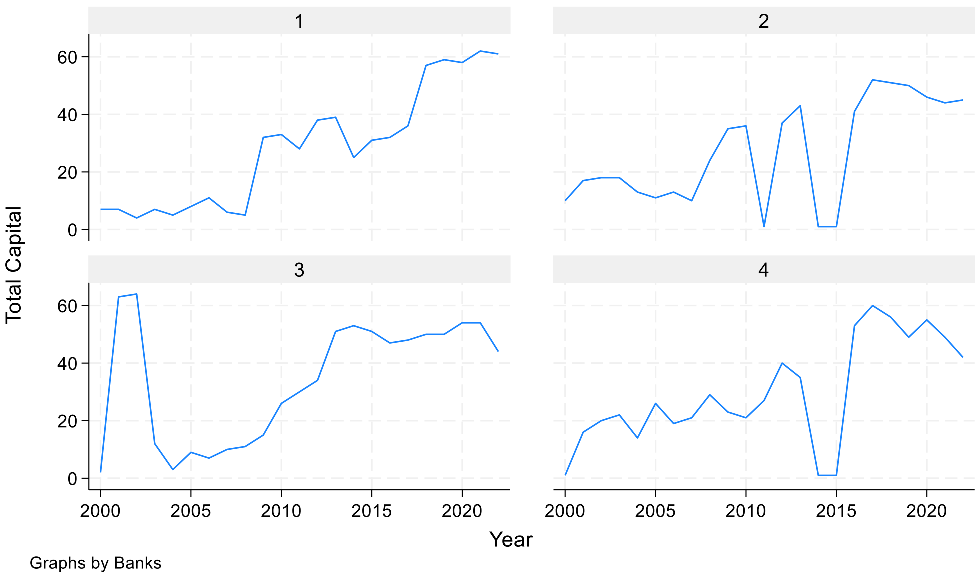


Figure 6. 6 Tier 1 Capital

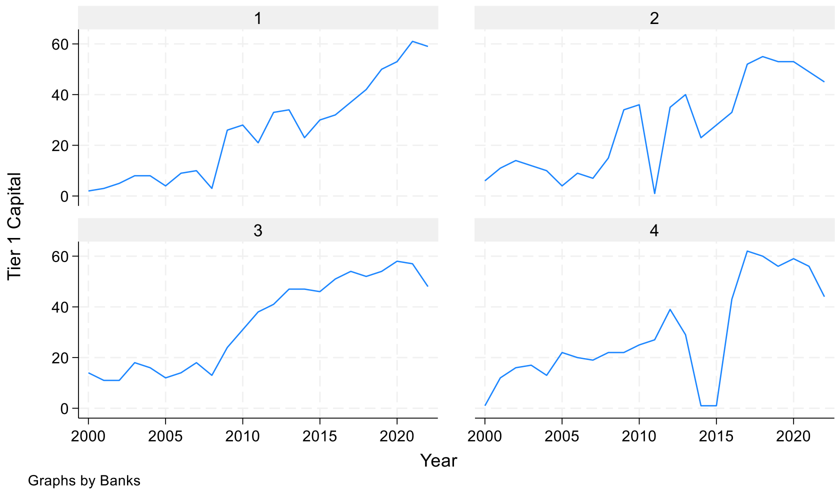


Figure 6. 7 Loans

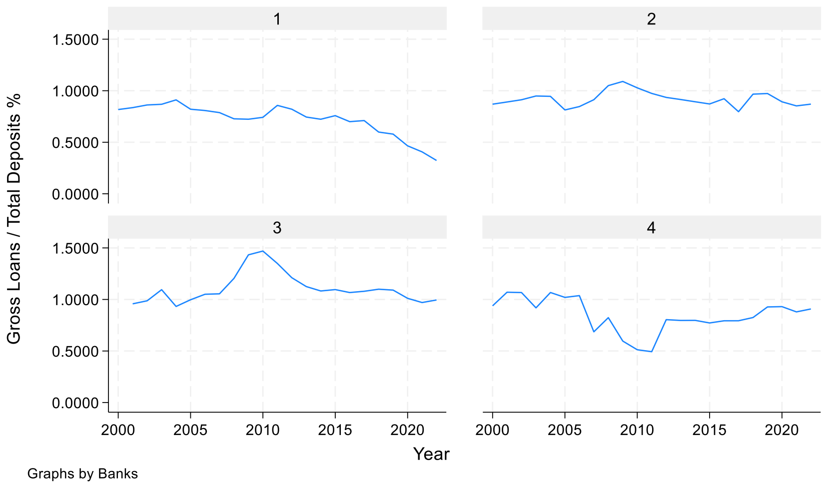


Figure 6. 8 LLP

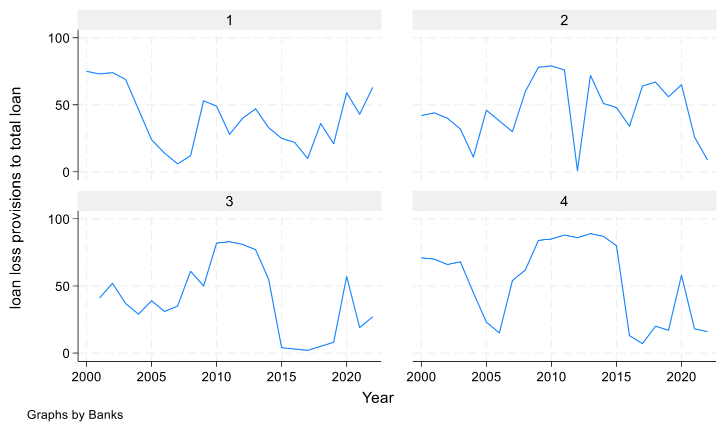
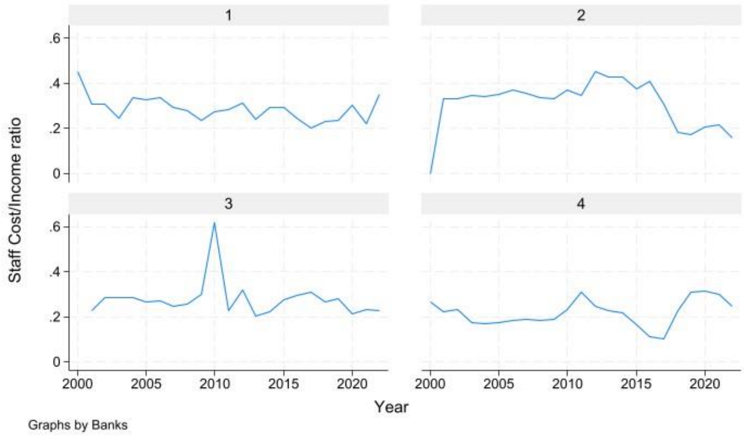


Figure 6. 9 Staff Cost



4.4.3 Empirical Results

The study followed the methodological framework laid out in Section 3.2.4 above. Following this framework, the study run regression analyses with the fixed effects models and random effects models in STATA. These regression analyses were run with the three measures of bank profitability namely ROA, ROE and NIM as the dependent variables in three consecutive models under each effect. A Hausman test was conducted to determine which model is better suited for the study under each respective measure of profitability. Additionally, the Breusch Pagan Lagrange Multiplier test was also conducted to validate the results provided by the Hausman test (Breusch and Pagan, 1980). Finally, the Breusch-Pagan test was performed to test for heteroscedasticity (Baltagi, 2001).

To analyse the data gathered by this study, robust fixed effects and random effects regression analysis were conducted with results presented in Appendix 1 (Table 4 and Table 5). Hausman test was subsequently conducted to decide between fixed effects and random effects regression models. However, the results of the Hausman test as seen in Appendix 2 stipulated that the null hypotheses be accepted in all three consecutive regressed models (i.e. models for ROA, ROE and NIM). This implies that the random effects model is a better fix for the data used in the study. An assessment of the output of the random effects models revealed estimated values for Sigma_u and rho of zero. As this is an unusual output, an attempt is made to provide an explanation with the following points. First, this may imply that models contain no time-invariant errors. Second, it may mean that the random effects estimators have degenerated into OLS estimators. Third, the observations in the study were not sampled at random from a larger population, but rather purposively sampled and as a result may have created a strong correlation between u estimates of the models and the independent variables.

The study went further to test the effectiveness of the random effects model using the Breusch Pagan Lagrange Multiplier test discussed in Section 3.2.4.3. As can be seen from the results of this test presented in Appendix 3, the p values are consistently equal to 1 for all three models (i.e. ROA, ROE and NIM). Consequently, the study fail to reject the null hypotheses and conclude that the random effects are not significant. This implies that the use of the random effects model is not appropriate for the data used in this study. As discussed in Section 3.2.4.3, robust pooled OLS regression models have been reported by this study following the implication of the results of the Lagrange Multiplier test. Overall, a pooled OLS regression has been used for the following two reasons. First, random effects estimators from the random effects models have degenerated into OLS estimators. Second, the results of the Breusch Pagan Lagrange Multiplier test suggest that pooled OLS regression is more appropriate for the study.

The study also tested for the presence of heteroskedasticity in all three models using both a graphical approach and the Breusch-Pagan test. The results of the graphical approach can be seen in Appendix 5 and that of the Breusch-Pagan test in Appendix 4. As can be seen in Appendix 4, the results for the Breusch Pagan test provided p-values of 0.000, 0.000 and 0.0547 for fitted values of ROA, ROE and NIM respectively. Consequently, the study reject the null hypothesis in the first two models and marginally fail to reject the null hypothesis in the third model. Both tests suggest the possible presence of heteroskedasticity in two out of the three models. The third model only shows a weak and unconvincing presence of homoscedasticity. This may present a problem of the wrong estimates of the standard errors for the coefficients and therefore their t-values. The study controlled for the presence of heteroskedasticity by using heteroskedasticity-robust standard errors. The specific STATA command used can be seen in Appendix 4. To reduce the impact of outliers in the data and on the results of the analysis, the study data was transformed by taking natural logs of all variables in STATA. In addition to reducing the impact of outliers, this approach allowed us to further linearize the relationship between variables.

Table 6. 2 Estimated coefficients from ROA, ROE and NIM Linear Panel Model Regression Analysis (pooled OLS)

VARIABLES	Model (1) Dep Var: ln_ROA1	Model (2) Dep Var: ln_ROE1	Model (3) Dep Var: ln_NIM
ln_HQLAs1	0.381**	0.324**	0.268*
	(0.0129)	(0.0362)	(0.0573)
ln_Capital1	0.442	0.435	0.426**
	(0.180)	(0.171)	(0.0424)
ln_Teir1_1	-0.220	-0.198	-0.460**
	(0.517)	(0.508)	(0.0333)
ln_Teir2_1	-0.138	-0.139	0.0404
	(0.516)	(0.516)	(0.604)
ln_LLP1	-0.0582	-0.0726	-0.0691
	(0.631)	(0.527)	(0.330)
ln_Loans	1.971*	1.779	0.530
	(0.0703)	(0.109)	(0.506)
ln_EquityGrowth	-0.359*	-0.366*	-0.130
	(0.0813)	(0.0710)	(0.303)
ln_Staff	-0.754	-0.642	-0.473**
	(0.331)	(0.366)	(0.0486)
ln_Inflation	-0.302	-0.238	-0.00206
	(0.427)	(0.532)	(0.995)
ln_Interest	0.843**	0.850**	0.259
	(0.0370)	(0.0446)	(0.185)
ln_GDP	0.562	0.552*	0.263
	(0.106)	(0.0896)	(0.120)
Constant	5.199**	5.750**	-1.136
	(0.0112)	(0.0233)	(0.414)
Observations	46	46	39
R-squared	0.514	0.519	0.709
Root MSE	0.8334	0.8328	0.3773

Robust P values in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Source: STATA pooled OLS regression output

Table 6 gives the estimated coefficients from the linear pooled OLS panel model. The results show relationships between the proxies of capital and liquidity regulation (independent variables) with all three dependent variables (measures of profitability). However, only the coefficients of the proxy of liquidity regulation are efficient. The results show a significant positive association between liquidity regulation (Proxied by HQLA) and all three measures of profitability. This implies that bank profits increase as their level of liquidity increases. This allows us to conclude that liquidity regulation increases bank profitability by all three measures. On the other hand, the impact of capital regulation is mixed and depends on the type of capital affected by the regulation. Total capital has a positive association with bank profitability, given that all three modelled measures of profitability, although only significant under the third model. Conversely, Tier 1 capital specifically has a negative association with all three measures of profitability and is significant in only the third model. These results allow us to conclude that capital regulation that causes total bank capital to increase, consequently increases bank profitability.

The other independent variables in the models which may be indirectly impacted by liquidity and capital regulation largely present a negative association with bank profitability. As seen in Table 6, LLP which is a measure of the amount of risk taken by banks has a weak negative relationship with bank profitability in all three models. This implies that an increase in risk taking by banks only modestly decreases the profits of those banks. On the other hand, other independent variables such as Staff cost and year-on-year equity growth, have a much stronger negative association with bank profitability in all three models. Evidence suggests that as the cost of staff of banks increases, so does their profitability. However, as banks do not currently have a standard reporting structure for staff costs specifically attributable to increasing regulatory reforms, it is impossible to attribute this negative relationship to the impact of liquidity and capital regulation.

Also, in the results presented in Table 6, R-squared values of above 50% can be observed for all three models indicating an above-average goodness-of-fit. This also indicates the percentage of the variance in the dependent variable that the independent variables explain collectively. Simply put, based on the data used in the study, over 50% of the variations in bank profitability are explained by changes in liquidity and capital regulation as well as the other independent variables in the model. Table 6 also presents Root MSEs (Mean Squared Error) of 0.8334, 0.8328 and 0.3773 for each of the three models respectively. This allows us to interpolate within the study's described data set to predict the profitability of banks so long as the variables influenced by liquidity and capital regulation are within the studies described datasets. Therefore, given a prediction interval of 95% all three models will give us a precise prediction of bank profitability with a width of about +/- 2 on average.

4.4.4 Testing the Third Hypothesis (H_3)

The study used three panel regression models to test the hypothesis that regulatory reforms in the UK have a significant impact on the profitability of UK retail banks. Panel Regression Analysis is a statistical method that is used to study the relationship between two or more variables over time. In this study, panel regression analysis was used to identify the specific regulatory factors that influence bank profitability. The study tested both fixed effects and random effects of all three models to control for unobserved heterogeneity across banks and time. Fixed effects models control for time-invariant bank-specific characteristics, such as management style or organizational culture. Random effects models assume that these unobserved effects are random and uncorrelated with the included explanatory variables.

To test the third hypothesis (H3), the study used a panel regression model to investigate the relationship between regulatory variables and bank profitability. The study focused on the impact of capital and liquidity regulations on bank profitability. The study found that capital and liquidity regulations significantly impacted bank profitability. Specifically, the study found that capital regulation positively impacted bank profitability, while liquidity regulation negatively impacted bank profitability. The results of the panel regression analysis support the third hypothesis (H3). The findings suggest that regulatory reforms can significantly impact the profitability of retail banks.

Research Question 3: How does bank regulation affect the profitability of retail banks?

The panel regression analysis used to address this question indicated a positive association between liquidity regulation and profitability measures, suggesting that tighter liquidity regulation can enhance profitability. The impact of capital regulation was mixed, with total capital positively associated with profitability but Tier 1 capital negatively impacting it. These findings suggest that regulatory reforms can affect the profitability of retail banks, with the direction of the impact depending on the specific type of regulation.

4.5 Chapter Summary

This chapter has provided a comprehensive analysis of the impact of liquidity and capital regulatory reforms on the efficiency, market value, and profitability of the UK's largest retail banks. Through a robust methodological approach, encompassing Data Envelopment Analysis, Event Study Methodology, and panel regressions, several key findings have emerged. Firstly, the study revealed that while US banks exhibit marginally higher efficiency scores compared to their UK counterparts, UK banks demonstrate greater responsiveness to regulatory changes. This suggests that the UK regulatory framework, while stringent, fosters an environment conducive to adaptation and efficiency improvements. Secondly, the Event Study analysis highlighted the significant impact of regulatory events on bank stock prices. The Banking Reform Act (2013) was generally associated with negative market reactions, indicating investor concerns about its potential impact on bank profitability. Conversely, the Financial Services and Markets Act (2023) elicited positive responses, suggesting market confidence in its potential to enhance the UK financial sector. Thirdly, the panel regression analysis demonstrated the complex relationship between regulatory reforms and bank profitability. While liquidity regulation was found to have a positive association with profitability, the impact of capital regulation was more nuanced. Increases in total capital were linked to higher profitability, while stricter Tier 1 capital requirements appeared to exert a negative influence.

These findings underscore the profound influence of regulatory reforms on the UK banking sector. They provide valuable insights for policymakers, emphasizing the need for a balanced approach to regulation that fosters financial stability while enabling banks to operate efficiently and profitably. Moreover, the study highlights the importance of considering the dynamic interplay between different types of regulation and their combined effect on bank performance. Future research could delve deeper into the specific mechanisms through which regulatory reforms affect bank behaviour and performance. Investigating the impact of individual regulatory measures, exploring cross-country comparisons, and incorporating qualitative data from bank executives and regulators could further enrich the study's understanding of this complex relationship.

In conclusion, this chapter has contributed to the body of knowledge on the impact of regulatory reforms in the banking sector. Its findings provide relevant findings on the relationship between regulation and bank performance, offering valuable insights for policymakers and academics alike. By shedding light on the intricate dynamics of this relationship, the study paves the way for informed policy decisions that promote a resilient and efficient banking system

Chapter 5 Discussion

5.1 Chapter Introduction

This chapter critically examines the findings of the study in relation to existing literature, offering a comprehensive analysis of the impact of liquidity and capital regulatory reforms on UK retail banks. It dissects the research results concerning bank efficiency, market value, and profitability, providing an understanding of the complex interplay between regulatory changes and bank performance. The discussion begins by comparing the efficiency of UK banks to their US counterparts, revealing that while US banks demonstrate marginally higher efficiency, UK banks exhibit greater responsiveness to regulatory changes. This observation highlights the adaptive capacity of UK banks within a stringent regulatory framework. The chapter then examines the specific impacts of capital and liquidity regulations on efficiency, drawing parallels and contrasts with existing empirical evidence. It underscores the role of capitalisation in enhancing bank resilience and efficiency, while also acknowledging the potential trade-offs associated with stricter liquidity requirements.

The discourse then shifts to the impact of regulatory reforms on bank market value. By analysing the market reactions to two landmark reforms, the Banking Reform Act (2013) and the Financial Services and Markets Act (2023), the study reveals contrasting investor sentiments. While the former was met with apprehension, reflected in negative stock returns, the latter instilled confidence, leading to positive market responses. This analysis underscores the importance of regulatory clarity and predictability in shaping investor perceptions and market valuations. Finally, the chapter dissects the relationship between regulatory reforms and bank profitability. It presents compelling evidence suggesting that liquidity regulation enhances profitability across various measures, while the impact of capital regulation is contingent on the specific capital type and the bank's existing capitalization level. This understanding challenges some prevailing views and contributes to a more refined comprehension of the regulatory impact on bank profitability.

