# Essays on Global Sustainable Banking

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**Thesis submitted to the University of Nottingham for the degree of Doctor of Philosophy**

**August 2024**

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*To my beloved grandmother*

# Acknowledgements

I would like to express my deepest gratitude to my research supervisors, Dr Ahmed Barakat and Professor Meryem Duygun, for their continued guidance and support throughout this thesis. Their expertise and knowledge were invaluable in helping gear the research towards policy relevant and contemporary banking issues. I am also very grateful for the opportunity to teach and mark some of their modules as a Post Graduate Teaching Assistant. My achievement of Fellow of Higher Education Association (FHEA) status is testimony to their trust and guidance. I will forever be indebted to you both.

My sincere thanks also go to the Nottingham University Business School for the partial financial support, which made the completion of this project possible. Special thanks to Dr Getinet Haile and Ms Karen Maltby for their support with this matter.

I am deeply thankful to Dr Aristeidis Dadoukis for his feedback, insightful discussions and academic support. As an internal reviewer, Dr Dadoukis provided very valuable comments and suggestions on my third annual review report which led to the progression and completion of the thesis.

Similarly, I'd like to thank my fellow PhDs Lan Yang, Asif Nawaz, Shiwani Varal and my dear friend Yvette Orton for their endless academic and emotional support.

I want to also acknowledge my family for their unwavering love and encouragement. I am forever indebted to my aunt Messaouda Hadjij who taught me everything I know about academic English; my aunts Hayat and Karima Hadjij who sharpen my critical thinking; my cousins Mouna and Abderahman Tab who inspire me to follow my dreams; and my three children the apple of my eye Ahmad, Adam and Younus Yousuf who taught me all about love, patience and hope.

Finally, my deepest gratitude goes to my dear mother Rekia Hadjij who is my role model. Without her love, sacrifice, hard work, giving and caring for all of us, I would not have been able to start and complete this PhD. Thank you for being the amazing person you are.

Lastly, to my late grandmother Fatna Bouzouada, whose dream was for me to graduate but sadly she passed away recently. I hope and pray you are happy and proud that I made it. Love and miss you immensely.

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# Introduction

This thesis investigates sustainable finance applications through three original studies. Motivated by contemporary issues facing the backbone of economies, the banking sector, the thesis delves into three different streams of research while maintaining focus on the main subject matter. The chapters investigate the effects of regulation, macroeconomic conditions and innovation on banks' sustainability making three key contributions. Chapter 1 opens a new line of investigation into the cost effect of macroprudential policies on green bonds' issuance. Chapter 2 highlights banks' Environmental Social and Governance (ESG) activities response to economic uncertainty. Chapter 3 presents a novel index constructed at bank level to measure and track banks' Fintech Adoption. These studies are of high relevance and importance to banks, regulators and policy makers alike. Investments into United Nations Sustainable Development Goals (SDGs), for instance, require sound and committed banking systems to achieve the targets. Therefore, investigating banks' response to major regulatory reforms following the 2007/2008 financial crisis, new climate change targets set by initiatives such as Paris agreement 2015 and technological innovations revolutionising the financial sector are of utmost importance.

In the first chapter, we investigate the relationship between macroprudential policies and green bonds' cost of issuance. We build on the works of Chen et al (2022) (Chen, M., Kang Q., Wu J. and Jeon B. 2022. Do macroprudential policies affect bank efficiency? Evidence from emerging economies. Journal of International Financial Markets, Institutions & Money, 77), and Painter (2020) (Painter, M., 2020. An inconvenient cost: The effects of climate change on municipal bonds. Journal of Financial Economics, 135(2), pp.468–482). We follow Chen et al (2022) methodology in gauging the effects of macroprudential policies by establishing long-term and short-term measures, classifying the policies into tightening and loosening, as well as categorising them into policy type categories. As for green bonds, we broaden the scope of Painter (2020) work by exploring the cost of issuance of bank bonds through a comparative study between green and non-green bonds. Corporate green and non-bonds' data was

collected from the Bloomberg database while macroprudential policies data was obtained from Alam et al (2019) also known as iMaPP IMF database.

Empirical results show that macroprudential policies have unintended negative effect on green bonds' cost of issuance. The results are consistent with the cost of regulation theory stating that firms face a compliance cost resulting from imposed regulatory requirements. In particular, macroprudential policies appear to enlarge the greenium which is the additional cost of issuing green bonds absorbed by offering lower yield at issue to investors. A larger greenium renders green bonds less competitive and attractive to investors in general and profit maximising ones in particular.

The findings show that in short-term, the cost of issuing bonds and subsequently the greenium increase when tighter macroprudential policies are introduced. An effect which is not present long-term or when looser policies are instigated. Further analysis of the policies by category show that liquidity policies appear to have the most significant effect on bonds' issuance cost.

In the second chapter, we further explore banks' sustainability but with a focus on the effects of economic uncertainty by building on the works of Dyck et al (2019) (Dyck, A., Lins, K., Roth, K. and Wagner, H. 2019. Do institutional investors drive corporate social responsibility? Journal of Financial Economics, 131, pp.693–714) and Cheng et al (2021) (Cheng, H., Gawande, K., Ongena, S. and Qi, S. 2021. Connected banks and economic policy uncertainty. Journal of Financial Stability, 56, pp.1572–3089). We use Economic and Policy Uncertainty (EPU) index created by Baker et al. (2016) as proxy for uncertainty and Environmental, Social and Governance (ESG) scores by Bloomberg as proxy for sustainability. We also explore whether banks' characteristics such as their size or Principles for Responsible Investment (PRI) signatory status change or mitigate the effect or economic uncertainty on their ESG activities. We further investigate if countries' economy type, in the form of developed or developing, along with their Sustainable Development Goals (SDG) rating influence banks' ESG activities during economic uncertainty.

Our results show that banks reduce their sustainability activities during economic uncertainty and the effect is stronger on Governance activities. The

results are in line with the resource allocation theory as they highlight how banks prioritise activities during economic uncertainty. They are robust to alternative measures of bank sustainability and economic uncertainty. Our findings also show that the uncertainty impact is more pronounced for Principles for Responsible Investment (PRI) Signatory banks and bigger banks. Lastly, banks operating in developing economies with low Sustainability Development Goals (SDG) rating appear more negatively affected by economic uncertainty compared to banks in developed economies with high SDG rating.

In the last chapter, we analyse the impact of Fintech Adoption on Islamic banks' performance, risk and environmental sustainability. Whilst we maintain the focus on sustainability, we explore it from the lens of ethical banks and technological advancements. As the Fintech literature is still growing and due to its similarities with Internet Banking, the latter's theories were used as the point of reference in this research. The Fintech adoption literature is dominated by consumer focussed research, business reports and country level adoption indices. Therefore, we create a Fintech Adoption Index using the Islamic Finance Development Indicator (IFDI) database purchased from Refinitiv (LSEG), as well as data hand collected from banks' websites and annual reports.

Our results show that Fintech Adoption increases Islamic banks' performance, which is in line with similar studies in the Internet Banking Adoption literature. As for risk, our results show a different effect of fintech adoption on banks' risk which supports the arguments that fintech has the potential of bringing significant benefits while increasing existing risks or creating new ones. In terms of sustainability, the findings highlight a positive relationship between fintech adoption and Islamic banks' environmental activities. The results are modest and only apply to one category of the Fintech Adoption index.

# Chapter 1

# Unintended Consequences of Macroprudential Policies on Green Bonds' Cost of Issuance

## 1.1 Introduction

In this paper we examine the effects of macroprudential policies on corporate bonds' cost of issuance, with a focus on green bonds issued by banks. Efficient banking services provision and effective risk management strategies are all affected by banks' business activities and their choices of funding (Ahnert et al., 2021). As the backbone of the economy, banks offer a wide range of lending products while having access to a selection of funding sources such as equity and wholesale funding. To minimise maturity mismatch and liquidity risk, the funding sources vary between short term and long-term funding.

The 2007-2008 financial crisis exposed how liquidity risks rise due to banks' dependency on short term wholesale funding and in response to market shocks (Choi & Choi, 2021). As a result, in the Basel III reforms, Basel Committee on Banking Supervision introduced new regulations in the form of Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) to address liquidity risks (BIS, 2021). As a key reform to promote banking resilience, NSFR requires banks to sustain a stable funding profile which limits dependency on short term wholesale funding and fosters funding stability (BIS, 2014).