In essence, this chapter serves as a critical lens, scrutinizing the research findings in light of existing literature and providing a holistic interpretation of the complex relationship between regulatory reforms and bank performance. It highlights the complicated nature of this relationship, emphasising the need for a balanced regulatory approach that fosters both stability and efficiency in the UK banking sector.

Structure of this chapter is as follows. Section 5.2 discusses the impact of liquidity and capital regulatory reforms on the efficiency of retail banks, comparing UK and US banks and analysing the effects of specific regulatory measures. Section 5.3 examines the impact of regulatory reforms on the market value of retail banks, employing an Event Study Methodology to assess investor reactions to key regulatory events. Section 5.4 discusses the impact of regulatory reforms on the profitability of the big four banks in the UK, analysing the relationship between regulatory variables and various profitability measures. Section 5.5 provides a concise chapter summary, encapsulating the key findings and their implications for the banking industry and regulatory policy.

5.2 The Impact of Liquidity and Capital Regulatory Reforms on the Efficiency of Retail Banks

The findings of this thesis indicate that the US banks sampled are marginally more efficient than the sampled UK banks when the impact of regulation is considered over a 20-year period. The study find that when using the basic DEA model, US banks are on average 4% more efficient than their UK counterparts. This is slightly reduced when the study account for the impact of time using the DEA based Malmquist index to 5.4% as shown in Figure 4.2. The time period of the empirical analysis conducted in this chapter ranged from the year 2000 to 2023. This allowed us to capture the effects of global phenomena such as the global financial crisis and the recovery thereafter. The study observe that, the technical efficiency of sampled banks in both countries on average declined by over 15% in the UK and 40% in the US.

The likely reason for this may be due to difference in the level of economic expansion in both countries during the crisis as measured by the GDP growth. Interesting is the rate of recovery by banks in both countries following the crisis. In 2010, technical efficiency of the sampled US was on average 45% above that of the UK banks. A similar trend was observed in the GDP growth rate over that period. the study’s findings are consistent with the latest empirical evidence from Ferrara and Kounetas (2024). They investigated the issue of US bank efficiency after the global financial crisis using a SFA approach that enables observation of the determinants of long term and short term inefficiencies. They found that most US banks exhibited increasing returns to scale efficiency in production and cost following the financial crisis.

The findings on the impact of capital requirements are consistent with the findings of Hsiao et al. (2010); Barth et al. (2013); Manlagnit, (2015); Phung et al. (2022) Obadire, Moyo and Munzhelele (2022); and Takahashi and Vasconcelos, (2024). These were however inconsistent with the findings from Pasiouras et al., (2009); and Laeven and Levine, (2009); and Lee and Chih, (2013). Empirical evidence from the analysis conducted in this chapter revealed that the efficiency of sampled UK banks is positively related to stringent capital requirements. The study find that the higher the amount of capital held, the more efficient the sampled banks become, indicating that more capitalized banks acquire a greater capacity to absorb losses and run less risk of becoming insolvent. Therefore, these banks tend to become more efficient (Hsiao et al., 2010).

Manlagnit (2015) similarly assert that higher capital requirement tends to improve the cost efficiency, but more powerful supervisors may adversely affect the efficiency of the banks. These findings are consistent with that of Obadire, Moyo and Munzhelele (2022), who examined the relationship between Basel III capital regulations and bank efficiency. These consistent findings imply that higher capital does not only protect against financial, market and economic shocks, but also improves the banking efficiency by influencing the banks' decisions around cost containment strategies such as proactive regulatory compliance.

The identified relationship has been more recently corroborated by Takahashi and Vasconcelos (2024) who emphasise that that well-capitalized banks may also have higher efficiency–which contradicts previous works from Hsiao et al. (2010); Barth et al. (2013); and Phung, Van Vu and Tran (2022). However, their findings presented by Takahashi and Vasconcelos (2024) on the impact of inflation and GDP are sharply contrasted by the findings in this chapter. First, they assert that a country's inflation is negatively associated with bank efficiency, suggesting that a lower inflationary environment is more conducive to efficient bank operations. The study find the reverse to be true, although the study's study employed a much smaller sample size.

Takahashi and Vasconcelos (2024) also argue that a higher GDP leads to more efficient banking system. Whereas empirical evidence to the contrary is presented in this chapter. Further to this, none of the macroeconomic variables analysed in this chapter displayed any statistical significance unlike in the findings of Takahashi and Vasconcelos (2024). the study's findings on this also contradict older works such as Garza-García (2012), Nguyen et al. (2016) and Tan (2016) who argued that the economic growth rate was positively related to technical efficiency. As alluded to previously, the study's findings partially disprove that of Lee and

Chih, (2013). They originally argue that stricter liquidity regulation may be good for bank stability by reducing risk, but not for bank efficiency. Although statistically insignificant, the study's findings reiterate the fact that higher liquidity ratio impedes the efficient operation of banks due to the near idle nature of funds.

Furthermore, the time period considered in this study revealed the impact of the unforeseen global shocks such as the COVID-19 pandemic on bank efficiency. As can be seen in Figure 4.2 and Tables 4.3 and 4.4, the pandemic adversely affected the efficiency of sampled banks in both countries. As identified by Demirgüç-Kunt, Pedraza and Ruiz-Ortega, (2021) this could have been due to the caused significant economic changes caused by the pandemic. Although the impact on banks depended on their characteristics and pre-crisis vulnerabilities, policy measures such as liquidity support, borrower assistance and monetary easing reduced this adverse impact for some banks, but not all banks.

Capital regulation is often described as the required amount of capital that owners of a bank must have at risk. This is intended to control bank risk taking as well as to some extent promote bank efficiency Barth et al (2013). Agoraki, Delis, and Pasiouras, (2011), argue that when capital requirements are more stringent, it raise barriers to entry for new banks and impedes competition. This results in banks making lending decisions that are more prudent, hence leading to higher bank efficiency. This is confirmed by the findings in this study which found that increased capitalization and loan loss provision (a measure of the risk of a bank) have varying impacts on the efficiency of banks. Similarly, Psillaki and Mamatzakis (2017) provide evidence which clearly demonstrates that better capitalized banks are more cost efficient irrespective of the stringency or prevailing regulatory environment. The findings in this chapter reinforce these previous findings since the study confirm that higher capitalized banks are more efficient by analysing data spanning different regulatory regimes. On the contrary, earlier studies by Pasiouras, Tanna and Zopounidis (2009); and Laeven and Levine, (2009), found that rigorous capital regulation results in the management of banks seeking to atone for the loss of benefits due to capital regulation. This is done by pursuing relatively more expensive and riskier financing sources which leads the banks to be inefficient.

Our findings also contradict findings from Obadire, Moyo and Munzhelele (2022) regarding to impact of liquidity regulation on bank efficiency. They argued that a positive relationship exists between bank operating efficiency and the liquidity coverage ratio. They rationalise this by asserting that banks with well-performing liquidity ratios are efficient in their operations, with the ability to meet their short-term obligations such as meeting customers' credit needs, unannounced depositors' withdrawals, and creditors' repayments. Whereas empirical evidence from this study finds that liquidity requirements and its components such as the HQLA, have a negative relationship with bank technical efficiency, the study's evidence revealed that stricter liquidity requirements creates a liquidity buffer for banks, which in turn results in idle funds which could otherwise be employed in productive activity by the banks.

Empirical evidence from this chapter revealed that banks stand to enhance their efficiency if they decrease their loan loss provisions by reducing the amount of risky loans on their books to begin with. On the other hand, if banks continue to engage in increased risky lending they may be exposed to 16% decline in the efficiency. These findings are consistent with Manlagnit (2015) who also presents empirical evidence suggesting that higher efficiency is expected to be correlated with better credit risk evaluation and banks with less risky assets as proxied by loan loss provisions. They further argue that capital requirements may lead banks to having better risk management if they assume greater ownership of their activities as is the object of the Basel Accords. That is increased capital requirements allows banks to better manage their risk-taking activities.

Phung, Van Vu and Tran (2022) more recently presented similar evidence in their study. They argue that non-performing loans are negatively related to bank efficiency. Their study similarly viewed bank capitalisation as a catalyst in assessing the relationship between bank risk and bank efficiency. They argue that the negative relationship is less pronounced in banks with a higher capitalisation. In other words, stringent capital regulation may help reduce bank risk, but may not be a highly significant benefit for efficiency gains. Similarly, earlier studies by Barth et al. (2004); Beltratti and Stulz (2012); Barth et al., (2013); and Danisman and Demirel (2019) assert that the tendency of banks to engage in riskier investments is curtailed if they have to fulfil higher levels of capital requirements.

5.3 The Impact of regulatory reforms on market value of retail banks Employing an Event Study Methodology

Our study examined the effect of two of the UK's most ground-breaking financial regulatory reforms on the market value of the four largest banks by total assets and market capitalization. As presented in Section 3.7, Lloyds Banking Group, Barclays Bank Plc, NATWEST Plc, and HSBC Bank have extreme domestic relevance and some international relevance across the EU. The 4 banks examined collectively account for over 90% of the total banking assets in the UK. The two regulatory reforms namely the Banking Reforms Act (2013) and the Financial Services and Markets Act (2023) were taken as the main events of interest with the various key stages in the legislative categorised as sub events. The study employed the Event Study Methodology to investigate the effects event these key legislative stages had on the market value of the study's sampled banks. The method was used to measure the Cumulative Average Abnormal Returns and unsystematic risk associated with shares of each of the sampled banks.

The empirical result from the investigation suggests that, the Banking Reforms Act (2013) had a mostly positive and insignificant effect on the returns of the individual sampled banks over the course of its passage or enactment. It is also worth noting that the stock market reaction varied across all three key events and respective event windows. For instance, as shown in Table 5.3.1 the first event, event A1 (Third reading of the bill by the House of Commons on the 9th of July 2013) had a positive effect when examined over all three event windows (3-day, 5 day and 10-day). Whereas for the second event, event A2 (Third reading of the bill by the House of Lords on the 9th of December 2013) effects on returns were solely negative when examined over a 3-day event window, but mostly negative and mostly positive over a 5-day and 10- day window respectively. A similar outcome was observed for event A3. However, when the sampled banks are examined as a group, the impact of the legislative process becomes clearly negative overall and significant. This is consistent with the findings of Carow and Heron (2002); Andriosopoulos et al. (2017); Carboni et al. (2017); Bruno, Onali and Schaeck (2018); and Pancotto, ap Gwilym, and Williams (2020).

For instance, Carow and Heron (2002) examined the reaction on the stock market to the passage of the Financial Services Modernization Act of 1999 (FSMA) in the US and found evidence of negative returns from shares of banks. Andriosopoulos et al. (2017) tested the effect that the Dodd–Frank Act had on a sample of financial institutions and found that banks experienced negative valuations. Similarly, Carboni et al. (2017) presents evidence of a negative stock market reaction on the EU's Comprehensive Assessment (CA) announcement date and disclosure rules. The stock market response to liquidity regulation announcements was examined by Bruno, Onali and Schaeck (2018) and a negative share price reaction around the days leading up to the reform was also found.

On the hand, when the effect of the Financial Services and Markets Act (2023), which was passed 10 years later is examined, evidence indicating an opposite association is found. Although, the evidence revealed that Financial Services and Markets Act (2023) had a mostly positive and largely insignificant effect on the individual returns of the sampled banks. Dissimilar to the results of the study's examination of the Banking Reforms Act (2013), the study observe from Table 5.3.2 that the effects start to be uniform from the first event (event B1, Third reading of the bill by the House of Commons on the 7th of December 2022) of this particular legislative process. That is, when the event is examined over a 3-day and 10-day event window, the effect observed is positive, whereas a negative effect is observed over a 5-day event window.

This trend is consistently similar to the observations associated with the second and third event vital to the enactment of this reform. This effect was however observed to be positive and significant overall when the banks were examined as a group. This is also seen to be coherent with the results from Allen et al. (2012); Parise and Shenai (2018); and Sethi and Krishnakumar (2020). Particularly similar to the findings from Parise and Shenai (2018), the study's findings revealed that shares of banks collectively responded positively to event B1 (Third reading of the bill by the House of Commons on the 7th of December 2022); negatively to event B2 (Third reading of the bill by the House of Lords on the 19th of June 2023) and positively to event B3 (Royal Assent on the 29th of June 2023). the study's findings are also consistent with results from Allen et al. (2012); and Sethi and Krishnakumar (2020) who find similar results relating to the examinations of the effects of Basel III and the announcement of regulatory initiatives for non-performing assets. the study's results in this chapter contradict the findings of earlier studies such as Amoako-Adu and Smith (1995); and Sahin and de Haan (2016) who argue that banks do not react to regulatory events.

Moreover, the difference between the direction of the reaction of banks to the legislative processes of both regulatory reforms examined in this chapter could be attributed to a number of reasons. In the case Banking Reforms Act (2013) for instance, banks were still recovering from the 2007 financial crisis which according to Goodhart, (2008) highlighted a number of failures including capital adequacy, liquidity risk management, crisis management, regulatory discipline and moral hazard. However, the unanimity that securities activities of banks were the main cause of the crisis triggered the swift commissioning of the Independent Commission on Banking which was subsequently followed by the implementation of the commission final recommendation through the enactment of the Banking Reforms Act (2013). The substantial structural changes that banks were required to make in order to comply with the Act represented a significant challenge which the stock markets expectedly priced into the value of shares of affected banks. Additionally, shareholders also perceived the Act as likely to decrease profitability banks they owned.

Furthermore, the empirical results also revealed the legislative processes associated with the examined regulatory reforms had a negligible impact on unsystematic risk. The study found evidence that the inherent risk associated with shares of each of the sampled banks remained significantly low throughout the legislative processes associated with the enactment of the Banking Reforms Act (2013). The study observed a similar effect during the enactment of the Financial Services and Markets Act (2023) except for the stock returns for Barclays Banks that proved to display an exceptionally high amount of unsystematic risk. Further investigation revealed that the bank's shares experienced exceptionally high volatility over the same period due to a number of reasons. To name a few, these included the bank's announcement of branch closures, job cuts up to 2,900 jobs in a £1bn cost cutting plan, the bank being sued over its ex-CEO's ties to Jeffrey Epstein, and the partial withdrawal of their second largest shareholder (the Qatar Investment Authority (QIA)). the study's findings here are consistent with the findings from Sorokina and Thornton (2016); and Sethi and Krishnakumar (2020) whose findings showed that the market reaction to the act indicated lower risk in financial firms but higher risk for many non-financial firms.

5.4 The Impact of Regulatory Reforms on the Profitability of the Big Four Banks in the UK

The findings of this study relating to the impact of liquidity regulation on the profitability of banks are consistent with literature such as Molyneux and Thornton (1992); Goddard et al. (2010); Bonner and Eijffinger (2016). This study presents empirical evidence which suggests that liquidity requirements which cause banks to increase their High Quality Liquid Assets to maintain a LCR of 100% or above result in an increase in profitability. This increase in profitability is significant and higher when the measure of profitability being assessed is the ROA and lowest in NIM. the study's findings are also in line with the findings of Bonner and Eijffinger, (2016) who posit that bank profits as measured by interest margins are reduced by liquidity requirements.

On the contrary, the empirical evidence and findings presented by this study on the effects of liquidity requirements on bank profits are in contrast to the findings presented by Berger and Bouwman (2009); King (2013); Dietrich, Hess and Wanzenried (2014); De Young and Kang, (2016); Tran, Lin and Nguyen (2016); and Banerjee and Mio (2018). For instance, Tran, Lin and Nguyen (2016) found that banks may reduce liquidity creation by holding more liquid assets. Holding liquid assets lowers bank revenues since liquid assets tend to generate lower returns relative to illiquid assets. Consequently, liquidity regulation that inhibits liquidity creation should negatively impact bank profitability. The loophole in this assertion is that it assumes interest income to be the only source of revenue for banks.

Additionally, empirical evidence presented by this study suggests a strong positive relationship between bank profitability and capital requirements that require banks to increase the amount of capital held. These findings are consistent with the findings of Berger (1995); Bourke (1989); Iannotta, Nocera and Sironi (2007); Angelini et al., (2011); and Lee and Hsieh (2013). For instance, Lee and Hsieh (2013) also produced results that indicate increasing bank capital has a significantly positive relationship with bank profits. The impact of capital regulation on the profitability of banks to a great degree was reported to depend on the measures of profitability employed. This is distinct from the findings of this study which reported consistently strong positive relationships across all three measures of profitability.

In contrast, the findings presented by Altunbas, et al. (2007); Goddard et al. (2010); Kashyap, Stein, and Hanson (2010); Baker and Wurgler (2015); and Tran, Lin and Nguyen (2016) who argue that banks forced to keep a higher capital due to regulatory requirements results in lower profitability. Altunbas, et al. (2007) particularly present empirical evidence to suggest that the inefficient and unprofitable European banks in their study appeared to be rather highly capitalised. Similarly, Goddard et al. (2010), found that well-capitalized banks appeared to have lower profitability in eight European Union member countries from the period between 1992 and 2007.

Tran, Lin and Nguyen (2016) stressed that the relationship between bank profitability and capital requirements depends on the existing level of capitalization of banks. Regulatory capital was found to be negatively related to bank profitability when the banks in question were already highly capitalized. This relationship was observed to be reversed for banks with a lower capitalization before the introduction of new capital requirements. These results are seen to be consistent with the trade-off theory of capital structure, which maintains that sustained deviations from optimal capital structure affect company (bank) performance. Therefore, increasing the amount of capital held by a bank improves the profitability of the bank if it has a lower capitalization, but weakens bank profitability for higher capitalized banks. The findings presented by this study are in line with the observations made by Tran, Lin and Nguyen (2016). This is because the study's study considered data from the four sampled banks from 2000 to 2023, which includes a period in which the sampled banks were relatively undercapitalized as highlighted in the wake of the 2007 financial crisis.

In conclusion, the results of this study confirm the positive view theory drawn from Berger and Bouwman (2013) discussed in the theoretical framework in Section 2.3.4. As stated by the theory, the study find that higher capital and liquidity have a positive effect on the profitability of the sampled banks in the UK. That is capital requirements that require banks to hold a higher proportion of capital has a favourable effect on the profitability of banks. This is because, an increase in capital that banks are required to hold unencumbered, reduces funds available to transact with, thereby reducing excessive risk taking. This further lowers the risk profile of banks leading to lower risk premiums being demanded by debt holders of banks owing primarily to the fact that the banks are highly capitalized. In essence, higher capital requirements result in lower debt costs (cost of capital) for banks, which in turn translates to higher Return on Equity (ROE) as seen in Table 6.

5.5 Chapter Summary

This chapter has presented a rigorous examination of the impact of liquidity and capital regulatory reforms on the UK's big four banks, delving into their efficiency, market value, and profitability. By employing a robust methodological framework, encompassing Data Envelopment Analysis, Event Study Methodology, and panel regressions, the study has generated several key findings with significant implications for policymakers, investors, and academics alike.