As a stable funding source, debt financing is critical for firms and the economy. Bonds especially are corporations' go to financing solutions when significant capital is required to fund new projects such as product development and takeovers, or to refinance their debt. Bonds allow the issuer to define inter alia the type of bond issued to be either fixed or variable, as well as the interest rate (coupon rate) and due date for when the loan is to be paid back in full (maturity date). As a fixed source of income, a bond acts as a loan from an investor (bond holder) to a borrower (bond issuer),

As a low-cost flexible debt financing tool, bonds could be issued either secured or unsecured with the issuer deciding their priority over other debts. The choice of having a substantial amount of debt on a fixed interest rate stabilises firm's financing offering protection against economic and interest rate changes (Rancan et al., 2023). Unlike equity, bond issuance doesn't require losing any control of the firm. This flexibility of designing the bond and its characteristics around the issuing bank or firm needs is what makes bonds more appealing than

other forms of borrowing such as bank loans (Park, 2020). According to the International Capital Markets Association (ICMA) estimations, the global bond market overall size was approximately $128.3 trillion US dollars at the end of 2020 (ICMA, 2023). As the global equity market is estimated at $106 trillion US dollars, the bond market is emerging as a crucial source of capital for both private and public sectors (Benos et al., 2022).

The bond market has also been influenced by the increase in climate change awareness as companies' commitments to sustainability came under scrutiny following the Paris agreement in 2015. The agreement set goals to reduce greenhouse gas emissions long-term which was accepted internationally. Public and private sectors, therefore, became under obligation to reduce their carbon emissions to the net zero targets by 2050. Consequently, innovative financial instruments such as green bonds became crucial to facilitate and support the transition to meet the Paris agreement targets. With a 21% growth rate as of 2022, financial corporations made large contributions to the global green issuance market (CBI, 2022). Green bonds market growth was attributed to the rise in investor demand as well as companies' renewed commitments to sustainability. While the investors seek yields with premiums higher than treasury bonds to maximise profits (BIS, 2023), companies use bonds to signal to the market their commitment to sustainability (Flammer, 2021).

Despite its expansion, the lack of sufficient financial sources geared towards sustainable investments, a phenomenon known as the green finance gap, is growing raising fears over potential risks. One of the green finance gap enhancers is argued to be financial regulation with its 'intrinsic caron bias' (D'Orazio & Popoyan, 2019). This bias is claimed to create obstacles for a smooth alignment of financial institutions' goals with sustainable transition objectives (Campiglio, 2016). Basel III represents significant financial regulations which were reformed in response to the 2007/2008 financial crisis. The regulations were enhanced aiming to lower individual banks' risks which in turn mitigates their contribution to systemic risk. To address the latter, specific policies emerged known as macroprudential policies designed to prevent global financial crises. These policies were devised to complement rather than replace other policies such as the monetary and fiscal ones. However, some countries

use Macroprudential policies as a substitute instead of a complement to macroeconomic policies. For instance, in Turkey and some countries in Eastern Europe, macroprudential policies were deployed instead of fiscal policies (Lim et al., 2011).

The most widely accepted definition is that of the IMF as they describe macroprudential policies as policies "designed to identify and mitigate risks to systemic stability, in turn reducing the cost to the economy from a disruption in financial services that underpin the workings of financial markets - such as the provision of credit, but also of insurance and payment and settlement services" (IMF, 2011). These regulations are intended to address the two dimensions of systemic risk, time dimension and cross-sectional dimension (Altunbas et al., 2017).

The time dimension feature of systemic risk relates to the lifespan of financial booms and the need to mitigate their negative effects (Borio, 2014). Present banks' decisions on the composition of both sides of their balance sheets might have serious implications on their future performance due to negative shocks. The cross-sectional dimension of systemic risk, however, relates to the financial institutions' interconnectedness. The latter means that one distressed financial institution could create amplified shockwaves that shake the whole financial sector which is an event macroprudential policies aim to avoid. Therefore, macroprudential policies appear to influence banks' risk-taking behaviour. Through policies such as capital conservation buffers, banks are expected to take advantage of good times by accruing capital which will be used in bad times to offset losses (Altunbas et al., 2017).

The balancing act of increasing economic growth while containing systemic risk has left macroprudential policies with trade-offs to juggle. Research has shown that whilst macroprudential policies reduce recession's severity, they also prevent the flow of credit to useful economic activities (Laeven et al., 2022). This results in low quality credit and investments which in turn affects long term economic growth (Boar, Gambacorta, Lombardo, & da Silva, 2017; Sanchez & Rohn, 2016). Macroprudential policies also appear to indirectly affect banks' profitability as they increase banks' costs (Davis et al., 2022). It is argued that in

an unregulated environment, banks maximise their profits based on a level of risk they determine according to their selection of costs and benefits (Beck et al., 2013). Restricting banks' choices through macroprudential policies, for instance, is likely to negatively impact on their profits (Davis et al., 2022). A bank's profitability is also said to be linked to how well it is capitalised (Symon, 2023). Depositors and investors perceive well capitalised banks as less risky and enjoy access to different inexpensive forms of debt funding like bonds, for instance (Gambacorta & Shin, 2016). Since debt financing accounts for more than 90 percent of the total liabilities, a bank's capital will have a considerable effect on its funding costs (Gambacorta & Shin, 2016). This will in turn affect the bank's decisions on lending activities, for instance, which are part of their portfolio allocation (ECB, 2016).

While it is apparent that macroprudential policies' objective is to improve financial stability, their effect on the cost of debt issuance as a stable source of funding for banks are not clear. The literature is yet to clarify whether macroprudential policies create favourable market conditions for cost efficient debt financing to grow. A gap in literature that this study aims to fill by investigating the effects of Macroprudential policies on bank bonds cost of issuance. Whilst the chapter examines two types of bonds, green and non-green, the focus will be on the former due to their role in narrowing the green finance gap and importance to sustainability and green finance debate. Therefore, our research aims to answer the following questions, do macroprudential policies increase bonds' cost of issuance which widens the green finance gap and exacerbates the transition to green economies? If so, which policies affect the cost the most and is it the same across different economies?

To address these questions, the chapter examines primary market data of banks' issuances of green and non-green corporate bonds between 2014 and 2021. Corporate green and non-bonds' data was collected from the Bloomberg database with the final dataset a total of 5,015 were 4,574 are non green bonds and 441 green bonds. These bonds were issued by 504 banks in 52 countries. Macroprudential policies data, on the other hand, was obtained from Alam et al. (2019) also known as iMaPP IMF database. One of the most comprehensive

datasets widely used to quantify macroprudential policies measures and changes over the years, with the latest version covering up until 2021.

This chapter makes several contributions to the literature. First, it contributes the cost of regulation literature. Since the banking sector is heavily regulated, studies have also investigated the changes in regulation or lack of it and their impact on banks' costs and income (Davis et al., 2022). There are very few papers that focus on the cost effect of Macroprudential policies on corporate bonds generally and non that we are aware of that examine green bonds. This paper will not only fill this gap but also focus on green bonds issued by banks only which makes its findings unique.

Our results also show different effects of macroprudential policies on corporate bonds' cost of issuance. While changes in these policies appear to have no direct significant effects on green bonds' cost of issuance proxied by yield at issue, they have a positive relationship with non-green bonds' yield at issue. This is consistent with the 'greenium'[1] argument discussed in primary market studies as they confirm its presence and how regulations enhance it (Caramichael & Rapp, 2022; Fatica et al., 2021; Zerbib, 2019; Baker et al., 2018). Since a higher cost for the issuer represents a higher return for an investor, higher yields of non - green bonds would render them more appealing to profit maximizing investors 'reaching for yield'[2]. The results add to a growing literature highlighting the negative effects of macroprudential policies on different aspects of bank activities such as on their liquidity (Van den Heuvel, 2008), risk-taking behaviour (Naceur et al., 2017; Noss & Toffano, 2016) and their profitability (Davis et al., 2022); although the latter evidence their results as unintended consequences of these policies.

Second contribution relates to the discussion on the transition to low carbon economies though green bonds under the current financial regulations. Whilst current regulatory frameworks attempt to foster a safe investment environment (Coelho & Restoy, 2023; EBF, 2017), the transition to low carbon economies is

[1] Greenium describes the idea that investors are willing to pay a premium to hold a green bond rather than a conventional bond, as they are willing to accept lower monetary returns in exchange for supporting environment-benefitting activities (Pietsch & Salakhova, 2022)

[2] An investors' propensity to buy risker assets to achieve higher yield is also a well-known fact documented in literature (Becker & Ivashina, 2018).

showing no sign of hitting the global set targets. Our results, show different effects of macroprudential policies occurring from the mismatch known in literature as an inherent bias towards carbon investments which forms barriers for green investments and sustainable economies transition strategies (Campiglio, 2016; D'Orazio & Popoyan, 2019). This is the result of the green bonds appearing to be less competitive compared to their non-green counterparts in light of macroprudential policies being introduced.

Third contribution is made to growing discussion regarding different macroprudential policies effects and the jurisdictions involved. The paper shows that out of the main five macroprudential policies categories, liquidity policies have the most effect on bonds' cost of issuance. As a stable source of funding, corporate bonds are a potential target of macroprudential policies aiming at minimising funding liquidity risk. Therefore, our results add to the argument highlighted in previous research which demonstrated the negative effects of liquidity measures on banks' preparedness to lend to green projects (D'Orazio & Popoyan, 2019; Spencer & Stevenson, 2013). We also highlight how the different usage of macroprudential policies across advanced and emerging economies yield relatively similar results and therefore effect on green versus non-green bonds' cost of issuance.

The rest of the chapter is organised as follows: section 2 reviews the literature on macroprudential policies and corporate green and non-green bonds. Section 3 details the data used in the study. Section 4 introduces the model and econometric methodology. Section 5 reports the main results with robustness checks. Section 6 concludes with highlight of this study's limitations and future research directions.

## 1.2 Literature Review

### 1.2.1 Macroprudential Policies and Cost of Regulation

Corporations such as banks adjust their financial operations in line with the market conditions and valuations (Pegoraro & Montagna, 2021). As a financial

activity, bond issuance will be initiated not only based on corporations funding needs but also on the current market situations. The latter is constantly monitored by monetary authorities such as central banks. Some of their main objectives are to manage monetary policy to prevent liquidity crises and attain price stability (Casu et al., 2021). Although they might appear coherent with each other, clashes between policies may occur. For instance, price stability policies might clash with interest rate policies. When unemployment drops, for example, during economic growth, it forces interest rates to rise. This leaves central banks with two difficult choices to choose from. Either allow interest rates to rise leading to increased inflation, or limit interest rates and this would lead to increased unemployment. This example of policies' conflicts is what monetary authorities must deal with when deciding on the best monetary or macroprudential policies to introduce (Casu et al., 2021). It is, therefore, clear that while policies aim to enhance economic robustness, they might result in unintended consequences such as increased cost. This additional cost is known in literature as the cost of regulation.

Cost of regulation literature has been expanding with different aspects of macroprudential policies being investigated over the years. The theory states that firms face a regulatory compliance cost as a result of imposed regulatory requirements (Calomiris et al., 2020). For instance, Capital adequacy policies are found to reduced banks' liquidity (Van den Heuvel, 2008) and change their risk-taking behaviour as they lean more towards safer investments (Roulet, 2018; Noss & Toffano, 2016; Tchana, 2012). Bank lending also appear to be negatively affected by macroprudential policies as it reduces in response to tighter capital requirement policies (Aiyar et al., 2014). Since they affect banks' resource allocation, macroprudential policies are also found to entail additional costs such as hindering the financial sector's development (Claessens et al., 2013). These findings, however, were criticised for ignoring the benefits of reducing potential financial crises which ultimately offsets the costs of regulation (Barrell et al., 2009; Davis et al., 2019).Regardless of whether the cost of regulation could be offset, its existence is known and widely recognised in literature.

Whilst this chapter is not designed as a cost and benefits analysis of macroprudential policies, it supports the arguments that macroprudential policies cause unintended consequences despite the good intentions behind introducing them Davis et al., 2022 (Claessens et al., 2013; Lim et al., 2011). While macroprudential policies do not aim to increase bond issuance costs or render green bonds less competitive than non-green bonds, these may come as an unintended consequence of increased capital or liquidity requirement policies. Therefore, we expect that macroprudential policies have a negative effect on bank bonds' cost of issuance which is a source of liquidity and subsequently bank's overall profitability. An increase in macroprudential policies would lead to an increase in the cost of bonds' issuance.

### 1.2.2 Macroprudential policies, Liquidity and Green Bonds

Despite macroprudential policies being primarily designed to promote financial stability and reduce systemic risks (Lim et al., 2011)., they can have negative effects on the cost of issuing green bonds. These include higher capital requirements (Laeven et al., 2022; Boar et al., 2017), increased compliance costs, reduced market liquidity and higher risk premiums. While the long-term benefits of macroprudential policies in preventing financial crises and managing systemic risks are important, these unintended consequences may increase the cost of green bond issuance, making it more challenging for issuers to raise funds for environmentally sustainable projects.

While this study examines the overall effect of macroprudential policies on bonds' issuance costs, we expect some measures to have more of an impact on bonds issuance than others. Corporate bond issuance is considered a stable source of funding which is monitored to minimise funding liquidity risk[3]. Since liquidity is linked to banks' liabilities which consist of various sources of funding including bonds, we expect liquidity measures such as Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) to effect bonds' issuance cost the most. In fact, previous studies have highlighted that

[3] Funding liquidity risk occurs when banks do not have enough collateral or cash to make payments when they fall due to customers and other parties. This is when the bank is classed as defaulted or sometimes referred to as bank becoming 'cash-flow insolvent' (Farag et al., 2013)

increased liquidity requirements effect negatively banks' preparedness to lend to green projects (D'Orazio & Popoyan, 2019; Spencer & Stevenson, 2013). Therefore, we expect macroprudential policies' liquidity measures to affect bonds' cost of issuance more than the other policies.

Low-carbon sectors' access to finance is known to be negatively affected by Macroprudential policies (Liebreich, 2013; Spencer & Stevenson, 2013). Since these sectors require long term credit, reallocation of investments to short term liquid assets resulting from strict liquidity requirements is becoming more problematic for low-carbon projects (Campiglio, 2016). Corporate bonds are classified into two types with regards to their maturity and liquidity. Green sector investments are characterised as long-term illiquid assets compared to short-term liquid non-green bonds (Spencer & Stevenson, 2013). This short-term versus long-term investment favouritism has been argued as one of the results of macroprudential policies' side effects (D'Orazio & Popoyan, 2019).

Therefore, issues with low carbon projects funding would hinder the transition to low carbon economies which require more rather than less finances to shift more towards green investments in sectors such as renewable energy and eco-buildings. These investments are characterised as high upfront capital costs and long-term projects (D'Orazio & Popoyan, 2019). Therefore, they necessitate financial means which firms could only obtain through equity or debt financing from external sources such as institutional investors. With approximately $71 trillion in financial assets, institutional investors have a significant role to play in the transition to green economy (Campiglio, 2016).

Institutional investors' Environmental, Social and Governance (ESG) activism has been increasing over the past years. Studies have linked greater ESG performance to greater firms' value (Dyck et al., 2019) and for the green promise investors are willing to accept lower returns (Flammer, 2021; Larcker & Watts, 2020). On the other hand, reaching for yield where investor's propensity to buy riskier assets to achieve higher yields remains an integral part of the credit cycle (Becker & Ivashina, 2018). In fact, research had shown that reaching for yield is known to exist in both primary and secondary markets.

### 1.2.3 The Greenium

As a debt obligation, bonds allow investors to lend money to bond issuers for a legal commitment that the issuer pays interest, usually during the lifetime of the bond, and returns the principal amount once the bond matures. In comparison to shareholders, bondholders do not own equity in the company and their interest payments and return of the principal are not linked to how profitable the company becomes or how high its stock prices rise. In case of financial difficulty or bankruptcy, however, bondholders are still to receive their interest payment and the principal as well as having priority over shareholders' claims in the company's assets (SEC, 2023). Common types of bonds are government bonds such as Treasuries in US or Gilts in UK, municipal bonds and corporate bonds both green and non-green.