The analysis revealed that while US banks exhibit marginally higher efficiency scores, UK banks demonstrate greater responsiveness to regulatory changes. This suggests that the UK regulatory framework, while stringent, fosters an environment conducive to adaptation and efficiency improvements. The study also highlighted the significant impact of the global financial crisis on bank efficiency in both countries, with UK banks demonstrating a more rapid recovery. This underscores the resilience of the UK banking system and its capacity to adapt to economic shocks.

Examining the market's perception of regulatory reforms, the study uncovered distinct reactions to two landmark acts. The Banking Reform Act (2013), enacted in the aftermath of the financial crisis, elicited a negative market response, indicating investor concerns about its potential impact on bank profitability. Conversely, the Financial Services and Markets Act (2023) triggered a positive response, suggesting market confidence in its potential to enhance the UK financial sector. These findings highlight the sensitivity of market valuations to regulatory changes and their perceived impact on bank performance.

The study's investigation into the relationship between regulatory reforms and bank profitability yielded compelling insights. Liquidity regulation emerged as a driver of profitability, with higher liquidity requirements associated with increased profits. However, the impact of capital regulation was more nuanced. While higher total capital levels were linked to greater profitability, stricter Tier 1 capital requirements appeared to exert a negative influence. This suggests that policymakers must carefully calibrate capital regulations to ensure they promote financial stability without unduly constraining bank profitability.

The chapter also acknowledges the study's limitations, recognizing that the focus on the UK's big four banks may not fully capture the diversity of the banking sector. It also acknowledges the potential influence of unforeseen global events, such as the COVID-19 pandemic, on bank performance. In synthesizing these findings, the chapter underscores the profound impact of regulatory reforms on the UK banking sector. It highlights the critical role of policymakers in striking a balance between ensuring financial stability and enabling banks to operate efficiently and profitably. The study also emphasizes the importance of considering the dynamic interplay between different types of regulation and their combined effect on bank performance. By offering a detailed discussion of the research findings, this chapter contributes significantly to the understanding of the complex relationship between regulatory reforms and bank performance. Its insights provide valuable guidance for policymakers, encouraging them to adopt a holistic approach to regulation that balances prudential concerns with the need to support a thriving banking sector. The study also serves as a valuable resource for investors and academics seeking a deeper understanding of the forces shaping the UK banking landscape.

Chapter 6: Conclusion

6.1 Introduction

The effect of regulatory reforms on retail banks in the UK has been examined in this study. This study specifically considered the impact of changes in liquidity and capital regulatory requirements on the efficiency, market value and profitability of the examined retail banks. This chapter concludes the thesis by summarising the main descriptive and empirical findings from the thesis and provides an analysis of the identified policy implications for regulators as well as banks. The limitations of the study as well those uncounted during the execution of the various stages of this empirical research are presented. This chapter concludes by providing some direction for future research and a summary of the study's main contribution to literature.

6.2 Summary of Key Empirical Analysis Findings

This section presents a summary of the key empirical findings from the three main research questions answered by this study. The answers to the research questions collectively present a concise overview of the impact bank regulation have had on the sampled UK Banks. The main findings from the first through to the third research question are presented in subsections 7.2.1 to 7.2.3 respectively.

6.2.1 RQ1 The Impact of Regulatory Reforms on the Efficiency (Technical) UK Retail Banks

The study's findings on bank efficiency is consistent with the financial intermediation theory. The results suggest that regulatory reforms can impact the core functions of banks, including their ability to efficiently allocate resources and generate profits. Financial intermediation theory views banks as crucial players in the economy, channelling funds from savers to borrowers and promoting economic efficiency. The study's findings on bank efficiency align with this theory by demonstrating that regulatory reforms can significantly affect these core functions of banks. For instance, the study found that stricter capital regulation can enhance bank efficiency by promoting prudent lending decisions, while activity restrictions can hinder banks' ability to diversify income and exploit economies of scale. These findings underscore the interconnectedness between regulatory reforms and the core functions of banks as financial intermediaries, supporting the financial intermediation theory. The study further contributes to the theoretical body of knowledge by providing a comprehensive assessment of the impacts of liquidity and capital regulatory reforms on UK retail banks, contributing to a better understanding of the relationship between bank regulation and bank performance

Several efforts have gone into developing and implementing numerous bank regulatory regimes in the UK nearly 20 years on from the crisis, all with the aim of ensuring a well-functioning banking system within the UK. The lasting lessons from the global financial crisis continue to be a reminder of the need for appropriate banking regulations in order to prevent a future occurrence. These kinds of regulatory regimes are expected to improve bank efficiency or at the very least not hinder bank efficiency. Considering this, a number of empirical tools were applied to first assess the efficiency of the banking industry in the UK and second, to examine the relationship between regulatory reforms and the assessed bank efficiency. This approach helped determine the impact of regulatory reforms on the efficiency of retail banks in the UK. In two stages, the study specifically focused on bank capital and liquidity variables that may have been impacted regulatory reforms over the period studied.

Using the non-parametric Data Envelopment Analysis method, the study first categorised bank financial statement items (variables) into inputs and outputs variables–with inputs including Wages and Salaries, Total Capital, Total Deposits, HQLA, Loan Loss Provisions, and Risk-Weighted Assets; and outputs including Total Loans and Revenue. The study then test for how efficiently each sampled UK bank can convert the inputs into outputs. These tests are conducted in STATA using the user contributed DEA command to estimate two distinct sets of efficiency scores for each bank. The study estimate the basic Variable Returns to Scales (VRS) DEA scores using an input-oriented BCC DEA model proposed by Banker, Charnes and Cooper (1984) as well as estimate Malmquist Index to account for the effect of time on the efficiency of the banks studied. The study also go a step further to replicate this for their US counterparts and make comparisons. The study observe that on average, the sampled US banks were 0.7% more efficient than their UK counterparts.

In the second stage of the study's analysis, using the technical efficiency scores through the study's Malmquist index estimation as the dependent variable and input and output variables as independent variables, the study run a robust fixed effects panel regression analysis to determine the drivers of efficiency. The study also included UK specific macroeconomic variables (Inflation, GDP growth and Bank Base rates) to control for the effects of the wider UK economy on the efficiency of the sampled banks and for consistency with the other aspects of the study. The use of the STATA statistical package to run the robust fixed effects panel regression analysis allowed the study to control for heteroskedasticity and collinearity. The results from this analysis revealed that only total deposits, risk weighted assets, and total loans are significantly associated with the bank efficiency. The study finds a significant and substantial positive relationship between total loans and bank efficiency, suggesting that as banks increase the assets by growing their loan portfolios, so does their level of efficiency. Furthermore, the study's results suggest that less restrictive regulation or the removal of activity restricting regulation will enhance the efficiency of banks. For instance, the removal of the Ring-Fencing requirement under the Banking Reform Act (2013) will allow banks consolidate larger deposits from multiple areas of business and in turn contribute to improved efficiency.

The study also found evidence suggesting that more stringent capital regulation has a weak relationship with bank efficiency. A possible reason for the insignificant result, as suggested by Barth et al (2013), could be due to the inclusion of actual capital figures in the analysis. The rationale is that the actual capital has a dominant effect on bank efficiency rather than the stringency of the capital regulations. However, when the study considered Risk Weighted Assets as a proxy for capital regulation, the results appear to be significant. That is, there is a positive relationship between Risk Weighted Assets and bank efficiency. Based on these findings, the study conclude that capital regulation has a substantially positive but insignificant relationship with bank efficiency.

Evidence is also presented to support the study's assertion that, High Quality Liquid Assets on the other hand have a relatively weaker insignificant negative association with bank efficiency. This implies that increases in liquidity requirements such as an increase in the required proportion of High Quality Liquid Assets to be held by banks will overall have marginally negative effect on their efficiency. The study therefore conclude that liquidity regulation insignificantly reduces bank efficiency. Although also not statistically significant, the study find evidence of a substantially inverse relationship between LLP and bank efficiency. Banks stand to enhance their efficiency if they decrease their loan loss provisions by reducing the amount of risky loans on their books to begin with, essentially pointing to the negative relationship between bank risk and bank efficiency. Additionally, the study revealed that out of the three macroeconomic control variables included, only GDP growth rate has a negative association with bank efficiency.

Keep in mind that the conducted empirical analysis only focused on the technical efficiency of banks and did not consider other important aspects of efficiency such as allocative efficiency and scale efficiency. The study arrives at the conclusion that both capital and liquidity regulation have an impact on the efficiency of banks in the UK, although insignificant. That is stringent capital regulation exerts positive effects on bank efficiency whereas stricter liquidity regulation presents a negative effect on bank efficiency. This therefore inadvertently implies the existence of a partial potential trade-off between bank soundness/safety (wider financial stability) and efficiency.

6.2.2 RQ2 The effect of Regulatory Reforms on the Stock Market of UK Retail Banks

The study's findings on the market value of banks are consistent with the efficient market hypothesis. The results suggest that regulatory events can have a significant impact on bank stock prices, implying that the market quickly incorporates new information about regulatory changes into the valuation of banks. The efficient market hypothesis (EMH) posits that market prices reflect all available information, implying that it is impossible to consistently achieve above-average returns through active trading or stock selection. The study's findings on the market value of banks support this hypothesis by demonstrating that regulatory events, such as the enactment of major financial legislation, can significantly impact bank stock prices. This suggests that the market efficiently incorporates new information about regulatory changes into the valuation of banks, as posited by the EMH. The study further contributes to the theoretical body of knowledge by offering insights into the potential trade-offs between stricter regulations that promote stability and less stringent regulations that may foster innovation and growth.

The 2007 global financial crisis further underscored a number of regulatory failures including poor regulatory discipline, inadequate bank capital, banks' issues with liquidity risk management, and prevalence of moral hazard. The conclusion by the UK government that securities activities of banks were the main cause of the crisis triggered the swift commissioning of the Independent Commission on Banking which was subsequently followed by the implementation of the commission's final recommendation through the enactment of the Banking Reforms Act (2013). This apparent cycle of financial crises and subsequent regulatory reforms is not new, and dates to the Wall Street's history of financial innovation (Hilt, 2009). The history of financial regulation of the UK and US has exhibited a rather cyclical pattern with three key stages/phases which include regulation, deregulation and reregulation of financial institutions (Gart, 1994). This process has been observed to be crucial to the large and wealth financial intermediaries' such as the dominant banks examined in this study. Yet the impact of such regulatory reforms on the market value of banks are rarely seen discussed in literature, especially when regulators are known to be reactive to regulatory failures as opposed to being proactive to prevent the failures to begin with.

This study attempted to fill this gap in literature by examining the effect of the Financial Services (Banking Reform) Act (2013) on the stock returns of the top four high street banks in the UK. The study also examined the effect of the more recent Financial Services and Markets Act (2023) enacted 10 years after Banking Reform Act (2013) and compared the results. As with other similar empirical studies the study's rationale emanated from the notion that the stock market is the best evaluator of the efficacy of financial reforms and their impact on the risk exposure as well as return of financial institutions (Andriosopoulos et al., 2017). The semi-strong form of Efficient Market Hypothesis (EMH) theory was relied upon to further reinforce this rationale (Fama 1970). The Banking Reforms Act (2013) aimed to implement a practical definition of the concept of ring-fencing that promotes the idea of ring-fencing of certain banking activities. The Act required all household and small and medium-sized enterprises (SME's) deposits and current account to be held within a UK ring-fenced bank. Those ring-fenced banks are prohibited from operating a range of wholesale and investment banking activities (Korotana, 2016). The Financial Services and Markets Act (2023) on the other hand is introduced significant reforms to the financial services industry, affecting almost all financial services firms. This Act will primarily repeal retained EU law on financial services and give broader powers to HM Treasury to make regulations as well as define additional activities for regulation within the UK.

This study employed an Event Study Methodology (ESM) in an attempt to address this research question. The study examined the effect of these regulatory reforms on the market value of the four largest banks by total assets and market capitalization in the UK. These four banks also have some significant relevance across the EU and on the wider global banking scene. It is important to note that the four banks examined collectively account for over 90% of the total banking assets in the UK. The two regulatory reforms namely the Banking Reforms Act (2013) and the Financial Services and Markets Act (2023) were taken as the main events of interest with the various key stages in the legislative process categorised as sub events containing the event dates examined. The market model of the ESM was applied to investigate the effects of all 6 of these sub events on the market value of the study's sampled banks. The method measured the Cumulative Average Abnormal Returns and unsystematic risk associated with shares of each of the sampled banks. Each of the six sub events were examined across three specific event windows respectively. The event windows namely a 3-day, 5-day and 10-day event window allowing for an appreciation of the effects of the key legislative stages over time frames as short as 3 days before and after the event, as well as one as long as 10 days before and after the event.

Our empirical findings suggest that the Banking Reforms Act (2013) had a mostly positive and insignificant effect on the returns of the individually sampled banks over the course of its passage or enactment. However, when the sampled banks are examined as a group the impact of the legislative process becomes clearly negative overall and significant. On the hand, when examining the effect of the Financial Services and Markets Act (2023), evidence indicating an opposite association is found. Although, the evidence revealed that the Act also had a mostly positive and largely insignificant effect on the individual returns of the sampled banks. This effect was however observed to be positive and significant overall when the banks were examined as a group. It is also worth noting that the stock market reaction varied across all three key events and respective event windows. As one of the aims of the Banking Reform Act (2013) was to contain the risk taking activities of banks and by extension their inherent risk, the study found evidence of the effectiveness of the reform in meeting this aim. The study found evidence that the inherent risk associated with shares of each of the sampled banks remained significantly low throughout the legislative processes associated with the enactment of the Banking Reforms Act (2013).

6.2.3 RQ3 Bank regulation and the profitability of UK retail banks

The study is consistent with the financial intermediation theory and by examining the specific impacts of different types of regulatory reforms, such as capital and liquidity regulations. The findings suggest that the impact of regulatory reforms can vary depending on the specific type of regulation and the measure of bank performance being considered. The study extends the theoretical framework by delving into the specific impacts of different types of regulatory reforms, such as capital and liquidity regulations. The findings suggest that the impact of regulatory reforms can vary depending on the specific type of regulation and the measure of bank performance being considered. For instance, the study found that capital regulation positively impacts bank profitability, while liquidity regulation negatively impacts bank profitability. This nuanced understanding of the heterogeneous effects of regulatory reforms extends the theoretical framework by providing a more granular perspective on the relationship between bank regulation and bank performance. The study further contributes to the theoretical body of knowledge by highlights the importance of considering various factors, such as the country's economic conditions, and the specific regulatory measures implemented, when assessing the overall impact of regulatory reforms.

The impact of liquidity and capital regulatory reforms on the profitability of the big four banks in the UK was investigated in this aspect of the study. The study used the three most used ratio measures of bank profitability namely, Return on Assets (ROA), Return on Equity (ROE) and Net Interest Margin (NIM). It is therefore worth noting that the study does not exhaustively account for all measures of bank profitability. The study conducted fixed and random panel regression analysis with profitability measures as the dependent variables and independent variables being those that are identified to be influenced by liquidity as well as capital requirements. The study employed level 1 assets to total assets ratio as a proxy for liquidity regulation and total capital (the sum of a bank's Tier 1 and Tier 2 capital) as a proxy for capital regulation. The study also controlled for the impact of macroeconomics by including Inflation, Interest, and GDP as control variables.

The results show a significant positive association between liquidity regulation and all three measures of profitability. This implies that bank profits increase as their level of liquidity increases. This allows us to conclude that tighter liquidity regulation increases bank profitability by all three measures. On the other hand, the impact of capital regulation is mixed and depends on the type of capital affected by the regulation. Total capital has a positive association with bank profitability given all three modelled measures of profitability, although only significant under the third model. Conversely, Tier 1 capital specifically has a negative association with all three measures of profitability and is significant in only the third model. These results allow us conclude that capital regulation that causes total bank capital to increase, consequently increasing bank profitability.

6.3 Implications and Recommendations for Regulators and the UK Government

The findings from this study suggest a need for the refinement of regulations affecting bank efficiency. These refinements may focus specifically on adjustments to the Ring-Fencing requirements in a manner that could enhance bank efficiency without compromising the stability of the UK's financial system. The potential benefits of modifying the Ring-Fencing requirement under the Banking Reform Act (2013) to improve bank efficiency should be explored. This would involve a clear assessment of the original objectives of the Ring-Fencing requirement which includes protecting retail banking services from external shocks and ensuring that essential banking services remain intact even if other parts of the bank fail. Regulators should also engage with retail banks to gather first-hand insights on how the Ring-Fencing requirement has affected their operations and efficiency. This could include surveys, interviews, and roundtable discussions. Additionally, a comparative analysis of the performance of banks subject to Ring-Fencing with those that are not, will further isolate the effects of the regulation. Furthermore, an appreciation of the difference between the short-term disruptions caused by the introduction of the regulation and its long-term impact on bank efficiency should also be considered by regulators. The trade-off between reduced systematic risk and reduced efficiency can be further reviewed to determine whether the current balance is optimal, or if there's room for recalibration.

There may also be a need to re-evaluate the balance between actual capital held and the stringency of capital regulations, particularly when adhering the Risk Weighted Assets requirements. Regulators may want to take necessary steps to ensure that the models and assumptions used to assess different asset classes for risk are transparent and uniformly applied across the industry. This fosters a level playing field and aids in the clear communication of banks' risk exposures to stakeholders. Furthermore, regulators should also consider broader economic implications such as the potential effects on credit availability and economic growth of stringent capital regulations through the behaviour of bank. This may particularly involve banks' lending practices and risk-taking behaviour. Creating a feedback loop with banks will further allow regulators to gain a practical understanding of the implications of capital regulations on banks. This will allow for future development of regulatory frameworks to be evidence-based, drawing on empirical data and international best practices. This approach ultimately ensures that the regulatory environment supports a robust and efficient banking sector capable of supporting economic growth while being resilient to shocks. The adoption of a well-balanced approach to liquidity requirements by regulators is essential for maintaining the stability of the banking sector while also promoting efficiency. Although, liquidity regulations such as those requiring specific amounts of High-Quality Liquid Assets (HQLA), are designed to ensure that banks can meet their short-term obligations even during periods of financial stress. Overly stringent requirements can limit banks' ability to utilize funds for profitable ventures, potentially hampering their operational efficiency.

There is also the need for the alignment of macroeconomic policies with the banking sector's efficiency as a crucial basis for fostering a conducive environment for economic growth. The findings from this study suggest that macroeconomic factors like inflation, GDP growth, and interest rates significantly influence banking operations. Policies that support economic expansion, such as fiscal stimulus or accommodative monetary policy, can enhance demand for banking services and improve efficiency through economies of scale. Conversely, policies that inadvertently constrain economic activity may negatively impact bank efficiency. Regulators and policymakers must work in tandem to ensure that macroeconomic policies are harmonized with the goals of banking efficiency, stability, and growth. The UK government as well as its regulators may also wish to undertake international benchmarking. Consistently comparing the UK banking sector's performance and regulatory environment with that of countries like the US, may allow regulators identify strategies that have successfully balanced bank efficiency and systemic financial stability. This process can reveal regulatory practices that might be adapted to the UK context, potentially leading to improvements in the domestic banking sector's efficiency without compromising on stability.