Considered important to company financing, corporate bonds play a critical role in firm's assets management (Nagel & Bundesbank, 2016). The majority are traded over the counter and facilitated by dealers (Benos et al., 2022). Arguably, green and non-green corporate bonds have similar financial characteristics in terms of their interest rate, credit ratings and maturity. Green bonds require a Green Bond Framework document to be issued to certify them. To earn the green label, the framework should set out how the bond aligns with the Green Bond Principles by detailing which assets will be financed or refinanced with the raised funds, the process involved in selecting these assets, how the collected proceeds are managed and how the allocation and impact of funds is reported. As the Green Bond Framework is not legally binding, non-compliance with its commitments will not be considered as legal default (IFC, 2020).

Green corporate bonds as fixed income long term debt securities are emerging as prominent financial instruments to lead the transition to low carbon economy. In 2014, the Green Bond Principles (GBP) were announced by the International Capital Market Association (ICMA) providing guidelines for investors and bond issuers as to what qualifies a bond to be labelled green (Reboredo, 2018). According to ICMA, "Green Bonds are any type of bond instrument where the proceeds or equivalent amount will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects and which

are aligned with the four core components of the Green Bond Principles" (ICMA, 2021, p5). Despite their positives, green bonds face allegations of being a tool of greenwashing which is the act of misrepresenting information about one's environmental activities and commitments (Berrone et al., 2017).

As major active participants in the green bond market, financial institutions are seen to have taken the greenwashing fraud seriously along with other new types of operational and reputational ESG risks. Indeed, reports such as the Global Risks 2023 report warn against environmental and social risks which would dominate the next decade (Weforum, 2023), while studies have shown that reputational risks materialise due to lack of reliable and quantifiable information regarding an operational risk event (Barakat et al., 2019).

Therefore, banks have been improving their ESG disclosures and subsequently their ESG activities and performance; as well as signalling their commitment towards sustainability through increased issuances of green bonds (Flammer, 2021). According to Bloomberg, outstanding green corporate bonds rose from 4% in 2014 to almost 6% in 2021 (Bloomberg Finance, 2021). However, despite their growth and expansion, comparisons are still drawn between green and non-green bonds, especially around their cost of issuance.

It is recognised in literature, although still debated, that the very process of issuing a green bond is different to that of a non-green bond. The former requires additional disclosures and reporting throughout the lifetime of the bond resulting in additional costs being incurred. To motivate green bond issuances, the additional costs are absorbed by offering lower yield at issue to investors as a borrowing cost advantage which is viewed as a cheaper source of funding for issuers (Caramichael & Rapp, 2022; Pietsch & Salakhova, 2022). This advantage is a market premium also known as the 'greenium'. The question of whether corporate green bonds are priced at a premium compared to non-green bonds has attracted a lot of academic research with mixed results.

Some studies support the existence of the greenium highlighting the extra cost is due to the need for green bonds to go through extra processes (Bedendo et al., 2022; CBI, 2022; Zerbib, 2019, Baker et al., 2018). They are costlier to issue than non-green bonds due to the requirements to comply with green bonds

standards and the risk of non-compliance damage to their reputation (Flammer, 2021). Several studies using predominantly municipal and sovereign bonds data also argue in favour of the existence of the greenium (Caramichael & Rapp, 2022a; Karpf & Mandel, 2017). Others, however, reject the existence of the premium claiming that future companies' profitability and risk are impacted by ESG and CSR which in turn affect asset prices (Flammer, 2021; Larcker & Watts, 2020).

Considering both camps' arguments and within the sphere of corporate bonds, it is extremely difficult to find the perfect match between green and non-green bonds. Although similar in many aspects, characteristics such as issue amount, coupon, coupon type, maturity, maturity type, issue date and industry differ from bond to bond. Therefore, a direct comparison between green and non-green bonds with an exact match would be extremely challenging. Added to this, institutions such as the Climate Bonds Initiatives, which certify newly issued green bonds, have documented the presence of the greenium in their quarterly reports using their own green bonds database (CBI, 2022). Therefore, this study's arguments thereafter align with the existence of the greenium school of thought.

The greenium also reflects the issuers and investors' attitudes towards risk. In an environment aiming to achieve financial stability, firms' risk-taking behaviour will be affected as the search for yield expends (Rajan, 2006). Low interest rates, for instance, could lead managers to take more risks and promise more returns. This results in investors moving away from government bonds which are historically low-risk to higher-risk corporate bonds which offered higher-yields (Altunbas et al., 2017). Although green bonds are historically known to offer lower yield at issue than the non-green bonds, we expect a negative effect of macroprudential policies resulting in an expansion of the greenium which will affect investors' risk-taking behaviour.

### 1.2.4 Tighter vs Looser Macroprudential Policies

Macroprudential policies are tightened or loosened depending on the economic climate. Some studies show that banks are more resilient and their systemic risk reduced when macroprudential policies on reserve requirements and credit

growth limits are tightened (Igan et al., 2023). Tighter foreign exchange macroprudential policies are also seen to mitigate banks' exposure to currency fluctuations with lesser effect on the broader economy (Ahnert et al., 2021). Other positive effects come from tighter household macroprudential policies which increase corporate lending of banks with large residential mortgage portfolios (Bhargava et al., 2021). The effects of macroprudential policies are also found to be greater than those of monetary policies (Biljanovska et al., 2023) as countries that use macroprudential policies more often have stronger and less volatile GDP (Boar et al., 2017). As for the bond market, tight macroprudential policies are found to have lesser sovereign spillover risk in the long run across different global markets (Aizenman et al., 2022).

Other studies, however, found tighter macroprudential policies to have negative effects on banks' profitability depending on their bank type (retail or universal) and market type (emerging or advanced) (Davis et al., 2020). Policy tightening is also linked to increased distributional effect on banks' efficiency and risk taking, size, market power and ownership status (Chen et al., 2022; Altunbas et al., 2017). Loan-to-Value (LTV) macroprudential policies are also found to reduce market output and affect credit and house price growth (Richter et al., 2018). Other studies link macroprudential policies with increased banks' regulatory arbitrage. For instant, a surprising increase in risky lending by Spanish banks is associated with strict dynamic loan loss provision measures (Jimé nez et al., 2017). Therefore, we expect tighter macroprudential policies affect bonds' cost of issuance more than looser ones.

### 1.2.5 Emerging Vs Advanced Economies

Although macroprudential policies, as we know them today, gained popularity following the 2007/2008 global financial crisis, some countries were using them well before the crisis. Emerging markets, especially in Asia have been using macroprudential policies since the 1990s. Studying banks operating in both types of economies would allow to cover countries' different experiences with the application of macroprudential policies (Altunbas et al., 2017). Although emerging economies used historically macroprudential policies more than their

advanced counter parts, we expect the effect of these policies to be more relatively similar in both economies. This is because of the sample period we examine (2014 to 2021) is post the financial crisis and the advanced economies' usage of macroprudential policies gradually increased by then.

Added to this, both advanced and emerging economies have made advancements in promoting green bond issuances through introducing new legislations. The European Union, for instance, has been in the spotlight in recent years with its EU taxonomy designed to promote sustainable finance in line with the 2015 Paris Agreement goals and targets. To attract more direct funds to enhance its sustainable growth, the EU announced the European Green Bonds (EuGB) in 2020. As a label for sustainable bonds marketed in the EU, EuGB aims to offer protection to investors as well as prevent risks associated with greenwashing. In Asia, on the other hand, initiatives such as the ASEAN Green Bond Standards (AGBS) launched in 2017 has helped green bond markets in emerging economies such as Malaysia's to grow significantly (ADB, 2022).

Although both advanced and emerging economies made progress on their green bonds' legislations, it is noted in the sample that advanced economies have more green bonds issuances than their emerging counterpart. This could relate to the movement of financial activity outside banks' regulatory boundaries which is a known fact (Davis et al., 2022), especially for investors looking for attractive markets. Nevertheless, from a macroprudential policies affect point of view, we expect the policies to have similar effect on both advanced and emerging economies. The following section details the data collected process and methodology used to address the research questions.

## 1.3 Methodology and Data

In this study, we use Bloomberg database which is renowned for its wealth of information on fixed income securities and has been used in other studies (Flammer, 2021; Larcker & Watts, 2020; Painter, 2020). The database has data on 2,525,909 security issuances with 334,969 are active bonds issued by corporates globally across all industries (Bloomberg, 2023).