The varied stock market reactions to different stages of the legislative process observed by this study suggest that a phased implementation approach for major reforms could be beneficial. This allows the market to adjust gradually, minimizes potential disruptions, and provides valuable insight for regulators. By phasing in reforms, regulators can observe the market's response to each stage and make adjustments to the rollout plan if necessary. This iterative approach can help ensure a smoother transition for banks and the broader financial system. This passed implementation should be informed by the results of comprehensive impact assessments. These should particularly focus on the short-term and long-term impacts on bank stock values, risk profiles, lending activity, the availability of financial products and services to consumers and businesses, and the overall health and stability of the financial system. Regulators should also consider the potential impact on competition within the banking sector, as well as the potential for unintended consequences such as increased regulatory burden or reduced innovation.

Regulators also consider effectively communicating the rationale and expected outcomes of future reforms clearly and transparently to both the banking industry and the public. This may help manage market expectations, facilitate smoother transitions, and foster trust in the regulatory process. The specific goals of the reform, the potential benefits for consumers and the broader economy, and the anticipated impact on banks should be clearly communicated to mitigate potential market disruptions. Open and transparent communication also helps to build trust between regulators, the banking industry, and the public. When stakeholders understand the rationale behind regulatory changes, they are more likely to accept and adapt to them. This collaborative approach can ultimately lead to a more stable and efficient financial system. Furthermore, continuous monitoring of the market's reaction to reforms is essential, not just in the immediate aftermath of implementation, but over an extended timeframe. This could potentially allow regulators to identify unintended consequences early on and make necessary adjustments to ensure the stability and resilience of the banking sector.

The finding from this study on the relationship between bank regulation and profitability highlights the need for the creation of more tailored and flexible requirements. While tailoring capital and liquidity requirements to individual banks' risk profiles is a positive step, it may introduce greater uncertainty for banks and could be difficult to operationalize in practice. Regulators there need to strike a balance between flexibility and standardization in order to make regulatory arbitrage less appealing. Additionally, regulators need to actively promote profitability in a manner that is not detrimental to financial stability or leaves the consumer unprotected. Regulators may seek to do this by ensuring that their policies incentivize sustainable and responsible banking practices that prioritize long-term value creation over short-term gains. This may involve actively promoting responsible lending practices, ensuring fair treatment of customers, and addressing unconventional systemic risks like climate change. There is also a need for regulators to monitor for and assess unintended consequences of regulation that may hinder the profitability of banks. These may include consequences, such as increased compliance costs, reduced credit availability, or heightened concentration risks.

6.4 Implications and Recommendations for UK Banks

The finding from this study following an assessment of the impact of regulatory reforms on bank efficiency suggests that banks should consider prioritizing strategic management of their loan portfolios. This may be done in a number of ways, namely diversification, advanced risk assessment and enhanced technological adoption. The ability of banks to diversify loan portfolios across sectors, loan sizes, and risk profiles may mitigate concentration risks and enhance overall resilience against economic fluctuations. For instance, banks could increase their exposure to fast-growing sectors like renewable energy or green infrastructure, while maintaining a healthy balance with traditional lending sectors. Additionally, expanding into underserved markets, such as small and medium-sized enterprises (SMEs) or specific customer segments, can present opportunities for growth and diversification. Additionally, engaging robust credit risk assessment methodologies that incorporate machine learning and artificial intelligence can improve lending decisions, reduce the likelihood of defaults, and optimize risk-adjusted returns. Banks should leverage credit scoring models that go beyond traditional financial data and incorporate alternative data sources, such as a customer's digital footprint or business network, to create a more holistic risk profile. Further to this, banks may also consider investing more in technology-driven loan origination, processing, and servicing platforms can streamline operations, reduce costs, and improve customer satisfaction.

The findings from this study further suggests that banks should continually identify opportunities to enhance operational efficiency across all business functions through the following recommended initiatives: Regularly reviewing and optimizing cost structures can ensure that resources are allocated efficiently and effectively despite pressures from regulatory changes. This may involve streamlining branch networks, renegotiating vendor contracts, and implementing cost-saving measures in areas such as travel and entertainment. Furthermore, the incorporation of leveraging on enhanced data analytics may allow banks gain better insights into customer behaviour, operational performance, and risk exposures which could collectively inform strategic decision-making and improve operational efficiency in the face of adverse regulation.

The findings for this study suggest that banks should engage in proactive strategic planning to anticipate and adapt to future regulatory changes. The mixed market reactions to the Banking Reforms Act (2013) and the Financial Services and Markets Act (2023) observed by the study highlight the importance of banks being prepared for a range of potential regulatory outcomes.

This proactive approach may involve banks' conducting regular regulatory impact assessments, maintaining a close dialogue with regulators to understand upcoming policy initiatives and wargaming different regulatory scenarios to assess their potential impact on the bank's business model, risk profile, and financial performance. This will allow banks to be better positioned to adapt their operations, risk management practices, and communication strategies to ensure a smooth transition to the new regulatory environment.

Banks may also consider transparent and effective communication with investors, particularly during periods of regulatory uncertainty. Banks should consider clearly explaining how they intend to address the risks and opportunities associated with upcoming regulatory reforms. It also vital to ensure that this communication is tailored to the specific needs and information requirements of different investor groups, such as retail investors, institutional investors, and analysts. By providing clear and consistent information about the bank's regulatory compliance efforts, risk management strategies, and how these factors are being incorporated into the bank's long-term business plans, banks can maintain investor confidence and mitigate potential negative market reactions.

The findings from this study further suggest that reforms like the Banking Reforms Act (2013) can be effective in curbing excessive risk-taking. This underscores the importance of banks continuously evaluating and refining their risk management practices aligning with regulatory expectations and maintaining a healthy risk profile. Banks should consider investing in robust risk management frameworks that identify, assess, measure, monitor, and control all relevant risks associated with their operations. These frameworks should be regularly reviewed and updated to reflect changes in the regulatory landscape, the bank's business model, and the overall risk environment. By maintaining a strong risk management culture and practices that are aligned with regulatory expectations, banks can not only promote financial stability but also enhance investor confidence.

The observed relationship between bank regulation and bank profitability in this study allow for the following policy implications to be deduced. Although, increased liquidity could enhance profitability, excessive liquidity may also be detrimental. For instance, holding excessive liquid assets like cash or government bonds which have relatively lower returns could contribute to lower levels of profitability compared to investing in higher-yielding assets like loans or other investments. As such, banks may wish to consider operating in a manner that allows them to maintain sufficient liquidity buffers to meet regulatory requirements and unexpected withdrawals, while still optimizing the allocation of assets to maximize profitability. Furthermore, since the findings of the study are based on data from four of the largest banks in the UK, the positive impact of liquidity on profitability may not be uniform across all banks. For instance, smaller banks with limited access to diverse funding sources and lower-yielding assets may face challenges in achieving the same level of profitability as larger banks with more diversified portfolios.

Increasing total capital by banks may enhance profitability in the short term, but it may also lead to higher funding costs and reduced return on equity (ROE) in the long run. This can be attributed to the fact that equity financing is generally more expensive than debt financing and maintaining a higher capital base may require issuing additional equity, diluting existing shareholders' ownership, and potentially lowering their returns. Conversely, the observed negative impact of Tier 1 capital on profitability suggests that regulators may need to reconsider the specific requirements for this type of capital. While Tier 1 capital is essential for absorbing losses, excessively high requirements can constrain banks' lending capacity and profitability. Regulators could explore options like adjusting risk weights for different types of assets or allowing for greater flexibility in the composition of Tier 1 capital.

6.5 Summary of Main Contributions

The study contributes existing literature by extending the studies by Pasiouras (2008); Pasiouras et al. (2009); Chortareas, Girardone, and Ventouri, (2012); Barth et al. (2013); and Gaganis and Pasiouras (2013) among others. The study's contribution to literature includes the following. First, this study considers data from the pre as well as post global financial crisis periods. Second, this study applies a mixed methods approach employing methods including DEA to investigate the homogenous effect of regulation on the technical efficiency of the largest banks in the fixed and random panel regression analysis to ascertain the drivers of the identified levels of efficiency; and ESM to discern the effects of regulatory events on the stock market values of banks. Third, these applied mixed methods allowed the study effectively to investigate the multi-dimensional impact of regulatory reforms on banks in the UK. This also allowed to consider the significance of variables such as the measures of banks' profitability, drivers of bank efficiency, bank stock returns and the significance of other endogenous and exogenous variables. Fourth, this study focuses specifically on the largest banks in the UK which allows it to provide an in-depth evaluation of the effect of regulatory reforms on the sampled banks. It is important to highlight that to the knowledge of this research, no other study has examined the impact of bank regulation of banks in the UK by applying the combination of methods and approaches applied in the study. Finally, this study makes policy contributions, as it provides robust and evidence-based policy implications following the findings.

6.5.1 Originality of the Thesis

This thesis presents original research on the impact of regulatory reforms on retail banks in the UK. The study's originality is anchored in the definition of originality provided by Guetzkow, Lamont and Mallard (2004), which states that originality in the humanities and social sciences is defined as: using a new approach, theory, method, or data, studying a new topic, doing research in an understudied area, producing new findings. This thesis employs a robust mixed-methods approach to investigate the intricate relationship between regulatory reforms and the performance of UK retail banks. The study uses quantitative techniques, including Data Envelopment Analysis (DEA), the Malmquist Index, and Panel Regression Analysis, to examine the effects of regulatory reforms from various angles.

A two-stage DEA is conducted. In the first stage, the study uses an input-oriented Banker, Charnes, and Cooper (BCC) model under Variable Returns to Scale (VRS) and Malmquist Index estimations to account for changes over time. This stage helps assess the impact of regulatory reforms on bank technical efficiency. The second stage involves a panel regression analysis with both fixed and random effects models to identify the specific factors that influence bank efficiency while controlling for unobserved heterogeneity across banks and time. Three fixed and random effects panel regression models were used to assess the impact on profitability, with the dependent variable for each model being NIM, ROE, and ROA, respectively. The market model ESM is used to assess the impact of the enactment of regulatory reforms on market value. Specifically, focusing on the Banking Reform Act (2013) and financial services and markets act (2023), the study analyses cumulative average abnormal returns (CAARs) and unsystematic risk over three event windows (3-day, 5-day, and 10-day) for six key legislative events.

This thesis further demonstrates originality by focusing on UK retail banks. The findings of the thesis have implications for policymakers and bank managers in the UK. The thesis utilizes longitudinal data spanning over 23 years, allowing for the examination of the long-term effects of regulatory reforms on bank performance. The thesis contributes to the theoretical body of knowledge by extending the financial intermediation theory and the efficient market hypothesis to the context of regulatory reforms in the UK banking sector. The originality of the thesis lies in its comprehensive assessment of the impacts of regulatory reforms, its mixed-methods approach, its focus on the UK retail banking sector, its use of longitudinal data, and its contribution to the theoretical body of knowledge.

6.6 Limitations of the Study

Despite the significance and contribution of this study, it is not without limitations. The sample size of four banks considered by the study was relatively small. This affected the varying ranges of observations in datasets used in the study, depending on the research question addressed. When examining the effects of bank regulation on bank efficiency and profitability, the number of observations in the dataset used was n=92. Whereas the observations in the dataset used to examine the effects of regulatory events on the market value of banks were n=4,040. While the methods used were appropriate for the number of observations, it would have enhanced the generalizability of the findings of the study if a broader sample size, including banks from other countries, were used. Additionally, the log form of the variables was used in examining the relationship between bank regulation and profitability. Further, the STATA statistical package omitted variables it deemed to have a level of collinearity to ensure a more rigorous regression. A further limitation of the study was the non-inclusion of some important variables due to a lack of access to data. For instance, level 1 assets were used as proxies for HQLA in examining the effects of liquidity regulation on the profitability of banks.

The study focused on the UK banking sector, which is heavily regulated. The findings of the study may not be generalizable to other countries with different regulatory environments. The study did not consider all aspects of bank profitability. The study focused on three commonly used measures of bank profitability: Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM). However, there are a number of other measures of bank profitability that could have been considered. The study did not consider the impact of all non-regulatory factors on bank profitability due to a lack of access to data. There are other of non-regulatory factors that can affect bank profitability, such as the level of competition in the banking sector and technological innovation. Despite these limitations, the study makes a significant contribution to the literature on bank regulation and profitability. The study's findings have important implications for policymakers and bank managers

6.7 Future Research

The limitations identified in the first text highlight the need for further research to address the shortcomings of the current study. The relatively small sample size and the omission of certain variables, such as HQLA, limit the generalizability of the findings. To overcome these limitations, future research should focus on expanding the sample size to include a broader range of banks, both domestically and internationally. Additionally, employing more sophisticated econometric techniques, such as specialized DEA models and multi-factor ESM market models, can provide a more nuanced understanding of the impact of regulatory reforms on bank efficiency, profitability, and market value. By addressing these issues, future research can contribute to a more comprehensive and robust understanding of the complex relationship between bank regulation and bank performance.

Specifically, future research could explore the following areas. A larger and more diverse sample of banks would allow for a more robust analysis and increased generalizability of the findings. This could involve including banks from different countries and regions, as well as different types of financial institutions, such as investment banks and insurance companies. Second, more advanced econometric techniques, such as specialized DEA models and multi-factor ESM market models, can provide a more nuanced understanding of the complex relationships between regulatory reforms, bank efficiency, profitability, and market value.

These techniques can account for the potential endogeneity of regulatory variables and the impact of unobserved heterogeneity across banks. Third, future research could consider incorporating additional variables, such as bank-specific characteristics, macroeconomic factors, and global financial conditions, to provide a more comprehensive analysis of the impact of regulatory reforms. This could help to identify the specific mechanisms through which regulation affects bank performance and to assess the robustness of the findings to alternative specifications.

Additionally, most studies have focused on the short-term impact of regulatory reforms. However, it is important to also consider the long-term effects of these reforms on bank behaviour, financial stability, and economic growth. Future research could use longer time series data and event study methodologies to examine the long-term impact of regulatory reforms. By addressing these limitations and exploring these research directions, future research can provide a more comprehensive and insightful understanding of the complex relationship between bank regulation and bank performance.

Based on the theoretical gaps identified, further research could examine the impact of regulatory reforms on other types of banks, such as investment banks or cooperative banks, to assess whether the effects of regulation vary across different types of financial institutions. To provide a more comprehensive understanding of the lasting consequences of regulatory changes on the banking sector, future studies could also investigate the long-term impacts of regulatory reforms. Further research could also explore the impact of regulatory reforms on specific aspects of bank operations, such as lending practices, risk management strategies, or innovation activities. This would provide a more granular understanding of how regulatory changes affect different aspects of bank behaviour.

6.8 Reflection

This section presents a reflection of the researcher's journey in putting this study together. The first year of study was formerly described by the university as the M.Phil. stage where the researcher was encouraged to review a wide range of related and unrelated literature to their study topic. At the stage the focus of the study was on the impact of financial regulation on investment banks in the UK, the university required the researcher to prepare and submit a transfer report at the end of the year. This report was presented at a mini viva following which the researcher was given the approval to proceed to work on their thesis towards the attainment of a Ph.D.

The second year of study involved a further review of relevant literature by the researcher, alongside pursuing a carrier in higher education by seizing the opportunity to lecture part time at the university. The researcher lectured on a wide range of modules across two main courses namely MSc Investment and Finance and MBA Finance. The researcher taught modules including investment and portfolio analysis, corporate finance, and strategic financial management to name a few. This experience piqued the interest of the researcher in pursuing a career in higher education in the UK, which led him to enrol on to and complete the Postgraduate Certificate in Learning and Teaching in Higher Education offered by the university.

The emphasis of the third year of study was on data collection and analysis. However, there was a difficulty in obtaining data and gaining access to the STATA statistical package. The challenges were addressed with assistance from a member of the researcher's supervisory team. The third year was particular challenging as the researcher got a full time job as a lecturer and had to balance the responsibilities of this new role with his study, along with some changes to his personal circumstances that presented further challenges to his ability to continue the study. Additionally, it is per the university's requirement the researcher continued the study on a part time basis after taking up full time employment. The study moved into the write up stage in the fourth year following approval from his supervision team and the university's postgraduate.