To identify active bonds issued by banks, the bonds were initially filtered by industry removing all non-bank issuances. Using the Bloomberg 'Green Instrument Indicator' which indicates a 'Yes' if the bond is green or 'No' otherwise, bonds were categorised as green or non-green bonds. Issuances with no yield at issue data were eliminated since it is the main proxy for cost of issuance which is the dependent variable in this study. The green bond market didn't grow substantially until after 2014 when the International Capital Market Association (ICMA) published the Green Bond Principles (GBP)[4] (Carbo-Valverde et al., 2021). These principles were the first of their kind to provide bond issuers and investors guidance and best practices around issuing and investing in green bonds. This market growth was enhanced further by the Paris Agreement 2015 as the latter supports financing and investments to address climate related issues (García et al., 2023). Since macroprudential policies data is so far only available until 2021, the time span of this research became 2014 to 2021.

To address the short-term funding versus long term funding of green financing liquidity argument (D'Orazio & Popoyan, 2019), bonds which matured during the sample period were excluded. Refining the search to active bonds only with yield at issue data available between 01/01/2014 and 31/12/2021 yields a total of 5,015 were 4,574 are non green bonds and 441 green bonds[5]. These bonds were issued by 504 banks in 52 countries (Argentina, Australia, Austria, Azerbaijan, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hong Kong, Iceland, India, Indonesia, Ireland, Italy, Japan, Latvia, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Peru, Philippines, Poland, Portugal, Romania, Singapore, Slovakia, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Arab Emirates, United kingdom, United States, Vietnam).

[4] The first green bond was issued in 2007 by the European Investment Bank (García et al., 2023)
[5] Out of the 2,525,909 securities, 33,580 were non green bonds and 97 green bonds with yield at issue data available between 01/01/2014 and 31/12/2021. These bonds were excluded from the set as they matured at different dates during the sample period (Bloomberg, 2023).

Descriptive statistics are presented in Table 1 for all bonds, in Table 2 by country and economy type, then by bond type green and non-green in Table 3. A list of variable definitions is presented in Table 4 with more details in Appendix 1.

### 1.3.1 Descriptive Statistics

Table 1 presents the descriptive statistics of our main variables including their mean, median and standard deviation. To reduce the effect of outliers, observations outside the range of 1st and 99th percentile in distribution were excluded (Flammer, 2021). The table shows that bonds on average have a yield at issue of around 2.17% with a price at issue 1.7% below Par value. Bonds are issued with an average of 10 years maturity term and 1.9% coupon rate. As for macroprudential policies, it is noted that the mean of the overall short-term (MP t1) indicator is positive at 0.04 suggesting more tightening policies were introduced over the sample period 2014-2021 than the loosening ones. Similar result is noted with long term macroprudential policies (MP t3) indicator with a positive mean of 1.21. In terms of issuing banks, the table shows a wide range of bank sizes from $2.34 to $1118 million in total assets. These banks have an average ESG disclosure score of 42.6.

Broken down by bond type in Table 3, however, shows noticeable differences between green and non-green bonds. Green bonds appear to have an average yield at issue of 1.35% which is 0.89% lower than their non-green bonds counterparts (2.24%). They also differ in terms of maturity term as green bonds have an average 8.83 maturity years which is shorter than the 10.13 years for non-green bonds. This is further highlighting the challenge facing investors when considering green investments which tend to be more long term oriented (D'Orazio & Popoyan, 2019).

Table 2, however, lists bond issuances by country where the top ten issuers are all European countries except for Australia, Japan and South Korea. Germany is noted to have issued a total of 1507 active bonds during the sample period, followed by France then the United States with 439 and 331 issuances respectively. In terms of issuances size, Thailand tops the list with an average of

$110 million issuance amount followed by $88.5 million in Italy and $78.2 million in Spain. The table also shows that the data consists of 31 advanced economies and 20 emerging ones.

**Table 1: Summary Statistics for All Bonds**

| | Mean | SD | Min | Median | Max | Obs |
|---|---|---|---|---|---|---|
| ***Bonds characteristics*** | | | | | | |
| Yield at issue (%) | 2.17 | 2.14 | 0.18 | 1.46 | 4.74 | 5,015 |
| Amount Issued (m $) | 2.29 | 4.08 | 0.98 | 5.27 | 7.51 | 5,015 |
| Maturity years | 10.01 | 6.83 | 2.00 | 10.00 | 70.00 | 5,015 |
| Bloomberg Rating | 1.98 | 3.40 | 0.00 | 0.00 | 7.00 | 5,015 |
| Maturity Type | 0.35 | 0.59 | 0.00 | 0.00 | 1.00 | 5,015 |
| Self-Underwriting | 0.64 | 0.48 | 0.00 | 1.00 | 1.00 | 5,015 |
| Coupon rate (%) | 1.87 | 2.14 | 0.01 | 1.01 | 4.50 | 5,015 |
| Coupon Type | 0.46 | 0.92 | 0.00 | 0.00 | 2.00 | 5,015 |
| Price at issue difference | -0.17 | 2.95 | -0.25 | 0.00 | 0.00 | 5,015 |
| ***Macroprudential Policies*** | | | | | | |
| MP t1 (short term) | 0.40 | 2.84 | -4.00 | 0.00 | 4.00 | 5,015 |
| MP t1_tightening | 2.26 | 1.55 | 0.00 | 2.00 | 4.00 | 5,015 |
| MP t1_loosening | -1.86 | 2.64 | -6.00 | -1.00 | 0.00 | 5,015 |
| Capital related MP t1 | -0.07 | 1.53 | -2.00 | 0.00 | 2.00 | 5,015 |
| LiquidityrelatedMP t1 | 0.17 | 0.92 | -1.00 | 0.00 | 1.00 | 5,015 |
| Asset related MP t1 | -0.05 | 0.95 | -1.00 | 0.00 | 1.00 | 5,015 |
| FX related MP t1 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 | 5,015 |
| Reserves relatedMP t1 | -0.04 | 0.34 | 0.00 | 0.00 | 0.00 | 5,015 |
| MP t3 (3-year window) | 1.21 | 5.32 | -6.00 | 1.00 | 8.00 | 5,015 |
| MP t3_tightening | -5.56 | 5.10 | -12.00 | -5.00 | 0.00 | 5,015 |
| MP t3_loosening | 6.77 | 3.16 | 3.00 | 7.00 | 11.00 | 5,015 |
| Capital related MP t3 | -0.21 | 2.84 | -4.00 | 0.00 | 3.00 | 5,015 |
| LiquidityrelatedMP t3 | 0.52 | 1.78 | -2.00 | 1.00 | 3.00 | 5,015 |
| Asset related MP t3 | -0.16 | 1.99 | -2.00 | 0.00 | 2.00 | 5,015 |
| FX related MP t3 | 0.01 | 0.38 | 0.00 | 0.00 | 0.00 | 5,015 |
| Reserves relatedMP t3 | -0.12 | 0.76 | 0.00 | 0.00 | 0.00 | 5,015 |
| ***Bank characteristics*** | | | | | | |
| Total Assets (m $) | 524.1 | 65.16 | 330.3 | 321.5 | 5534 | 5,015 |
| Return on Assets (%) | 0.45 | 0.54 | 0.06 | 0.30 | 1.12 | 5,015 |
| Tangibility ratio (%) | 0.99 | 6.74 | 0.15 | 0.33 | 1.21 | 5,015 |
| NonPerformingLoan(%) | 5.27 | 24.84 | 0.22 | 0.60 | 6.96 | 5,015 |
| Capital ratio (%) | 19.42 | 57.43 | 12.03 | 15.33 | 18.42 | 5,015 |
| TobinsQ (%) | 1.01 | 0.00 | 0.97 | 1.01 | 1.04 | 5,015 |
| Leverage (%) | 33.21 | 18.74 | 11.47 | 29.46 | 56.49 | 5,015 |
| ESG disclosure Index | 42.61 | 13.28 | 18.25 | 42.61 | 59.74 | 5,015 |
| ***Country characteristics*** | | | | | | |
| GDP growth rate % | 1.22 | 3.93 | -3.70 | 2.21 | 5.16 | 5,015 |
| Monetary policy | 0.44 | 1.70 | -0.32 | 0.05 | 1.96 | 5,015 |
| Inflation rate % | 1.71 | 1.77 | 0.47 | 1.48 | 3.14 | 5,015 |
| Unemployment (%) | 5.16 | 2.25 | 3.26 | 4.21 | 8.41 | 5,015 |
| Supervisory Power Indx | 11.18 | 1.69 | 10.00 | 11.00 | 13.00 | 5,015 |
| Capital Stringency Indx | 5.42 | 1.18 | 3.00 | 6.00 | 6.00 | 5,015 |
| FEX Depreciation % | 1.52 | 6.79 | -4.36 | 0.30 | 8.54 | 5,015 |
| Short term interest % | -0.20 | 1.32 | -0.51 | -0.07 | 0.03 | 5,015 |
| Credit growth % | 0.04 | 0.05 | -0.03 | 0.03 | 0.11 | 5,015 |