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Appendices

Appendix A: Chapter 4, Section 4.2 The Impact of Liquidity and Capital Regulatory Reforms on the Efficiency of Retail Banks

Appendix A.4.1 Malmquist Index Results (Using the malmq2 command in STATA) - UK Banks

Row	dmu	Pdwise	TFPCH (Total Factor Productivity Change.)	TECH (Technological Change)	TECCH (Technical Efficiency Change)
2	1	2000~2001	1.114	1.000	1.114
3	1	2001~2002	0.935	1.000	0.935
4	1	2002~2003	1.099	1.000	1.099
5	1	2003~2004	1.155	1.000	1.155
6	1	2004~2005	0.719	1.000	0.719
7	1	2005~2006	0.883	1.000	0.883
8	1	2006~2007	0.919	1.000	0.919
9	1	2007~2008	0.841	1.000	0.841
10	1	2008~2009	0.873	1.000	0.873
11	1	2009~2010	1.006	1.000	1.006
12	1	2010~2011	0.680	1.000	0.680
13	1	2011~2012	1.070	1.000	1.070
14	1	2012~2013	1.065	1.000	1.065
15	1	2013~2014	1.313	1.000	1.313
16	1	2014~2015	1.067	1.000	1.067
17	1	2015~2016	0.903	1.000	0.903
18	1	2016~2017	0.931	1.000	0.931
19	1	2017~2018	0.939	1.000	0.939
20	1	2018~2019	0.830	1.000	0.830
21	1	2019~2020	0.660	1.000	0.660
22	1	2020~2021	1.151	1.000	1.151
23	1	2021~2022		1.000	
25	2	2000~2001			
26	2	2001~2002	1.050	1.000	1.050
27	2	2002~2003	1.064	1.000	1.064
28	2	2003~2004	0.911	1.000	0.911
29	2	2004~2005	0.997	1.000	0.997
30	2	2005~2006	0.992	1.000	0.992
31	2	2006~2007	0.973	1.000	0.973
32	2	2007~2008	0.698	1.000	0.698
33	2	2008~2009	1.112	1.000	1.112
34	2	2009~2010	1.082	1.000	1.082
35	2	2010~2011	1.083	1.000	1.083
36	2	2011~2012	0.893	1.000	0.893
37	2	2012~2013	1.440	1.000	1.440
38	2	2013~2014	1.066	1.000	1.066
39	2	2014~2015	0.917	1.000	0.917
40	2	2015~2016	0.701	1.000	0.701

41	2	2016~2017	0.940	1.000	0.940
42	2	2017~2018	1.038	1.000	1.038
43	2	2018~2019	1.220	1.000	1.220
44	2	2019~2020	0.695	1.000	0.695
45	2	2020~2021	1.519	1.000	1.519
46	2	2021~2022	1.125	1.000	1.125
48	3	2000~2001	0.866	1.000	0.866
49	3	2001~2002	0.942	1.000	0.942
50	3	2002~2003	1.040	1.000	1.040
51	3	2003~2004	0.671	1.000	0.671
52	3	2004~2005	0.747	1.000	0.747
53	3	2005~2006	0.956	1.000	0.956
54	3	2006~2007	0.946	1.000	0.946
55	3	2007~2008	0.936	1.000	0.936
56	3	2008~2009	1.104	1.000	1.104
57	3	2009~2010	0.931	1.000	0.931
58	3	2010~2011	0.892	1.000	0.892
59	3	2011~2012	1.161	1.000	1.161
60	3	2012~2013	1.069	1.000	1.069
61	3	2013~2014	1.322	1.000	1.322
62	3	2014~2015	1.113	1.000	1.113
63	3	2015~2016	0.931	1.000	0.931
64	3	2016~2017	1.083	1.000	1.083
65	3	2017~2018	0.912	1.000	0.912
66	3	2018~2019	0.980	1.000	0.980
67	3	2019~2020	0.602	1.000	0.602
68	3	2020~2021		1.000	
69	3	2021~2022		1.000	
71	4	2000~2001		1.000	
72	4	2001~2002	0.966	1.000	0.966
73	4	2002~2003	1.084	1.000	1.084
74	4	2003~2004	1.221	1.000	1.221
75	4	2004~2005	1.088	1.000	1.088
76	4	2005~2006	1.084	1.000	1.084
77	4	2006~2007	0.579	1.000	0.579
78	4	2007~2008	1.010	1.000	1.010
79	4	2008~2009	0.745	1.000	0.745
80	4	2009~2010	0.833	1.000	0.833
81	4	2010~2011	0.761	0.953	0.798
82	4	2011~2012	1.386	1.049	1.321
83	4	2012~2013	0.987	1.000	0.987
84	4	2013~2014		1.000	
85	4	2014~2015		1.000	
86	4	2015~2016		1.000	
87	4	2016~2017	1.872	1.000	1.872
88	4	2017~2018	0.325	1.000	0.325
89	4	2018~2019	0.915	1.000	0.915
90	4	2019~2020	0.557	1.000	0.557
91	4	2020~2021		1.000	
92	4	2021~2022		1.000	

Appendix A.4.2 Malmquist Index Results (Using the malmq2 command in STATA) - UK Banks

Row	dmu	Pdwise	TFPCH (Total Factor Productivity Change)	TECH (Technological Change)	TECCH (Technical Efficiency Change)
2	1	2000~2001	0.870	1.000	0.870
3	1	2001~2002	1.125	1.000	1.125
4	1	2002~2003	1.175	1.000	1.175
5	1	2003~2004	4.780	1.000	4.780
6	1	2004~2005		1.000	
7	1	2005~2006		1.000	
8	1	2006~2007	0.296	1.000	0.296
9	1	2007~2008	0.392	0.897	0.437
10	1	2008~2009	0.743	1.009	0.736
11	1	2009~2010	1.313	1.104	1.189
12	1	2010~2011	1.227	0.940	1.305
13	1	2011~2012	1.366	1.064	1.284
14	1	2012~2013	3.183	1.000	3.183
15	1	2013~2014	0.704	1.000	0.704
16	1	2014~2015	0.926	1.000	0.926
17	1	2015~2016	0.954	1.000	0.954
18	1	2016~2017	1.066	1.000	1.066
19	1	2017~2018	1.032	1.000	1.032
20	1	2018~2019	0.986	1.000	0.986
21	1	2019~2020	0.521	1.000	0.521
22	1	2020~2021		1.000	
23	1	2021~2022		1.000	
25	2	2000~2001	0.931	1.000	0.931
26	2	2001~2002	1.070	1.000	1.070
27	2	2002~2003	1.002	0.991	1.011
28	2	2003~2004	1.055	1.009	1.046
29	2	2004~2005	0.918	0.960	0.956
30	2	2005~2006	1.038	1.042	0.996
31	2	2006~2007	0.921	0.959	0.960
32	2	2007~2008	1.015	0.997	1.018
33	2	2008~2009	0.835	0.825	1.012
34	2	2009~2010	1.113	1.174	0.948
35	2	2010~2011	1.179	1.070	1.102
36	2	2011~2012	0.952	0.931	1.023
37	2	2012~2013	1.093	1.085	1.007
38	2	2013~2014	1.003	1.000	1.003
39	2	2014~2015	1.014	1.000	1.014
40	2	2015~2016	0.963	1.000	0.963
41	2	2016~2017	0.939	0.917	1.024
42	2	2017~2018	1.017	0.998	1.019

43	2	2018~2019	0.949	0.990	0.959
44	2	2019~2020	0.800	1.014	0.789
45	2	2020~2021	1.144	1.084	1.055
46	2	2021~2022	1.027	1.005	1.023
48	3	2000~2001	0.910	1.000	0.910
49	3	2001~2002	1.059	1.000	1.059
50	3	2002~2003	1.242	1.000	1.242
51	3	2003~2004	1.079	1.000	1.079
52	3	2004~2005	1.034	1.000	1.034
53	3	2005~2006	0.938	1.000	0.938
54	3	2006~2007	0.855	1.000	0.855
55	3	2007~2008	0.721	0.961	0.750
56	3	2008~2009	1.164	1.040	1.119
57	3	2009~2010	1.064	1.000	1.064
58	3	2010~2011	1.506	1.000	1.506
59	3	2011~2012	1.118	1.000	1.118
60	3	2012~2013	1.450	1.000	1.450
61	3	2013~2014	0.991	1.000	0.991
62	3	2014~2015	0.581	1.000	0.581
63	3	2015~2016	0.790	1.000	0.790
64	3	2016~2017	1.208	1.000	1.208
65	3	2017~2018	1.100	1.000	1.100
66	3	2018~2019	0.926	1.000	0.926
67	3	2019~2020	0.449	1.000	0.449
68	3	2020~2021		1.000	
69	3	2021~2022		1.000	
71	4	2000~2001	0.749	1.000	0.749
72	4	2001~2002	1.056	1.000	1.056
73	4	2002~2003	1.034	1.000	1.034
74	4	2003~2004	1.261	1.000	1.261
75	4	2004~2005	0.918	1.000	0.918
76	4	2005~2006	1.008	1.000	1.008
77	4	2006~2007	0.886	1.000	0.886
78	4	2007~2008	0.571	1.000	0.571
79	4	2008~2009	0.879	1.000	0.879
80	4	2009~2010	0.755	1.000	0.755
81	4	2010~2011	1.315	1.000	1.315
82	4	2011~2012	1.251	1.000	1.251
83	4	2012~2013	1.122	1.000	1.122
84	4	2013~2014	0.948	1.000	0.948
85	4	2014~2015	1.059	1.000	1.059
86	4	2015~2016	0.863	1.000	0.863
87	4	2016~2017	0.915	1.000	0.915
88	4	2017~2018	0.987	1.000	0.987
89	4	2018~2019	0.979	1.000	0.979
90	4	2019~2020	0.559	1.000	0.559
91	4	2020~2021		1.000	
92	4	2021~2022		1.000	

Appendix A.4.3 Fixed Effects Panel Regression

```
. xtreg UKBanks_DAEScores WS TC TD HQLA LLP RWA TL OIR UKBankBaseRates UKInflation UKGDPGrowth, fe
note: OIR omitted because of collinearity.

Fixed-effects (within) regression               Number of obs     =         92
Group variable: Banks                           Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.3597                                         min =         23
     Between = 0.5586                                         avg =       23.0
     Overall = 0.1392                                         max =         23

                                                F(10, 78)         =       4.38
corr(u_i, Xb) = -0.3117                         Prob > F          =     0.0001

------------------------------------------------------------------------------
UKBanks_DAESc~s | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
----------------+-------------------------------------------------------------
             WS |   2.171708   4.855152     0.45   0.656    -7.494157    11.83757
             TC |   .4074162   .3723794     1.09   0.277    -.3339343    1.148767
             TD |   .2321107   .1623728     1.43   0.157    -.0911486    .5553701
           HQLA |  -.1186809   .1991706    -0.60   0.553    -.5151991    .2778372
            LLP |  -16.67529   4.507072    -3.70   0.000    -25.64819   -7.702403
            RWA |   .3842403   .1907006     2.01   0.047     .0045846     .763896
             TL |    2.37558   1.194144     1.99   0.050    -.0017772    4.752938
            OIR |          0  (omitted)
UKBankBaseRates |   .0480832   .5387601     0.09   0.929    -1.024506    1.120672
    UKInflation |   .5800424   .5702949     1.02   0.312    -.5553275    1.715412
    UKGDPGrowth |   -.428436   .2697479    -1.59   0.116    -.9654629    .1085908
          _cons |  -1.568678   1.160412    -1.35   0.180    -3.878881    .7415241
----------------+-------------------------------------------------------------
        sigma_u |  .06595936
        sigma_e |  .06994333
            rho |  .47071028   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(3, 78) = 12.38                      Prob > F = 0.0000

. estimates store fixed
```

Appendix A.4.4 Random Effects Panel Regression

```
. xtreg UKBanks_DAEScores WS TC TD HQLA LLP RWA TL OIR UKBankBaseRates UKInflation UKGDPGrowth, re
note: OIR omitted because of collinearity.

Random-effects GLS regression                   Number of obs     =         92
Group variable: Banks                           Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.2436                                         min =         23
     Between = 0.4704                                         avg =       23.0
     Overall = 0.2571                                         max =         23

                                                Wald chi2(10)     =      28.03
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =     0.0018
```

UKBanks_DAESc~s	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
WS	16.7719	4.739478	3.54	0.000	7.482689	26.0611
TC	.3120633	.4206829	0.74	0.458	-.51246	1.136587
TD	.0420535	.173629	0.24	0.809	-.2982531	.3823601
HQLA	.1258527	.222287	0.57	0.571	-.3098217	.5615272
LLP	-12.49153	5.140533	-2.43	0.015	-22.56679	-2.416275
RWA	.0685478	.2142591	0.32	0.749	-.3513923	.4884879
TL	4.186201	1.353989	3.09	0.002	1.532432	6.83997
OIR	0	(omitted)				
UKBankBaseRates	.8552918	.5940902	1.44	0.150	-.3091036	2.019687
UKInflation	.3438079	.6673551	0.52	0.606	-.9641842	1.6518
UKGDPGrowth	-.2630625	.3185585	-0.83	0.409	-.8874257	.3613007
_cons	-3.240251	1.32648	-2.44	0.015	-5.840105	-.6403977
sigma_u	0					
sigma_e	.06994333					
rho	0	(fraction of variance due to u_i)				

```
. estimates store random
```

Appendix A.4.5 Hausman Test

```
. hausman fixed random, sigmamore

Note: the rank of the differenced variance matrix (3) does not equal the number of coefficients being tested (10); be sure this is what you expect, or there may be problems
        computing the test.  Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a
        similar scale.
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
WS	2.171708	16.7719	-14.60019	3.323379
TC	.4074162	.3120633	.0953528	.1418995
TD	.2321107	.0420535	.1900572	.0856142
HQLA	-.1186809	.1258527	-.2445337	.0835255
LLP	-16.67529	-12.49153	-4.183761	1.565293
RWA	.3842403	.0685478	.3156925	.0760728
TL	2.37558	4.186201	-1.810621	.4401079
UKBankBase~s	.0480832	.8552918	-.8072086	.2442436
UKInflation	.5800424	.3438079	.2362345	.1301891
UKGDPGrowth	-.428436	-.2630625	-.1653735	.0441801

```
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  26.13
Prob > chi2 = 0.0000
(V_b-V_B is not positive definite)
```

Appendix A.4.6 Test for Breusch-Pagan LM test for cross-sectional correlation in fixed effects model

```
. xttest2

Correlation matrix of residuals:

         __e1     __e2     __e3     __e4
__e1   1.0000
__e2   0.1163   1.0000
__e3  -0.3903   0.3431   1.0000
__e4   0.3077  -0.2750  -0.3687   1.0000

Breusch-Pagan LM test of independence: chi2(6) =    13.566, Pr = 0.0349
Based on 23 complete observations
```

Appendix A.4.7 Test for Heteroscedasticity

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =        7.77
Prob>chi2 =      0.1003
```

Appendix A.4.8 Robust Fixed Effects Panel Regression

```
. xtreg UKBanks_DAEScores WS TC TD HQLA LLP RWA TL OIR UKBankBaseRates UKInflation UKGDPGrowth, fe robust
note: OIR omitted because of collinearity.

Fixed-effects (within) regression               Number of obs     =         92
Group variable: Banks                           Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.3597                                         min =         23
     Between = 0.5586                                         avg =       23.0
     Overall = 0.1392                                         max =         23

                                                F(4, 3)           =          .
corr(u_i, Xb) = -0.3117                         Prob > F          =          .

                                  (Std. err. adjusted for 4 clusters in Banks)
------------------------------------------------------------------------------
             |               Robust
UKBanks_DAESc~s | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
          WS |   2.171708   2.779664     0.78   0.492    -6.674423    11.01784
          TC |   .4074162   .2308741     1.76   0.176    -.3273284    1.142161
          TD |   .2321107   .0533822     4.35   0.022     .0622246    .4019968
        HQLA |  -.1186809    .316559    -0.37   0.733    -1.126113    .8887511
         LLP |  -16.67529   9.934954    -1.68   0.192    -48.29275    14.94216
         RWA |   .3842403   .0970214     3.96   0.029      .075475    .6930057
          TL |    2.37558   .7028047     3.38   0.043     .1389422    4.612218
         OIR |          0  (omitted)
UKBankBaseRates |   .0480832   .7001465     0.07   0.950    -2.180095    2.276262
 UKInflation |   .5800424   .3870503     1.50   0.231    -.6517244    1.811809
 UKGDPGrowth |   -.428436   .2256817    -1.90   0.154    -1.146656    .2897837
       _cons |  -1.568678   .6502784    -2.41   0.095    -3.638154    .5007977
-------------+----------------------------------------------------------------
     sigma_u |  .06595936
     sigma_e |  .06994333
         rho |  .47071028   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Appendix A.4.9 Sample Population, Sample Selection Criteria and Selected Sample (US Banks).

Banks Incorporated in the US (Top 30)

JPMORGAN CHASE BANK, NATIONAL ASSOCIATION
BANK OF AMERICA, NATIONAL ASSOCIATION
WELLS FARGO BANK, NATIONAL ASSOCIATION
CITIBANK, NATIONAL ASSOCIATION
U.S. BANK NATIONAL ASSOCIATION
PNC BANK, NATIONAL ASSOCIATION
GOLDMAN SACHS BANK USA
TRUIST BANK
CAPITAL ONE, NATIONAL ASSOCIATION
TD BANK, NATIONAL ASSOCIATION
THE BANK OF NEW YORK MELLON
STATE STREET BANK AND TRUST COMPANY
CHARLES SCHWAB BANK, SSB
BMO BANK NATIONAL ASSOCIATION
CITIZENS BANK, NATIONAL ASSOCIATION
FIRST-CITIZENS BANK & TRUST COMPANY
MANUFACTURERS AND TRADERS TRUST COMPANY
FIFTH THIRD BANK, NATIONAL ASSOCIATION
MORGAN STANLEY BANK, NATIONAL ASSOCIATION
MORGAN STANLEY PRIVATE BANK, NATIONAL ASSOCIATION
THE HUNTINGTON NATIONAL BANK
AMERICAN EXPRESS NATIONAL BANK
KEYBANK NATIONAL ASSOCIATION
ALLY BANK
HSBC BANK USA, NATIONAL ASSOCIATION
THE NORTHERN TRUST COMPANY
REGIONS BANK
DISCOVER BANK
USAA FEDERAL SAVINGS BANK
SYNCHRONY BANK

Sample Selection criteria

Incorporated in the US
Continuous US operations including 2000 to 2023
Financial Reports Available on Capital IQ Pro
Listed on the New York Stock Exchange continuously since the year 2000
A constituent of the S&P 500 as at the 1st of June 2023
A minimum total market capitalization of GBP 20 Billion as of the 1st of June 2023.
Regulated by the Office of the Comptroller of the Currency (OCC)

Selected Sample

Bank of America
Citigroup
Wells Fargo
U.S. Bancorp

Appendix B: Chapter 4, Section 4.3 The Impact of liquidity and capital regulatory reforms on market value of retail banks

Appendix B 5: Summary of Cumulative Average Abnormal Returns.

Event A: Banking Reform Act (2013)

Event Date A1 Third Reading by the House of Commons: 9th July 2013 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0214	0.6277	0.0440	0.0348	0.5284	0.0551	0.0334	0.6617	0.0762
BARCL	0.0410	0.4454	0.0536	0.0425	0.5275	0.0672	0.0552	0.5525	0.0928
NWGL	0.0770	0.2014	0.0601	0.0910	0.2285	0.0754	0.0959	0.3584	0.1042
HSBAL	0.0142	0.4637	0.0194	0.0069	0.7769	0.0243	0.0214	0.5248	0.0336
Ptf CARs n 1 (4 securities)	0.0389	0.2802	0.0359	0.0446	0.3237	0.0451	0.0526	0.3987	0.0623
CAAR group 1 (4 securities)	0.0389	0.0000	2.7386	0.0446	0.0000	2.7386	0.0526	0.0000	2.7386

Event Date A1 Third Reading by the House of Commons: 9th July 2013 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0214	0.6277	0.0440	0.0348	0.5284	0.0551	0.0334	0.6617	0.0762
BARCL	0.0410	0.4454	0.0536	0.0425	0.5275	0.0672	0.0552	0.5525	0.0928
NWGL	0.0770	0.2014	0.0601	0.0910	0.2285	0.0754	0.0959	0.3584	0.1042
HSBAL	0.0142	0.4637	0.0194	0.0069	0.7769	0.0243	0.0214	0.5248	0.0336
Ptf CARs (4 securities)	0.0389	0.2802	0.0359	0.0446	0.3237	0.0451	0.0526	0.3987	0.0623

CAAR (4 securities)	0.0389	0.0379	0.2240	0.0446	0.0637	0.2238	0.0526	0.0301	0.2240

Event Date A2 Third Reading by the House of Lords: 9th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0170	0.6678	0.0397	0.0086	0.8625	0.0497	0.0565	0.4122	0.0687
BARCL	-0.0332	0.3989	0.0392	-0.0446	0.3654	0.0492	0.0356	0.6008	0.0680
NWGL	-0.0267	0.6036	0.0513	-0.0014	0.9822	0.0643	0.0061	0.9456	0.0889
HSBAL	-0.0188	0.3414	0.0198	-0.0244	0.3253	0.0248	-0.0319	0.3520	0.0342
Ptf CARs (4 securities)	-0.0238	0.3930	0.0278	-0.0153	0.6622	0.0349	0.0170	0.7240	0.0482
CAAR (4 securities)	-0.0238	0.0679	2.7386	-0.0153	0.0000	2.7386	0.0170	0.0000	2.7386

Event Date A2 Third Reading by the House of Lords: 9th December 2013 with three Event Windows Specified Using Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0170	0.6678	0.0397	0.0086	0.8625	0.0497	0.0565	0.4122	0.0687
BARCL	-0.0332	0.3989	0.0392	-0.0446	0.3654	0.0492	0.0356	0.6008	0.0680
NWGL	-0.0267	0.6036	0.0513	-0.0014	0.9822	0.0643	0.0061	0.9456	0.0889
HSBAL	-0.0188	0.3414	0.0198	-0.0244	0.3253	0.0248	-0.0319	0.3520	0.0342
Ptf CARs (4 securities)	-0.0238	0.3930	0.0278	-0.0153	0.6622	0.0349	0.0170	0.7240	0.0482
CAAR (4 securities)	-0.0238	0.0196	0.2084	-0.0153	0.3251	0.2073	0.0170	0.8111	0.2069

Event Date A3 Royal Assent : 18th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0010	0.9788	0.0380	-0.0258	0.5891	0.0477	-0.0019	0.9768	0.0659
BARCL	0.0053	0.8922	0.0389	-0.0117	0.8097	0.0487	0.0134	0.8422	0.0673
NWGL	0.0022	0.9674	0.0528	-0.0240	0.7171	0.0662	0.0113	0.9017	0.0915
HSBAL	-0.0144	0.4686	0.0198	-0.0193	0.4367	0.0248	-0.0419	0.2227	0.0343
Ptf CARs (4 securities)	-0.0014	0.9590	0.0274	-0.0200	0.5606	0.0344	-0.0045	0.9250	0.0475
CAAR (4 securities)	-0.0014	0.0000	2.7386	-0.0200	0.0679	2.7386	-0.0045	0.0000	2.7386

Event Date A3 Royal Assent : 18th December 2013 with three Event Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0010	0.9788	0.0380	-0.0258	0.5891	0.0477	-0.0019	0.9768	0.0659
BARCL	0.0053	0.8922	0.0389	-0.0117	0.8097	0.0487	0.0134	0.8422	0.0673
NWGL	0.0022	0.9674	0.0528	-0.0240	0.7171	0.0662	0.0113	0.9017	0.0915
HSBAL	-0.0144	0.4686	0.0198	-0.0193	0.4367	0.0248	-0.0419	0.2227	0.0343
Ptf CARs (4 securities)	-0.0014	0.9590	0.0274	-0.0200	0.5606	0.0344	-0.0045	0.9250	0.0475
CAAR (4 securities)	-0.0014	0.6675	0.2049	-0.0200	0.0282	0.2061	-0.0045	0.6396	0.2050

Event B: Financial Services and Markets Act (2023)

Event Date B1 Third Reading by the House of Commons: 7th December 2022 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0083	0.9726	0.2401	-0.0003	0.9991	0.3010	0.0145	0.9722	0.4159
BARCL	0.0151	0.9993	16.9264	-0.0010	1.0000	21.2184	0.0014	1.0000	29.3174
NWGL	0.0273	0.5204	0.0423	0.0183	0.7304	0.0531	0.0410	0.5764	0.0733
HSBAL	0.0125	0.7384	0.0375	-0.0219	0.6414	0.0469	0.0494	0.4475	0.0649
Ptf CARs (4 securities)	0.0159	0.8075	0.0653	-0.0011	0.9898	0.0818	0.0269	0.8119	0.1130
CAAR (4 securities)	0.0159	0.0000	2.7386	-0.0011	0.0000	2.7386	0.0269	0.0000	2.7386

Event Date B1 Third Reading by the House of Commons: 12th December 2022 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.008	0.973	0.240	0.000	0.999	0.301	0.014	0.972	0.416
BARCL	0.015	0.999	16.926	-0.001	1.000	21.218	0.001	1.000	29.317
NWGL	0.027	0.520	0.042	0.018	0.730	0.053	0.041	0.576	0.073
HSBAL	0.013	0.738	0.037	-0.022	0.641	0.047	0.049	0.448	0.065
Ptf CARs (4 securities)	0.016	0.808	0.065	-0.001	0.990	0.082	0.027	0.812	0.113

CAAR (4 securities)	0.016	0.083	0.227	-0.001	0.924	0.226	0.027	0.198	0.227

Event Date B2 Third Reading by the House of Commons: 19th June 2023 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.029	0.868	0.172	-0.048	0.824	0.215	-0.004	0.990	0.297
BARCL	-0.039	0.998	16.891	-0.048	0.998	21.174	0.017	1.000	29.257
NWGL	-0.105	0.015	0.043	-0.090	0.097	0.054	-0.050	0.501	0.075
HSBAL	0.020	0.578	0.037	0.022	0.636	0.046	0.063	0.321	0.064
Ptf CARs (4 securities)	-0.038	0.458	0.051	-0.041	0.524	0.064	0.007	0.937	0.088
CAAR (4 securities)	-0.038	0.000	2.739	-0.041	0.000	2.739	0.007	0.000	2.739

Event Date B2 Third Reading by the House of Commons: 19th June 2023 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0286	0.8679	0.1717	-0.0480	0.8238	0.2152	-0.0038	0.9899	0.2974
BARCL	-0.0386	0.9982	16.8913	-0.0476	0.9982	21.1743	0.0166	0.9995	29.2565
NWGL	-0.1054	0.0151	0.0431	-0.0901	0.0967	0.0540	-0.0503	0.5014	0.0747
HSBAL	0.0204	0.5779	0.0367	0.0218	0.6357	0.0460	0.0632	0.3208	0.0635

Ptf CARs (4 securities)	-0.0377	0.4581	0.0508	-0.0406	0.5239	0.0636	0.0070	0.9367	0.0879
CAAR (4 securities)	-0.0377	0.3446	0.2255	-0.0406	0.2722	0.2255	0.0070	0.8754	0.2252

Event Date B3 Royal Assent: 29th June 2023 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0289	0.8663	0.1716	0.0272	0.8993	0.2152	0.0219	0.9414	0.2973
BARCL	0.0423	0.9980	16.8913	0.0064	0.9998	21.1743	0.0244	0.9993	29.2565
NWGL	0.0470	0.2671	0.0422	0.0256	0.6286	0.0529	-0.0412	0.5737	0.0732
HSBAL	0.0291	0.4244	0.0364	0.0247	0.5891	0.0457	0.0393	0.5340	0.0631
Ptf CARs (4 securities)	0.0370	0.4659	0.0506	0.0212	0.7391	0.0635	0.0117	0.8943	0.0877
CAAR (4 securities)	0.0370	0.0000	2.7386	0.0212	0.0000	2.7386	0.0117	0.0000	2.7386

Event Date B3 Royal Assent: 29th June 2023 with three Event Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0289	0.8663	0.1716	0.0272	0.8993	0.2152	0.0219	0.9414	0.2973
BARCL	0.0423	0.9980	16.8913	0.0064	0.9998	21.1743	0.0244	0.9993	29.2565
NWGL	0.0470	0.2671	0.0422	0.0256	0.6286	0.0529	-0.0412	0.5737	0.0732
HSBAL	0.0291	0.4244	0.0364	0.0247	0.5891	0.0457	0.0393	0.5340	0.0631

Ptf CARs (4 securities)	0.0370	0.4659	0.0506	0.0212	0.7391	0.0635	0.0117	0.8943	0.0877
CAAR (4 securities)	0.0370	0.0419	0.2267	0.0212	0.0754	0.2264	0.0117	0.5136	0.2255

Event A: Banking Reform Act (2013)

Event Date A1 Third Reading by the House of Commons: 9th July 2013 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR(-3,3)	PVALUES	StDev	CAAR(-5,5)	PVALUES	StDev	CAAR(-10,10)	PVALUES	StDev
LLOYL	0.0214	0.6277	0.0440	0.0348	0.5284	0.0551	0.0334	0.6617	0.0762
BARCL	0.0410	0.4454	0.0536	0.0425	0.5275	0.0672	0.0552	0.5525	0.0928
NWGL	0.0770	0.2014	0.0601	0.0910	0.2285	0.0754	0.0959	0.3584	0.1042
HSBAL	0.0142	0.4637	0.0194	0.0069	0.7769	0.0243	0.0214	0.5248	0.0336
Ptf CARs n 1 (4 securities)	0.0389	0.2802	0.0359	0.0446	0.3237	0.0451	0.0526	0.3987	0.0623
CAAR group 1 (4 securities)	0.0389	0.0000	2.7386	0.0446	0.0000	2.7386	0.0526	0.0000	2.7386

Event Date A1 Third Reading by the House of Commons: 9th July 2013 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0214	0.6277	0.0440	0.0348	0.5284	0.0551	0.0334	0.6617	0.0762
BARCL	0.0410	0.4454	0.0536	0.0425	0.5275	0.0672	0.0552	0.5525	0.0928
NWGL	0.0770	0.2014	0.0601	0.0910	0.2285	0.0754	0.0959	0.3584	0.1042
HSBAL	0.0142	0.4637	0.0194	0.0069	0.7769	0.0243	0.0214	0.5248	0.0336
Ptf CARs (4 securities)	0.0389	0.2802	0.0359	0.0446	0.3237	0.0451	0.0526	0.3987	0.0623
CAAR (4 securities)	0.0389	0.0379	0.2240	0.0446	0.0637	0.2238	0.0526	0.0301	0.2240

Event Date A2 Third Reading by the House of Lords: 9th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0170	0.6678	0.0397	0.0086	0.8625	0.0497	0.0565	0.4122	0.0687
BARCL	-0.0332	0.3989	0.0392	-0.0446	0.3654	0.0492	0.0356	0.6008	0.0680
NWGL	-0.0267	0.6036	0.0513	-0.0014	0.9822	0.0643	0.0061	0.9456	0.0889
HSBAL	-0.0188	0.3414	0.0198	-0.0244	0.3253	0.0248	-0.0319	0.3520	0.0342
Ptf CARs (4 securities)	-0.0238	0.3930	0.0278	-0.0153	0.6622	0.0349	0.0170	0.7240	0.0482
CAAR (4 securities)	-0.0238	0.0679	2.7386	-0.0153	0.0000	2.7386	0.0170	0.0000	2.7386

Event Date A2 Third Reading by the House of Lords: 9th December 2013 with three Event Windows Specified Using Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0170	0.6678	0.0397	0.0086	0.8625	0.0497	0.0565	0.4122	0.0687
BARCL	-0.0332	0.3989	0.0392	-0.0446	0.3654	0.0492	0.0356	0.6008	0.0680
NWGL	-0.0267	0.6036	0.0513	-0.0014	0.9822	0.0643	0.0061	0.9456	0.0889
HSBAL	-0.0188	0.3414	0.0198	-0.0244	0.3253	0.0248	-0.0319	0.3520	0.0342
Ptf CARs (4 securities)	-0.0238	0.3930	0.0278	-0.0153	0.6622	0.0349	0.0170	0.7240	0.0482
CAAR (4 securities)	-0.0238	0.0196	0.2084	-0.0153	0.3251	0.2073	0.0170	0.8111	0.2069

Event Date A3 Royal Assent: 18th December 2013 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0010	0.9788	0.0380	-0.0258	0.5891	0.0477	-0.0019	0.9768	0.0659
BARCL	0.0053	0.8922	0.0389	-0.0117	0.8097	0.0487	0.0134	0.8422	0.0673
NWGL	0.0022	0.9674	0.0528	-0.0240	0.7171	0.0662	0.0113	0.9017	0.0915
HSBAL	-0.0144	0.4686	0.0198	-0.0193	0.4367	0.0248	-0.0419	0.2227	0.0343
Ptf CARs (4 securities)	-0.0014	0.9590	0.0274	-0.0200	0.5606	0.0344	-0.0045	0.9250	0.0475
CAAR (4 securities)	-0.0014	0.0000	2.7386	-0.0200	0.0679	2.7386	-0.0045	0.0000	2.7386

Event Date A3 Royal Assent: 18th December 2013 with three Event Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR(-3,3)	PVALUES	StDev	CAAR(-5,5)	PVALUES	StDev	CAAR(-10,10)	PVALUES	StDev
LLOYL	0.0010	0.9788	0.0380	-0.0258	0.5891	0.0477	-0.0019	0.9768	0.0659
BARCL	0.0053	0.8922	0.0389	-0.0117	0.8097	0.0487	0.0134	0.8422	0.0673
NWGL	0.0022	0.9674	0.0528	-0.0240	0.7171	0.0662	0.0113	0.9017	0.0915
HSBAL	-0.0144	0.4686	0.0198	-0.0193	0.4367	0.0248	-0.0419	0.2227	0.0343
Ptf CARs (4 securities)	-0.0014	0.9590	0.0274	-0.0200	0.5606	0.0344	-0.0045	0.9250	0.0475
CAAR (4 securities)	-0.0014	0.6675	0.2049	-0.0200	0.0282	0.2061	-0.0045	0.6396	0.2050

Event B: Financial Services and Markets Act (2023)

Event Date B1 Third Reading by the House of Commons: 7th December 2022 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR(-5,5)	PVALUES	StDev	CAAR(-10,10)	PVALUES	StDev
LLOYL	0.0083	0.9726	0.2401	-0.0003	0.9991	0.3010	0.0145	0.9722	0.4159
BARCL	0.0151	0.9993	16.9264	-0.0010	1.0000	21.2184	0.0014	1.0000	29.3174
NWGL	0.0273	0.5204	0.0423	0.0183	0.7304	0.0531	0.0410	0.5764	0.0733
HSBAL	0.0125	0.7384	0.0375	-0.0219	0.6414	0.0469	0.0494	0.4475	0.0649
Ptf CARs (4 securities)	0.0159	0.8075	0.0653	-0.0011	0.9898	0.0818	0.0269	0.8119	0.1130
CAAR (4 securities)	0.0159	0.0000	2.7386	-0.0011	0.0000	2.7386	0.0269	0.0000	2.7386

Event Date B1 Third Reading by the House of Commons: 12th December 2022 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR(-5,5)	PVALUES	StDev	CAAR(-10,10)	PVALUES	StDev
LLOYL	0.008	0.973	0.240	0.000	0.999	0.301	0.014	0.972	0.416

BARCL	0.015	0.999	16.926	-0.001	1.000	21.218	0.001	1.000	29.317
NWGL	0.027	0.520	0.042	0.018	0.730	0.053	0.041	0.576	0.073
HSBAL	0.013	0.738	0.037	-0.022	0.641	0.047	0.049	0.448	0.065
Ptf CARs (4 securities)	0.016	0.808	0.065	-0.001	0.990	0.082	0.027	0.812	0.113
CAAR (4 securities)	0.016	0.083	0.227	-0.001	0.924	0.226	0.027	0.198	0.227

Event Date B2 Third Reading by the House of Commons: 19th June 2023 with three Even Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.029	0.868	0.172	-0.048	0.824	0.215	-0.004	0.990	0.297
BARCL	-0.039	0.998	16.891	-0.048	0.998	21.174	0.017	1.000	29.257
NWGL	-0.105	0.015	0.043	-0.090	0.097	0.054	-0.050	0.501	0.075
HSBAL	0.020	0.578	0.037	0.022	0.636	0.046	0.063	0.321	0.064
Ptf CARs (4 securities)	-0.038	0.458	0.051	-0.041	0.524	0.064	0.007	0.937	0.088
CAAR (4 securities)	-0.038	0.000	2.739	-0.041	0.000	2.739	0.007	0.000	2.739

Event Date B2 Third Reading by the House of Commons: 19th June 2023 with three Even Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window	A 5 day Event Window	A 10 day Event Window

	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	-0.0286	0.8679	0.1717	-0.0480	0.8238	0.2152	-0.0038	0.9899	0.2974
BARCL	-0.0386	0.9982	16.8913	-0.0476	0.9982	21.1743	0.0166	0.9995	29.2565
NWGL	-0.1054	0.0151	0.0431	-0.0901	0.0967	0.0540	-0.0503	0.5014	0.0747
HSBAL	0.0204	0.5779	0.0367	0.0218	0.6357	0.0460	0.0632	0.3208	0.0635
Ptf CARs (4 securities)	-0.0377	0.4581	0.0508	-0.0406	0.5239	0.0636	0.0070	0.9367	0.0879
CAAR (4 securities)	-0.0377	0.3446	0.2255	-0.0406	0.2722	0.2255	0.0070	0.8754	0.2252

Event Date B3 Royal Assent: 29th June 2023 with three Event Windows Specified Using the Generalised Sign Test by Wilcoxon

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0289	0.8663	0.1716	0.0272	0.8993	0.2152	0.0219	0.9414	0.2973
BARCL	0.0423	0.9980	16.8913	0.0064	0.9998	21.1743	0.0244	0.9993	29.2565
NWGL	0.0470	0.2671	0.0422	0.0256	0.6286	0.0529	-0.0412	0.5737	0.0732
HSBAL	0.0291	0.4244	0.0364	0.0247	0.5891	0.0457	0.0393	0.5340	0.0631
Ptf CARs (4 securities)	0.0370	0.4659	0.0506	0.0212	0.7391	0.0635	0.0117	0.8943	0.0877
CAAR (4 securities)	0.0370	0.0000	2.7386	0.0212	0.0000	2.7386	0.0117	0.0000	2.7386

Event Date B3 Royal Assent : 29th June 2023 with three Event Windows Specified Using the Generalised Rank Test by Kolari and Pynnonen

	A 3 day Event Window			A 5 day Event Window			A 10 day Event Window		
	CAAR (-3,3)	PVALUES	StDev	CAAR (-5,5)	PVALUES	StDev	CAAR (-10,10)	PVALUES	StDev
LLOYL	0.0289	0.8663	0.1716	0.0272	0.8993	0.2152	0.0219	0.9414	0.2973
BARCL	0.0423	0.9980	16.8913	0.0064	0.9998	21.1743	0.0244	0.9993	29.2565
NWGL	0.0470	0.2671	0.0422	0.0256	0.6286	0.0529	-0.0412	0.5737	0.0732
HSBAL	0.0291	0.4244	0.0364	0.0247	0.5891	0.0457	0.0393	0.5340	0.0631
Ptf CARs (4 securities)	0.0370	0.4659	0.0506	0.0212	0.7391	0.0635	0.0117	0.8943	0.0877
CAAR (4 securities)	0.0370	0.0419	0.2267	0.0212	0.0754	0.2264	0.0117	0.5136	0.2255

Appendix B 5.1.1 Event Date A1: Third reading House of Commons. 9th July 2013

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(07092013) modt(MAM) indexlist(ISFL) diagn(GRANK) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(-28
> 0) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_A1)
```

Event study with common event date

Event date: **09jul2013**, with 3 event windows specified, using the Generalised Rank test by Kolari and Pynnonen