**Table 2: Summary Statistics by country and economy type**

| Country name | Bonds | Mean | SD | Min | Max | EM | AD |
|---|---|---|---|---|---|---|---|
| Germany | 1507 | 8.50 | 19.14 | 0.02 | 200.00 | 0 | 1 |
| France | 439 | 21.03 | 42.13 | 0.10 | 245.04 | 0 | 1 |
| United States | 331 | 48.61 | 74.91 | 0.06 | 350.00 | 0 | 1 |
| United Kingdom | 319 | 16.75 | 36.29 | 0.08 | 225.00 | 0 | 1 |
| Australia | 290 | 41.30 | 52.84 | 0.10 | 200.00 | 0 | 1 |
| Austria | 253 | 5.41 | 12.69 | 0.03 | 122.52 | 0 | 1 |
| Japan | 226 | 22.93 | 16.41 | 1.30 | 118.58 | 0 | 1 |
| South Korea | 193 | 18.49 | 14.33 | 0.85 | 58.18 | 0 | 1 |
| Switzerland | 158 | 13.71 | 31.83 | 0.15 | 300.00 | 0 | 1 |
| Netherlands | 136 | 51.79 | 63.18 | 0.61 | 239.59 | 0 | 1 |
| Taiwan | 131 | 11.03 | 8.86 | 0.68 | 48.70 | 0 | 1 |
| UAE | 100 | 10.10 | 18.45 | 0.68 | 100.00 | 1 | 0 |
| Italy | 96 | 88.55 | 62.09 | 0.39 | 300.00 | 0 | 1 |
| Canada | 96 | 28.17 | 29.08 | 0.16 | 103.62 | 0 | 1 |
| Malaysia | 69 | 12.02 | 12.44 | 0.82 | 60.53 | 1 | 0 |
| New Zealand | 48 | 42.88 | 29.25 | 1.12 | 100.00 | 0 | 1 |
| India | 47 | 23.43 | 25.03 | 0.77 | 92.12 | 1 | 0 |
| Chile | 47 | 18.66 | 20.36 | 0.00 | 75.00 | 1 | 0 |
| Singapore | 42 | 34.73 | 36.49 | 1.33 | 100.00 | 0 | 1 |
| China | 40 | 62.86 | 76.15 | 1.60 | 300.00 | 1 | 0 |
| Finland | 40 | 35.12 | 45.28 | 1.00 | 150.00 | 0 | 1 |
| Hong Kong | 39 | 12.10 | 29.71 | 0.30 | 163.35 | 0 | 1 |
| Indonesia | 39 | 6.94 | 7.09 | 0.45 | 30.00 | 1 | 0 |
| Sweden | 34 | 61.82 | 43.86 | 2.29 | 140.00 | 0 | 1 |
| Turkey | 33 | 54.31 | 26.68 | 1.37 | 125.00 | 1 | 0 |
| Brazil | 27 | 42.62 | 32.88 | 0.01 | 100.00 | 1 | 0 |
| Norway | 25 | 43.77 | 46.99 | 1.09 | 125.00 | 0 | 1 |
| Luxembourg | 25 | 4.89 | 10.43 | 0.14 | 50.00 | 0 | 1 |
| Ireland | 24 | 31.41 | 34.26 | 1.00 | 100.00 | 0 | 1 |
| Philippines | 21 | 18.58 | 18.59 | 1.84 | 75.00 | 1 | 0 |
| Belgium | 20 | 66.21 | 58.05 | 0.56 | 224.55 | 0 | 1 |
| Denmark | 20 | 64.20 | 51.96 | 0.14 | 150.00 | 0 | 1 |
| Mexico | 18 | 62.78 | 29.14 | 16.09 | 100.00 | 1 | 0 |
| Peru | 15 | 50.69 | 24.91 | 0.81 | 85.00 | 1 | 0 |
| Colombia | 12 | 62.92 | 28.40 | 30.00 | 110.00 | 1 | 0 |
| Spain | 11 | 78.16 | 39.38 | 5.65 | 135.47 | 0 | 1 |
| Portugal | 6 | 44.38 | 37.88 | 5.67 | 109.49 | 0 | 1 |
| Nigeria | 6 | 40.00 | 8.94 | 30.00 | 50.00 | 1 | 0 |
| Iceland | 5 | 34.03 | 19.29 | 4.45 | 58.03 | 0 | 1 |
| Thailand | 4 | 110.00 | 11.55 | 100.00 | 120.00 | 1 | 0 |
| Greece | 4 | 54.24 | 6.61 | 44.90 | 59.11 | 0 | 1 |
| Poland | 3 | 24.65 | 29.94 | 2.70 | 58.76 | 1 | 0 |
| Slovakia | 3 | 22.83 | 29.90 | 1.01 | 56.91 | 0 | 1 |
| Vietnam | 3 | 9.75 | 3.44 | 6.47 | 13.34 | 1 | 0 |
| Argentina | 2 | 40.00 | 0.00 | 40.00 | 40.00 | 1 | 0 |
| Estonia | 2 | 31.80 | 4.86 | 28.36 | 35.23 | 0 | 1 |
| Georgia | 2 | 30.00 | 0.00 | 30.00 | 30.00 | 1 | 0 |
| Czech Republic | 1 | 59.04 | 0.00 | 59.04 | 59.04 | 0 | 1 |
| Azerbaijan | 1 | 50.00 | 0.00 | 50.00 | 50.00 | 1 | 0 |
| Romania | 1 | 13.69 | 0.00 | 13.69 | 13.69 | 1 | 0 |
| Latvia | 1 | 2.39 | 0.00 | 2.39 | 2.39 | 0 | 1 |
| Total | 5015 | | | | | 20 | 31 |

**Table 3: Summary Statistics by bonds type green and non-green**

| | Green Bonds | | | | | | Non-Green Bonds | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | Min | Median | Max | N | Mean | SD | Min | Median | Max |
| ***Bond Characteristics*** | | | | | | | | | | | | |
| Yield at issue (%) | 441 | 1.35 | 2.03 | 0.10 | 0.52 | 3.72 | 4,574 | 2.24 | 2.14 | 0.20 | 1.60 | 4.80 |
| Amount Issued (m $) | 441 | 14.69 | 29.41 | 1.18 | 2.90 | 50.00 | 4,574 | 23.68 | 41.67 | 0.95 | 5.55 | 75.00 |
| Maturity years | 441 | 8.83 | 4.65 | 2.00 | 8.00 | 33.00 | 4,574 | 10.13 | 7.00 | 2.00 | 10.00 | 70.00 |
| Bloomberg Rating | 441 | 1.05 | 2.51 | 0.00 | 0.00 | 6.00 | 4,574 | 2.07 | 3.46 | 0.00 | 0.00 | 7.00 |
| Maturity Type | 441 | 0.20 | 0.47 | 0.00 | 0.00 | 1.00 | 4,574 | 0.36 | 0.60 | 0.00 | 0.00 | 1.00 |
| Self-Underwriting | 441 | 0.78 | 0.42 | 0.00 | 1.00 | 1.00 | 4,574 | 0.62 | 0.49 | 0.00 | 1.00 | 1.00 |
| Coupon rate (%) | 441 | 1.17 | 1.90 | 0.05 | 0.48 | 3.20 | 4,574 | 1.94 | 2.15 | 0.01 | 1.15 | 4.56 |
| Coupon Type | 441 | 0.46 | 0.97 | 0.00 | 0.00 | 2.00 | 4,574 | 0.46 | 0.91 | 0.00 | 0.00 | 2.00 |
| Price at issue difference | 441 | -0.25 | 3.47 | -0.17 | 0.00 | 0.00 | 4,574 | -0.16 | 2.90 | -0.27 | 0.00 | 0.00 |
| ***Macroprudential Policies*** | | | | | | | | | | | | |
| MP t1 (short term) | 441 | -0.30 | 2.35 | -3.00 | 0.00 | 3.00 | 4,574 | 0.47 | 2.88 | -4.00 | 0.00 | 4.00 |
| MP t1_tightening | 441 | 2.24 | 1.23 | 1.00 | 2.00 | 4.00 | 4,574 | 2.26 | 1.58 | 0.00 | 2.00 | 4.00 |
| MP t1_loosening | 441 | -2.54 | 2.75 | -6.00 | -1.00 | 0.00 | 4,574 | -1.79 | 2.62 | -6.00 | -1.00 | 0.00 |
| Capital related MP t1 | 441 | -0.51 | 1.39 | -2.00 | 0.00 | 1.00 | 4,574 | -0.03 | 1.54 | -2.00 | 0.00 | 2.00 |
| Liquidity related MP t1 | 441 | 0.22 | 0.95 | -1.00 | 1.00 | 1.00 | 4,574 | 0.17 | 0.92 | -1.00 | 0.00 | 1.00 |
| Asset related MP t1 | 441 | -0.12 | 0.91 | -1.00 | 0.00 | 1.00 | 4,574 | -0.05 | 0.95 | -1.00 | 0.00 | 1.00 |
| FX related MP t1 | 441 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 4,574 | 0.01 | 0.17 | 0.00 | 0.00 | 0.00 |
| Reserves related MP t1 | 441 | -0.01 | 0.14 | 0.00 | 0.00 | 0.00 | 4,574 | -0.04 | 0.36 | 0.00 | 0.00 | 0.00 |
| MP t3 (3-year window) | 441 | 0.34 | 4.72 | -6.00 | 0.00 | 6.00 | 4,574 | 1.29 | 5.37 | -6.00 | 2.00 | 8.00 |
| MP t3_tightening | 441 | -6.50 | 4.80 | -13.00 | -7.00 | 0.00 | 4,574 | -5.47 | 5.12 | -12.00 | -4.00 | 0.00 |
| MP t3_loosening | 441 | 6.81 | 2.70 | 4.00 | 7.00 | 10.00 | 4,574 | 6.77 | 3.21 | 3.00 | 7.00 | 11.00 |
| Capital related MP t3 | 441 | -0.71 | 2.64 | -4.00 | 0.00 | 2.00 | 4,574 | -0.16 | 2.86 | -4.00 | 0.00 | 3.00 |
| Liquidity related MP t3 | 441 | 0.67 | 1.72 | -1.00 | 1.00 | 3.00 | 4,574 | 0.50 | 1.79 | -2.00 | 1.00 | 3.00 |
| Asset related MP t3 | 441 | -0.17 | 1.95 | -2.00 | 0.00 | 2.00 | 4,574 | -0.16 | 1.99 | -2.00 | 0.00 | 2.00 |
| FX related MP t3 | 441 | 0.01 | 0.34 | 0.00 | 0.00 | 0.00 | 4,574 | 0.01 | 0.38 | 0.00 | 0.00 | 0.00 |
| Reserves related MP t3 | 441 | -0.06 | 0.46 | 0.00 | 0.00 | 0.00 | 4,574 | -0.12 | 0.79 | 0.00 | 0.00 | 0.00 |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets (ml $) | 441 | 507.2 | 72.6 | 896 | 3200 | 5534 | 4,574 | 525.7 | 64.4 | 3300 | 3200 | 5109 |
| Return on Assets (%) | 441 | 0.30 | 0.33 | 0.06 | 0.15 | 0.77 | 4,574 | 0.47 | 0.55 | 0.06 | 0.32 | 1.15 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tangibility ratio (%) | 441 | 0.43 | 0.62 | 0.15 | 0.26 | 0.91 | 4,574 | 1.04 | 7.05 | 0.15 | 0.35 | 1.24 |
| NonPerformingLoan % | 441 | 4.66 | 33.89 | 0.35 | 0.37 | 1.81 | 4,574 | 5.33 | 23.80 | 0.22 | 0.66 | 7.09 |
| Capital ratio (%) | 441 | 15.90 | 5.18 | 13.06 | 15.94 | 17.98 | 4,574 | 19.76 | 60.11 | 11.95 | 15.15 | 18.58 |
| TobinsQ (%) | 441 | 1.00 | 2.21 | 0.99 | 1.01 | 1.01 | 4,574 | 1.01 | 0.04 | 0.97 | 101.20 | 1.04 |
| Leverage (%) | 441 | 41.99 | 17.38 | 17.29 | 50.11 | 56.49 | 4,574 | 32.37 | 18.65 | 11.14 | 28.22 | 56.49 |
| ESG disclosure Index | 441 | 37.93 | 13.85 | 18.25 | 42.60 | 54.71 | 4,574 | 43.05 | 13.14 | 18.25 | 42.61 | 60.46 |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate % | 441 | 0.59 | 3.81 | -3.70 | 1.99 | 4.56 | 4,574 | 1.29 | 3.94 | -3.70 | 2.21 | 5.70 |
| Monetary policy | 441 | 0.74 | 1.69 | -0.32 | 0.03 | 1.96 | 4,574 | 0.41 | 1.70 | -0.32 | 0.05 | 1.96 |
| Inflation rate % | 441 | 1.51 | 1.34 | 0.49 | 0.80 | 3.14 | 4,574 | 1.73 | 1.81 | 0.38 | 1.51 | 3.14 |
| Unemployment (%) | 441 | 4.76 | 1.99 | 3.57 | 3.86 | 8.01 | 4,574 | 5.20 | 2.27 | 3.14 | 4.36 | 8.41 |
| Supervisory Power Index | 441 | 10.61 | 1.27 | 10.00 | 10.00 | 13.00 | 4,574 | 11.24 | 1.71 | 10.00 | 11.00 | 13.00 |
| Capital Stringency Index | 441 | 5.80 | 0.72 | 5.00 | 6.00 | 6.00 | 4,574 | 5.38 | 1.21 | 3.00 | 6.00 | 6.00 |
| FEX Depreciation % | 441 | 1.03 | 6.67 | -1.88 | -0.60 | 6.56 | 4,574 | 1.57 | 6.80 | -4.36 | 0.30 | 8.54 |
| Short term interest % | 441 | -0.16 | 0.30 | -0.24 | -0.12 | -0.04 | 4,574 | -0.20 | 1.39 | -0.54 | -0.07 | 0.04 |
| Credit growth % | 441 | 0.04 | 0.05 | -0.02 | 0.07 | 0.08 | 4,574 | 0.04 | 0.05 | -0.03 | 0.03 | 0.11 |