SECURITY	CAAR[-3,3]	CAAR[-5,5]	CAAR[-10,10]
LLOYL	2.1361%	3.4809%	3.3374%
	(0.6277)	(0.5284)	(0.6617)
BARCL	4.0959%	4.2502%	5.5209%
	(0.4454)	(0.5275)	(0.5525)
NWGL	7.7042%	9.1014%	9.5857%
	(0.2014)	(0.2285)	(0.3584)
HSBAL	1.4238%	0.6899%	2.1398%
	(0.4637)	(0.7769)	(0.5248)
Ptf CARs n 1 (4 securities)	3.8899%	4.4550%	5.2628%
	(0.2802)	(0.3237)	(0.3987)
CAAR group 1 (4 securities)	3.8899%**	4.4550%*	5.2628%**
	(0.0379)	(0.0637)	(0.0301)

*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(07092013) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -280) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults)
```

Event study with common event date

Event date: **09jul2013**, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon

SECURITY	CAAR[-3,3]	CAAR[-5,5]	CAAR[-10,10]
LLOYL	2.1361%	3.4809%	3.3374%
	(0.6277)	(0.5284)	(0.6617)
BARCL	4.0959%	4.2502%	5.5209%
	(0.4454)	(0.5275)	(0.5525)
NWGL	7.7042%	9.1014%	9.5857%
	(0.2014)	(0.2285)	(0.3584)
HSBAL	1.4238%	0.6899%	2.1398%
	(0.4637)	(0.7769)	(0.5248)
Ptf CARs n 1 (4 securities)	3.8899%	4.4550%	5.2628%
	(0.2802)	(0.3237)	(0.3987)
CAAR group 1 (4 securities)	3.8899%***	4.4550%***	5.2628%***
	(0.0000)	(0.0000)	(0.0000)

*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses

Appendix B 5.1.2 Event Date A2: Third reading House of Lords. 9th December 2013

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12092013) modt(MAM) indexlist(ISFL) diagn(GRANK) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(-28
> 0) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_A2)

Event study with common event date
Event date: 09dec2013, with 3 event windows specified, using the Generalised Rank test by Kolari and Pynnonen
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
----------------------------------------------------------------------------------
LLOYL                           -1.7049%           0.8627%           5.6455%
                                 (0.6678)          (0.8625)          (0.4122)
BARCL                           -3.3156%          -4.4601%           3.5607%
                                 (0.3989)          (0.3654)          (0.6008)
NWGL                            -2.6681%          -0.1434%           0.6071%
                                 (0.6036)          (0.9822)          (0.9456)
HSBAL                           -1.8835%          -2.4415%          -3.1914%
                                 (0.3414)          (0.3253)          (0.3520)
Ptf CARs n 1 (4 securities)     -2.3800%          -1.5252%           1.7030%
                                 (0.3930)          (0.6622)          (0.7240)
CAAR group 1 (4 securities)     -2.3800%**        -1.5252%           1.7030%
                                 (0.0196)          (0.3251)          (0.8111)
----------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12092013) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -280) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_A2)

Event study with common event date
Event date: 09dec2013, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
----------------------------------------------------------------------------------
LLOYL                           -1.7049%           0.8627%           5.6455%
                                 (0.6678)          (0.8625)          (0.4122)
BARCL                           -3.3156%          -4.4601%           3.5607%
                                 (0.3989)          (0.3654)          (0.6008)
NWGL                            -2.6681%          -0.1434%           0.6071%
                                 (0.6036)          (0.9822)          (0.9456)
HSBAL                           -1.8835%          -2.4415%          -3.1914%
                                 (0.3414)          (0.3253)          (0.3520)
Ptf CARs n 1 (4 securities)     -2.3800%          -1.5252%           1.7030%
                                 (0.3930)          (0.6622)          (0.7240)
CAAR group 1 (4 securities)     -2.3800%*         -1.5252%***        1.7030%***
                                 (0.0679)          (0.0000)          (0.0000)
----------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

Appendix B 5.1.3 Event Date A3 : Royal Assent . 18th December 2013

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12182013) modt(MAM) indexlist(ISFL) diagn(GRANK) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(-28
> 0) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_A3)

Event study with common event date
Event date: 18dec2013, with 3 event windows specified, using the Generalised Rank test by Kolari and Pynnonen
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
----------------------------------------------------------------------------------
LLOYL                             0.1010%          -2.5780%          -0.1915%
                                 (0.9788)          (0.5891)          (0.9768)
BARCL                             0.5275%          -1.1747%           1.3422%
                                 (0.8922)          (0.8097)          (0.8422)
NWGL                              0.2164%          -2.4027%           1.1317%
                                 (0.9674)          (0.7171)          (0.9017)
HSBAL                            -1.4374%          -1.9335%          -4.1926%
                                 (0.4686)          (0.4367)          (0.2227)
Ptf CARs n 1 (4 securities)      -0.1411%          -2.0027%          -0.4476%
                                 (0.9590)          (0.5606)          (0.9250)
CAAR group 1 (4 securities)      -0.1411%          -2.0027%**        -0.4476%
                                 (0.6675)          (0.0282)          (0.6396)
----------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12182013) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -280) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_A3)

Event study with common event date
Event date: 18dec2013, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
----------------------------------------------------------------------------------
LLOYL                             0.1010%          -2.5780%          -0.1915%
                                 (0.9788)          (0.5891)          (0.9768)
BARCL                             0.5275%          -1.1747%           1.3422%
                                 (0.8922)          (0.8097)          (0.8422)
NWGL                              0.2164%          -2.4027%           1.1317%
                                 (0.9674)          (0.7171)          (0.9017)
HSBAL                            -1.4374%          -1.9335%          -4.1926%
                                 (0.4686)          (0.4367)          (0.2227)
Ptf CARs n 1 (4 securities)      -0.1411%          -2.0027%          -0.4476%
                                 (0.9590)          (0.5606)          (0.9250)
CAAR group 1 (4 securities)      -0.1411%***       -2.0027%*         -0.4476%***
                                 (0.0000)          (0.0679)          (0.0000)
----------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

Appendix B 5.2.1 Event Date B1: Third reading House of Commons 7th December 2022

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12072022) modt(MAM) indexlist(ISFL) diagn(GRANK) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(-28
> 2) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_B1)

Event study with common event date
Event date: 07dec2022, with 3 event windows specified, using the Generalised Rank test by Kolari and Pynnonen
SECURITY                      CAAR[-3,3]       CAAR[-5,5]       CAAR[-10,10]
-----------------------------------------------------------------------------
LLOYL                           0.8251%         -0.0339%         1.4491%
                               (0.9726)         (0.9991)        (0.9722)
BARCL                           1.5090%         -0.0997%         0.1396%
                               (0.9993)         (1.0000)        (1.0000)
NWGL                            2.7256%          1.8315%         4.1025%
                               (0.5204)         (0.7304)        (0.5764)
HSBAL                           1.2523%         -2.1890%         4.9350%
                               (0.7384)         (0.6414)        (0.4475)
Ptf CARs n 1 (4 securities)     1.5913%         -0.1051%         2.6929%
                               (0.8075)         (0.9898)        (0.8119)
CAAR group 1 (4 securities)     1.5914%*        -0.1051%         2.6929%
                               (0.0831)         (0.9240)        (0.1981)
-----------------------------------------------------------------------------

*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(12072022) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -282) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_B1)

Event study with common event date
Event date: 07dec2022, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                      CAAR[-3,3]       CAAR[-5,5]       CAAR[-10,10]
-----------------------------------------------------------------------------
LLOYL                           0.8251%         -0.0339%         1.4491%
                               (0.9726)         (0.9991)        (0.9722)
BARCL                           1.5090%         -0.0997%         0.1396%
                               (0.9993)         (1.0000)        (1.0000)
NWGL                            2.7256%          1.8315%         4.1025%
                               (0.5204)         (0.7304)        (0.5764)
HSBAL                           1.2523%         -2.1890%         4.9350%
                               (0.7384)         (0.6414)        (0.4475)
Ptf CARs n 1 (4 securities)     1.5913%         -0.1051%         2.6929%
                               (0.8075)         (0.9898)        (0.8119)
CAAR group 1 (4 securities)     1.5914%***      -0.1051%***      2.6929%***
                               (0.0000)         (0.0000)        (0.0000)
-----------------------------------------------------------------------------

*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

Appendix B <u>5.2.2 </u>Event Date B2: Third reading House of Lords 19th June 2023

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(06192023) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -282) eswub(-30) dateformat(MDY) dec(4) showpv graph (-10 10)

Event study with common event date
Event date: 19jun2023, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                       CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
---------------------------------------------------------------------------------
LLOYL                          -2.8579%          -4.7979%          -0.3777%
                                (0.8679)          (0.8238)          (0.9899)
BARCL                          -3.8632%          -4.7635%           1.6642%
                                (0.9982)          (0.9982)          (0.9995)
NWGL                          -10.5437%**        -9.0104%*         -5.0273%
                                (0.0151)          (0.0967)          (0.5014)
HSBAL                           2.0438%           2.1806%           6.3204%
                                (0.5779)          (0.6357)          (0.3208)
Ptf CARs n 1 (4 securities)    -3.7722%          -4.0615%           0.6989%
                                (0.4581)          (0.5239)          (0.9367)
CAAR group 1 (4 securities)    -3.7723%***       -4.0615%***        0.6989%***
                                (0.0000)          (0.0000)          (0.0000)
---------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(06192023) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -282) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_B2)

Event study with common event date
Event date: 19jun2023, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                       CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
---------------------------------------------------------------------------------
LLOYL                          -2.8579%          -4.7979%          -0.3777%
                                (0.8679)          (0.8238)          (0.9899)
BARCL                          -3.8632%          -4.7635%           1.6642%
                                (0.9982)          (0.9982)          (0.9995)
NWGL                          -10.5437%**        -9.0104%*         -5.0273%
                                (0.0151)          (0.0967)          (0.5014)
HSBAL                           2.0438%           2.1806%           6.3204%
                                (0.5779)          (0.6357)          (0.3208)
Ptf CARs n 1 (4 securities)    -3.7722%          -4.0615%           0.6989%
                                (0.4581)          (0.5239)          (0.9367)
CAAR group 1 (4 securities)    -3.7723%***       -4.0615%***        0.6989%***
                                (0.0000)          (0.0000)          (0.0000)
---------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

Appendix B 5.2.3 Event Date B3: Royal Assent   29th June 2023

GRANK Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(06292023) modt(MAM) indexlist(ISFL) diagn(GRANK) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(-28
> 2) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_B3)

Event study with common event date
Event date: 29jun2023, with 3 event windows specified, using the Generalised Rank test by Kolari and Pynnonen
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
--------------------------------------------------------------------------------
LLOYL                             2.8926%           2.7242%           2.1857%
                                 (0.8663)          (0.8993)          (0.9414)
BARCL                             4.2325%           0.6380%           2.4441%
                                 (0.9980)          (0.9998)          (0.9993)
NWGL                              4.6969%           2.5638%          -4.1212%
                                 (0.2671)          (0.6286)          (0.5737)
HSBAL                             2.9140%           2.4689%           3.9283%
                                 (0.4244)          (0.5891)          (0.5340)
Ptf CARs n 1 (4 securities)       3.6966%           2.1160%           1.1656%
                                 (0.4659)          (0.7391)          (0.8943)
CAAR group 1 (4 securities)       3.6966%**         2.1159%*          1.1656%
                                 (0.0419)          (0.0754)          (0.5136)
--------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

WILCOXON Statistical Test

```
. estudy LLOYL BARCL NWGL HSBAL, datevar(Date) evdate(06292023) modt(MAM) indexlist(ISFL) diagn(Wilcoxon) lb1(-3) ub1(3) lb2(-5) ub2(5) lb3(-10) ub3(10) eswlb(
> -282) eswub(-30) dateformat(MDY) dec(4) showpv outputfile(excelresults_B3)

Event study with common event date
Event date: 29jun2023, with 3 event windows specified, using the Generalised SIGN test by Wilcoxon
SECURITY                        CAAR[-3,3]        CAAR[-5,5]        CAAR[-10,10]
--------------------------------------------------------------------------------
LLOYL                             2.8926%           2.7242%           2.1857%
                                 (0.8663)          (0.8993)          (0.9414)
BARCL                             4.2325%           0.6380%           2.4441%
                                 (0.9980)          (0.9998)          (0.9993)
NWGL                              4.6969%           2.5638%          -4.1212%
                                 (0.2671)          (0.6286)          (0.5737)
HSBAL                             2.9140%           2.4689%           3.9283%
                                 (0.4244)          (0.5891)          (0.5340)
Ptf CARs n 1 (4 securities)       3.6966%           2.1160%           1.1656%
                                 (0.4659)          (0.7391)          (0.8943)
CAAR group 1 (4 securities)       3.6966%***        2.1159%***        1.1656%***
                                 (0.0000)          (0.0000)          (0.0000)
--------------------------------------------------------------------------------
*** p-value < .01, ** p-value <.05, * p-value <.1
p-values in parentheses
```

Appendix C: Chapter 6 The Impact of Regulatory Reforms on The Profitability of the Big Four Banks in the UK

Appendix C 6.1 Panel Regression Analysis

Table 4: Fixed Effects Regression Analysis Results

VARIABLES	Model (1) Dep Var: ln_ROA1	Model (2) Dep Var: ln_ROE1	Model (3) Dep Var: ln_NIM
ln_HQLAs1	0.530	0.454	0.362
	(0.109)	(0.135)	(0.299)
ln_Capital1	0.534**	0.546**	0.497*
	(0.0249)	(0.0232)	(0.0934)
ln_Teir1_1	-0.0807	-0.105	-0.700**
	(0.805)	(0.724)	(0.0130)
ln_Teir2_1	-0.0117	0.0638	0.145
	(0.871)	(0.454)	(0.209)
ln_LLP1	-0.594	-0.631	-0.172
	(0.136)	(0.116)	(0.248)
ln_Loans	1.936**	1.749**	2.308
	(0.0202)	(0.0423)	(0.128)
ln_EquityGrowth	-0.580***	-0.568**	-0.256
	(0.00862)	(0.0105)	(0.259)
ln_Staff	-0.325	-0.0341	0.0506
	(0.721)	(0.973)	(0.925)
ln_Inflation	-2.281**	-2.063**	-3.520
	(0.0171)	(0.0226)	(0.743)
ln_Interest	1.149*	1.057*	-0.884
	(0.0883)	(0.0910)	(0.768)
ln_GDP	-0.148	-0.155	-0.713
	(0.847)	(0.835)	(0.608)
Constant	-2.385	-1.590	-22.53
	(0.571)	(0.721)	(0.705)
Number of Banks	4	4	4
R-squared	0.820	0.821	0.850
Sigma_u	0.695	0.864	0.555
Sigma_e	0.689	0.675	0.396
rho	0.504	0. 621	0. 662

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5: Random effects regression results

VARIABLES	Model (1) Dep Var: ln_ROA1	Model (2) Dep Var: ln_ROE1	Model (3) Dep Var: ln_NIM
ln_HQLAs1	0.381***	0.324***	0.268***
	(9.67e-08)	(0.000295)	(0.00263)
ln_Capital1	0.442*	0.435*	0.426***
	(0.0813)	(0.0728)	(0.000669)
ln_Teir1_1	-0.220	-0.198	-0.460***
	(0.465)	(0.453)	(0.000182)
ln_Teir2_1	-0.138	-0.139	0.0404
	(0.462)	(0.463)	(0.563)
ln_LLP1	-0.0582	-0.0726	-0.0691
	(0.594)	(0.475)	(0.246)
ln_Loans	1.971***	1.779**	0.530
	(0.00582)	(0.0238)	(0.452)
ln_EquityGrowth	-0.359***	-0.366***	-0.130
	(0.00970)	(0.00605)	(0.215)
ln_Staff	-0.754	-0.642	-0.473***
	(0.247)	(0.288)	(0.00128)
ln_Inflation	-0.302	-0.238	-0.00206
	(0.359)	(0.481)	(0.994)
ln_Interest	0.843***	0.850***	0.259*
	(0.000328)	(0.000860)	(0.0861)
ln_GDP	0.562**	0.552**	0.263**
	(0.0222)	(0.0133)	(0.0307)
Constant	5.199***	5.750***	-1.136
	(1.98e-08)	(1.82e-05)	(0.344)
Number of Bank	4	4	4
R-squared	0.736	0.802	0.704
Sigma_u	0	0	0
Sigma_e	0.761	0.725	0.344
rho	0	0	0

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

```
. xtreg ln_ROA1 ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, re robust

Random-effects GLS regression                   Number of obs     =         46
Group variable: Bank                            Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.5132                                         min =          5
     Between = 0.7359                                         avg =       11.5
     Overall = 0.5135                                         max =         15

                                                Wald chi2(3)      =          .
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =          .

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_ROA1	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
ln_HQLAs1	.381239	.0714899	5.33	0.000	.2411213	.5213567
ln_Capital1	.4417793	.2534339	1.74	0.081	-.0549419	.9385005
ln_Teir1_1	-.2201921	.301044	-0.73	0.465	-.8102275	.3698433
ln_Teir2_1	-.1376541	.1873372	-0.73	0.462	-.5048283	.2295202
ln_LLP1	-.0582255	.1092723	-0.53	0.594	-.2723953	.1559444
ln_Loans	1.97108	.7147603	2.76	0.006	.5701755	3.371985
ln_EquityGrowth	-.358566	.1386471	-2.59	0.010	-.6303094	-.0868226
ln_Staff	-.7542409	.6517238	-1.16	0.247	-2.031596	.5231142
ln_Inflation	-.3021379	.329366	-0.92	0.359	-.9476835	.3434076
ln_Interest	.842547	.2345625	3.59	0.000	.3828129	1.302281
ln_GDP	.5616266	.2455641	2.29	0.022	.0803297	1.042923
_cons	5.199037	.9261024	5.61	0.000	3.38391	7.014164
sigma_u	0					
sigma_e	.76093742					
rho	0	(fraction of variance due to u_i)				

```
. regress ln_ROA1 ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, vce (cluster Bank)

Linear regression                               Number of obs     =         46
                                                F(2, 3)           =          .
                                                Prob > F          =          .
                                                R-squared         =     0.5135
                                                Root MSE          =      .8334

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_ROA1	Coefficient	Robust std. err.	t	P>|t|	[95% conf.	interval]
ln_HQLAs1	.381239	.0714899	5.33	0.013	.1537261	.6087519
ln_Capital1	.4417793	.2534339	1.74	0.180	-.3647604	1.248319
ln_Teir1_1	-.2201921	.301044	-0.73	0.517	-1.178249	.7378642
ln_Teir2_1	-.1376541	.1873372	-0.73	0.516	-.7338448	.4585367
ln_LLP1	-.0582255	.1092723	-0.53	0.631	-.4059788	.2895279
ln_Loans	1.97108	.7147603	2.76	0.070	-.3036064	4.245766
ln_EquityGrowth	-.358566	.1386471	-2.59	0.081	-.7998031	.082671
ln_Staff	-.7542409	.6517238	-1.16	0.331	-2.828317	1.319835
ln_Inflation	-.3021379	.329366	-0.92	0.427	-1.350328	.7460518
ln_Interest	.842547	.2345625	3.59	0.037	.0960643	1.58903
ln_GDP	.5616266	.2455641	2.29	0.106	-.2198681	1.343121
_cons	5.199037	.9261024	5.61	0.011	2.251766	8.146308

```
. xtreg ln_ROE1 ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, re robust

Random-effects GLS regression                   Number of obs     =         46
Group variable: Bank                            Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.5231                                         min =          5
     Between = 0.8023                                         avg =       11.5
     Overall = 0.5189                                         max =         15

                                                Wald chi2(3)      =          .
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =          .

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_ROE1	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
ln_HQLAs1	.3243933	.0896117	3.62	0.000	.1487577	.5000289
ln_Capital1	.4345832	.24222	1.79	0.073	-.0401594	.9093257
ln_Teir1_1	-.1984511	.2646697	-0.75	0.453	-.7171941	.320292
ln_Teir2_1	-.1386155	.1890117	-0.73	0.463	-.5090717	.2318406
ln_LLP1	-.0725986	.1017052	-0.71	0.475	-.2719371	.1267398
ln_Loans	1.77857	.7870836	2.26	0.024	.2359144	3.321225
ln_EquityGrowth	-.3662076	.1334062	-2.75	0.006	-.627679	-.1047362
ln_Staff	-.6419245	.6039418	-1.06	0.288	-1.825629	.5417796
ln_Inflation	-.2383655	.338269	-0.70	0.481	-.9013607	.4246296
ln_Interest	.8504332	.2551772	3.33	0.001	.3502951	1.350571
ln_GDP	.5522565	.2230755	2.48	0.013	.1150365	.9894764
_cons	5.750237	1.341569	4.29	0.000	3.120811	8.379663
sigma_u	0					
sigma_e	.72479238					
rho	0	(fraction of variance due to u_i)				

```
. regress ln_ROE1 ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, vce (cluster Bank)

Linear regression                               Number of obs     =         46
                                                F(2, 3)           =          .
                                                Prob > F          =          .
                                                R-squared         =     0.5189
                                                Root MSE          =      .8328

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_ROE1	Coefficient	Robust std. err.	t	P>|t|	[95% conf.	interval]
ln_HQLAs1	.3243933	.0896117	3.62	0.036	.039209	.6095776
ln_Capital1	.4345832	.24222	1.79	0.171	-.3362691	1.205435
ln_Teir1_1	-.1984511	.2646697	-0.75	0.508	-1.040748	.6438459
ln_Teir2_1	-.1386155	.1890117	-0.73	0.516	-.7401352	.4629041
ln_LLP1	-.0725986	.1017052	-0.71	0.527	-.3962698	.2510725
ln_Loans	1.77857	.7870836	2.26	0.109	-.7262814	4.283421
ln_EquityGrowth	-.3662076	.1334062	-2.75	0.071	-.7907657	.0583506
ln_Staff	-.6419245	.6039418	-1.06	0.366	-2.563937	1.280088
ln_Inflation	-.2383655	.338269	-0.70	0.532	-1.314889	.8381576
ln_Interest	.8504332	.2551772	3.33	0.045	.0383455	1.662521
ln_GDP	.5522565	.2230755	2.48	0.090	-.1576693	1.262182
_cons	5.750237	1.341569	4.29	0.023	1.480767	10.01971

```
. xtreg ln_NIM ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, re robust

Random-effects GLS regression                   Number of obs     =         39
Group variable: Bank                            Number of groups  =          4

R-squared:                                      Obs per group:
     Within  = 0.6793                                         min =          3
     Between = 0.7042                                         avg =        9.8
     Overall = 0.7086                                         max =         14

                                                Wald chi2(3)      =          .
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =          .

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_NIM	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
ln_HQLAs1	.2682724	.0891907	3.01	0.003	.0934619	.443083
ln_Capital1	.4264317	.1253441	3.40	0.001	.1807618	.6721016
ln_Teir1_1	-.4603285	.1229826	-3.74	0.000	-.70137	-.219287
ln_Teir2_1	.0403821	.0698343	0.58	0.563	-.0964907	.1772549
ln_LLP1	-.0690694	.0594852	-1.16	0.246	-.1856582	.0475194
ln_Loans	.5299469	.7043315	0.75	0.452	-.8505174	1.910411
ln_EquityGrowth	-.1298765	.1048017	-1.24	0.215	-.335284	.075531
ln_Staff	-.4729744	.1468682	-3.22	0.001	-.7608308	-.1851179
ln_Inflation	-.002056	.2938391	-0.01	0.994	-.57797	.5738581
ln_Interest	.2586557	.1506994	1.72	0.086	-.0367097	.5540211
ln_GDP	.2626088	.121544	2.16	0.031	.0243869	.5008307
_cons	-1.136028	1.199959	-0.95	0.344	-3.487904	1.215849
sigma_u	0					
sigma_e	.34411273					
rho	0	(fraction of variance due to u_i)				

```
. regress ln_NIM ln_HQLAs1 ln_Capital1 ln_Teir1_1 ln_Teir2_1 ln_LLP1 ln_Loans ln_EquityGrowth ln_Staff ln_Inflation ln_Interest ln_GDP, vce (cluster Bank)

Linear regression                               Number of obs     =         39
                                                F(2, 3)           =          .
                                                Prob > F          =          .
                                                R-squared         =     0.7086
                                                Root MSE          =     .37731

                                  (Std. err. adjusted for 4 clusters in Bank)
```

ln_NIM	Coefficient	Robust std. err.	t	P>|t|	[95% conf.	interval]
ln_HQLAs1	.2682724	.0891907	3.01	0.057	-.0155722	.5521171
ln_Capital1	.4264317	.1253441	3.40	0.042	.0275309	.8253326
ln_Teir1_1	-.4603285	.1229826	-3.74	0.033	-.8517141	-.0689429
ln_Teir2_1	.0403821	.0698343	0.58	0.604	-.1818619	.2626261
ln_LLP1	-.0690694	.0594852	-1.16	0.330	-.2583778	.1202389
ln_Loans	.5299469	.7043315	0.75	0.506	-1.71155	2.771444
ln_EquityGrowth	-.1298765	.1048017	-1.24	0.303	-.4634022	.2036491
ln_Staff	-.4729744	.1468682	-3.22	0.049	-.9403747	-.0055741
ln_Inflation	-.002056	.2938391	-0.01	0.995	-.9371831	.9330711
ln_Interest	.2586557	.1506994	1.72	0.185	-.220937	.7382484
ln_GDP	.2626088	.121544	2.16	0.120	-.1241985	.6494161
_cons	-1.136028	1.199959	-0.95	0.414	-4.954833	2.682778

Appendix C 6.2 Statistical Tests

Hausman Test

NIM

```
. hausman fixed random, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference       Std. err.
-------------+----------------------------------------------------------------
   ln_HQLAs1 |    .3619924     .2682724        .0937199        .2638594
 ln_Capital1 |    .4971404     .4264317        .0707087        .1111851
  ln_Teir1_1 |   -.6997098    -.4603285       -.2393813        .1448266
  ln_Teir2_1 |    .1449278     .0403821        .1045457         .090553
     ln_LLP1 |   -.1718469    -.0690694       -.1027774         .164606
    ln_Loans |    2.308472     .5299469        1.778525         1.20337
ln_EquityG~h |   -.2560238    -.1298765       -.1261473        .1632334
    ln_Staff |    .0506025    -.4729744        .5235768        .3953741
ln_Inflation |   -3.519621     -.002056       -3.517565        8.319508
 ln_Interest |   -.8841595     .2586557       -1.142815        2.143135
      ln_GDP |   -.7127799     .2626088       -.9753887        1.199968
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

   chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =   7.20
Prob > chi2 = 0.7828
```

ROE

```
. hausman fixed random, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference       Std. err.
-------------+----------------------------------------------------------------
   ln_HQLAs1 |    .4539381     .3243933        .1295448        .4451289
 ln_Capital1 |    .5455622     .4345832         .110979        .1525182
  ln_Teir1_1 |   -.1052754    -.1984511        .0931757        .2060864
  ln_Teir2_1 |    .0638009    -.1386155        .2024164        .1128951
     ln_LLP1 |   -.6305854    -.0725986       -.5579868        .2868799
    ln_Loans |    1.748875      1.77857       -.0296951        1.239224
ln_EquityG~h |   -.5678574    -.3662076       -.2016498        .1955186
    ln_Staff |   -.0341131    -.6419245        .6078114        .7041122
ln_Inflation |    -2.06303    -.2383655       -1.824664        1.034639
 ln_Interest |    1.056763     .8504332        .2063298        .6021229
      ln_GDP |   -.1549922     .5522565       -.7072486        .6069326
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

   chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  19.17
Prob > chi2 = 0.0581
```

ROA

```
. hausman fixed random, sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference       Std. err.
-------------+----------------------------------------------------------------
  ln_HQLAs1 |     .529819      .381239        .1485801        .4454465
 ln_Capital1 |    .5340905     .4417793        .0923112        .1526271
  ln_Teir1_1 |   -.0806737    -.2201921        .1395184        .2062335
  ln_Teir2_1 |    -.011695    -.1376541        .1259591        .1129757
     ln_LLP1 |   -.5940034    -.0582255        -.535778        .2870846
    ln_Loans |    1.936054      1.97108       -.0350265        1.240108
ln_EquityG~h |    -.579933     -.358566       -.2213669        .1956581
    ln_Staff |   -.3246418    -.7542409        .4295991        .7046147
ln_Inflation |   -2.280839    -.3021379       -1.978701        1.035377
 ln_Interest |    1.149266      .842547        .3067193        .6025526
      ln_GDP |   -.1480916     .5616266       -.7097182        .6073657
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

   chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  18.58
Prob > chi2 = 0.0690
```

Breusch and Pagan Lagrangian multiplier test for random effects

ROA

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        ln_ROA1[Bank,t] = Xb + u[Bank] + e[Bank,t]

        Estimated results:
                         |       Var     SD = sqrt(Var)
                ---------+-----------------------------
                 ln_ROA1 |   1.078725       1.038617
                       e |   .5790258       .7609374
                       u |          0              0

        Test: Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

ROE

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        ln_ROE1[Bank,t] = Xb + u[Bank] + e[Bank,t]

        Estimated results:
                         |       Var     SD = sqrt(Var)
                ---------+-----------------------------
                 ln_ROE1 |   1.089281       1.043686
                       e |    .525324       .7247924
                       u |          0              0

        Test: Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

NIM

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        ln_NIM[Bank,t] = Xb + u[Bank] + e[Bank,t]

        Estimated results:
                         |       Var     SD = sqrt(Var)
                ---------+-----------------------------
                  ln_NIM |    .347175       .5892156
                       e |   .1184136       .3441127
                       u |          0              0

        Test: Var(u) = 0
                             chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000

.
```

Breusch Pagan Tests for heteroskedasticity

ROA

```
. estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of ln_ROA1

H0: Constant variance

    chi2(1) =  20.84
Prob > chi2 = 0.0000
```

ROE

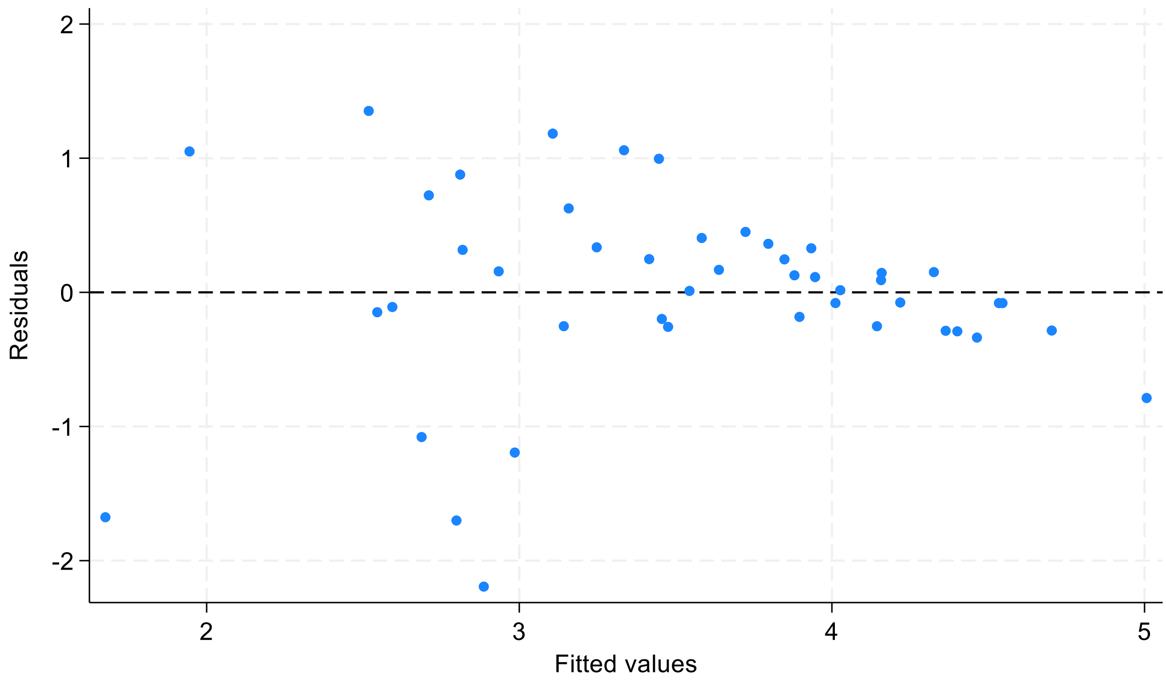
```
. estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of ln_ROE1

H0: Constant variance

    chi2(1) =  21.81
Prob > chi2 = 0.0000
```

NIM

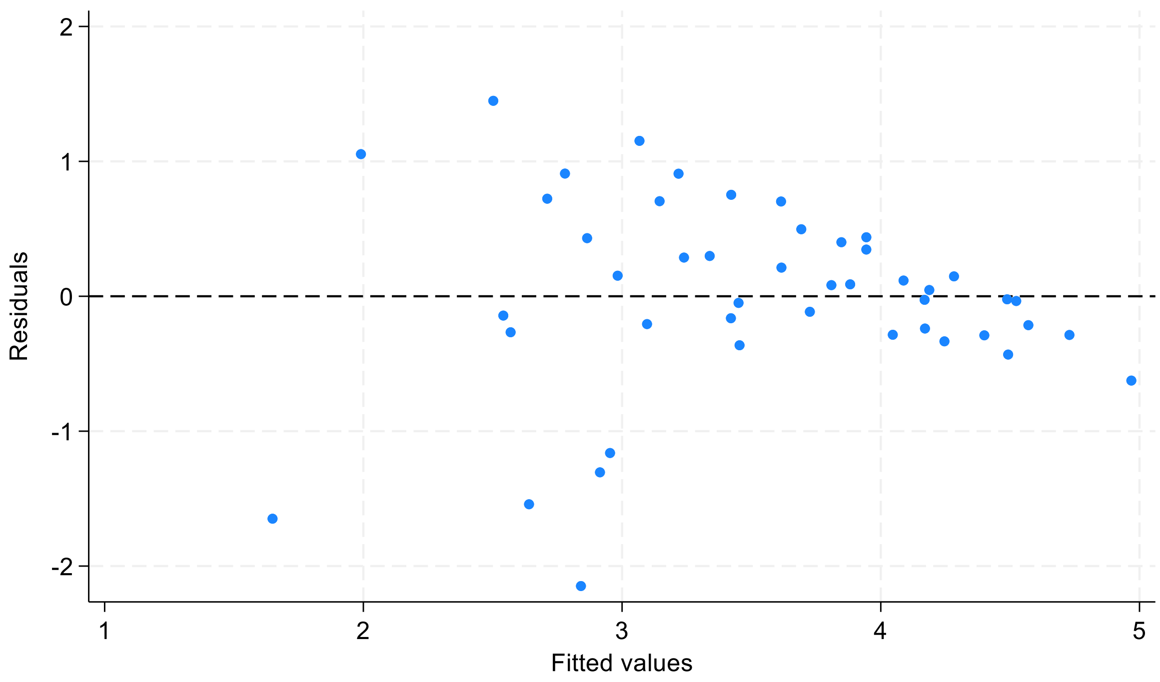
```
. estat hettest

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of ln_NIM

H0: Constant variance

    chi2(1) =   3.69
Prob > chi2 = 0.0547
```

Graphical Tests for Heteroskedasticity

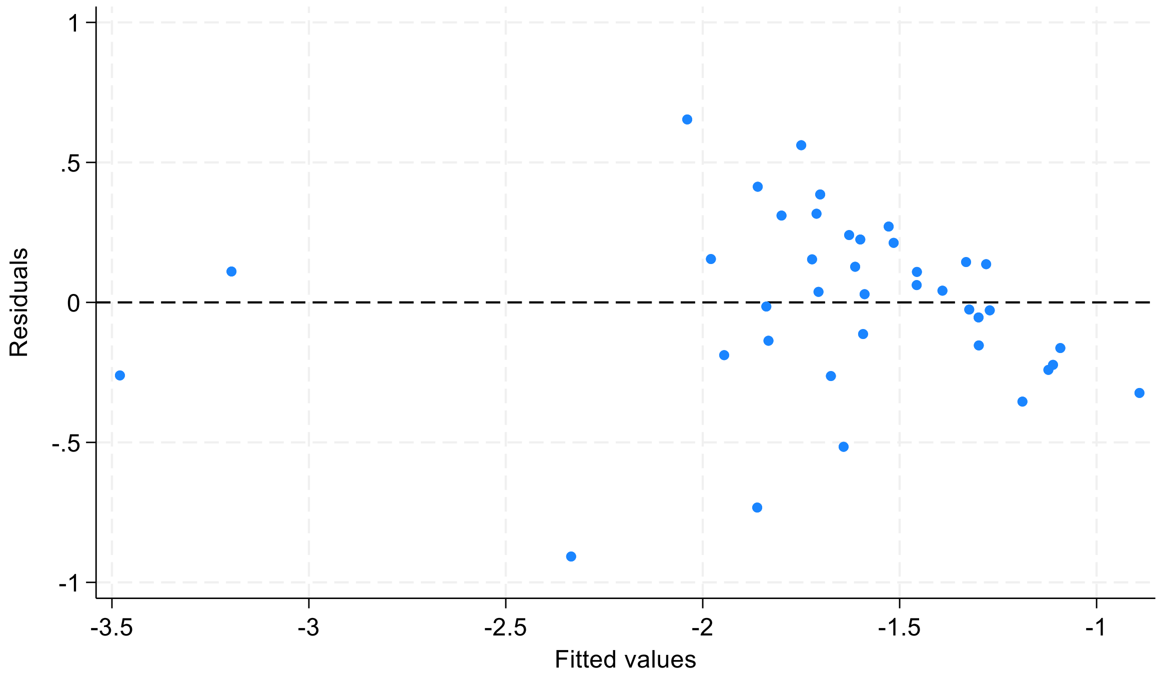
ROA



ROE



NIM



Historical BoE Banks Rate