## Table 4: Variables definitions

| Variables | Definitions | Source |
|---|---|---|
| ***Bonds characteristics*** | | |
| Yield at issue | The yield the bond offered on the issue date. Calculated as bond's coupon divided by bond's price. | Bloomberg |
| Amount Issued | The issuance amount (in $M). | Bloomberg |
| Maturity years | Number of years until the bonds matures. | Bloomberg |
| Bloomberg Rating | A combination of ratings from agencies including Standard & Poor's, Fitch, Moody's and DBRS. | Bloomberg |
| Maturity Type | Three main maturity types: At Maturity (A bond redeemed at maturity), Callable (A bond which could be redeemed by the issuer before the bond's maturity date), Sinkable (A bond backed by a fund reserved by the issuer). | Bloomberg |
| Self-underwriting | Indicates whether the Lead Manager/Underwriter is the same as the issuer or not (1/0). | Bloomberg |
| Coupon rate | Interest rate paid annually on fixed income securities from the issuance date until they mature | Bloomberg |
| Coupon type | Whether coupon rate is fixed or variable | Bloomberg |
| Price at issue difference | Difference between the price at par and the price at which the security is sold to the public. | Bloomberg |
| ***Macroprudential Policies*** | | |
| MP t1 (short term) | Monthly series of macroprudential policies converted into annual data by summing up the monthly records for each year. Following Chen et al., (2022), this would assess the short-term effects of these policies. Appendix 1 contains macroprudential policies definitions | Alam et al., (2019) Chen et al., (2022) |
| MP t1_tightening | Monthly series of tightening macroprudential policies converted into annual data by summing up the monthly records for each year. Following Chen et al., (2022), this would assess the short-term effects of tighter policies. | Alam et al., (2019) Chen et al., (2022) |
| MP t1_loosening | Monthly series of loosening macroprudential policies converted into annual data by summing up the monthly records for each year. Following Chen et al., (2022), this would assess the short-term effects of looser policies. | Alam et al., (2019) Chen et al., (2022) |
| Capital related MP t1 | Capital Macroprudential policies overall indices including counter-cyclical capital buffer, capital conservation requirements, other capital requirements, and the restrictions on bank leverage in year t. | Alam et al., (2019) |
| Liquidity related MP t1 | Macroprudential policies with respect to liquidity, including the requirements on bank liquidity in yeart. | Alam et al., (2019) |
| Asset related MP t1 | Bank assets macroprudential policies overall indices including the limits on credit growth, other loan restrictions, the limits to the loan-to-value ratios, the limits to the debt service-to-income ratios and the loan-to-income ratios, taxes and levies applied to specified assets, the limits to the loan-to-deposit ratios and the dynamic loan loss provisions in year t. | Alam et al., (2019) |
| FX related MP t1 | Foreign exchanges Macroprudential policies overall indices including the limits on foreign currency lending and the limits on foreign exchange positions in year t. | Alam et al., (2019) |

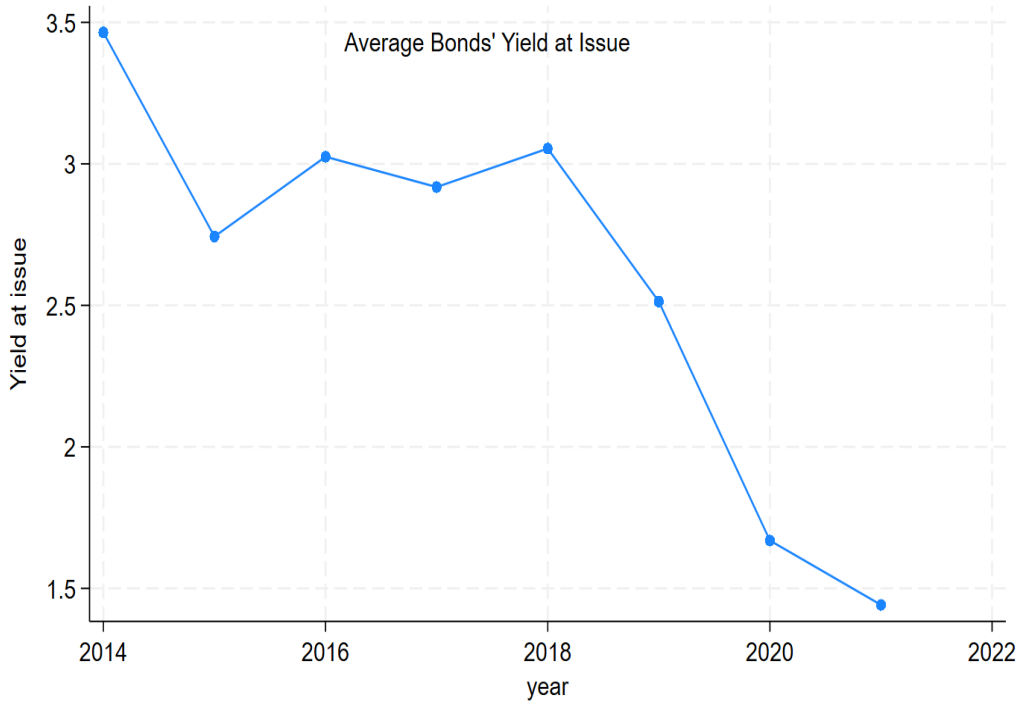
| | | |
|---|---|---|
| Reserves related MP t1 | Reserve requirements macroprudential policies overall indices in year t. | Alam et al., (2019) |
| MP t3 (3-year window) | A 3-year rolling window used to aggregate the macroprudential policy tightening and loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for the overall index (both tighter and looser policies combined) | Alam et al., (2019)<br>Chen et al., (2022) |
| MP t3_tightening | A 3-year rolling window used to aggregate the macroprudential policy tightening indicators defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for tighter policies | Alam et al., (2019)<br>Chen et al., (2022) |
| MP t3_loosening | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for looser policies | Alam et al., (2019)<br>Chen et al., (2022) |
| Capital related MPt3 | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for Capital Macroprudential policies overall indices including counter-cyclical capital buffer, capital conservation requirements, other capital requirements, and the restrictions on bank leverage. | Alam et al., (2019)<br>Chen et al., (2022) |
| Asset related MPt3 | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for Bank assets macroprudential policies overall indices including the limits on credit growth, other loan restrictions, the limits to the loan-to-value ratios, the limits to the debt service-to-income ratios and the loan-to-income ratios, taxes and levies applied to specified assets, the limits to the loan-to-deposit ratios and the dynamic loan loss provisions | Alam et al., (2019)<br>Chen et al., (2022) |
| Liquidity related MPt3 | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for liquidity, including the requirements on bank liquidity. | Alam et al., (2019)<br>Chen et al., (2022) |
| FX related MPt3 | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for Foreign Exchanges Macroprudential policies overall indices including the limits on foreign currency lending and the limits on foreign exchange positions. | Alam et al., (2019)<br>Chen et al., (2022) |
| Reserves related MPt3 | A 3-year rolling window used to aggregate the macroprudential policy loosening indicators combined defined in Appendix 1 in year t, t-1, t-2 to account for lagged effects. Following Chen et al., (2022), the 3-year window is calculated for Reserve requirements macroprudential policies overall indices. | Alam et al., (2019)<br>Chen et al., (2022) |
| ***Bank characteristics*** | | |
| Total Assets | Natural logarithm of banks' total assets in millions of US dollars | Bloomberg |
| Return on Assets | Ratio of operating income before depreciation to the book value of total assets | Bloomberg |

| | | |
|---|---|---|
| Tangibility ratio | Property, Plant and Equipment to total assets | Bloomberg |
| Non-Performing Loans | Ratio of Gross Non-performing Loans to total assets. NPLs are loans in default or close to default, and do not accrue interest. All loans that have an impairment provision are classified as non-accrual. | Bloomberg |
| Capital ratio | Ratio of banks' tier 1 capital to its total risk-weighted assets RWA | Bloomberg |
| TobinsQ | Ratio of the market value of total assets (obtained as the book value of total assets plus the market value of common stock minus the book value of common stock) to the book value of total assets | Bloomberg |
| Leverage | Ratio of debt (long-term debt plus debt in current liabilities) to the book value of total assets | Bloomberg |
| ESG disclosure | Environmental Social and Governance disclosure index | Bloomberg |
| ***Country characteristics*** | | |
| GDP | Annual growth rate of GDP at market prices based using local currency | World Bank |
| Monetary policy | The residual of the interest rate equation in a five-variable VAR model composed of the growth rate of GDP growth rate, the inflation rate, the first order differenced short-term interest rate, credit growth rate and the FEX depreciation rate. | Chen et al., (2022) |
| Inflation rate | Annual percentage change in the cost to the average consumer spending on goods and services. | World Bank |
| Unemployment | Percentage of the labor force available for and seeking employment but without work | World Bank |
| Supervisory Power Index | Supervisory Power Index | (Barth et al., 2004, 2008, 2013; 2018) |
| Capital Stringency Index | Overall Capital Stringency Index | (Barth et al., 2004, 2008, 2013; 2018) |
| FEX Depreciation | Annual Foreign Exchange rate collected from IMF, then depreciation rate calculated using the difference in rate between year t-1 and year t divided by the rate in year t times 100%. | IMF |
| Short term interest | Rates used for inter-financial institution borrowing. Referred to as Money Market rate by IMF and Short-Term interest rate by OCED or also as Treasury Bill rate. Calculated its first difference. | IMF and OCDE |
| Credit growth | Domestic credit to private sector by banks (% of GDP) | IMF |

### 1.3.2 Bonds' Cost of Issuance and Characteristics

The cost of debt literature contains fewer studies on green bonds' cost of issuance compared to non-green bonds. Proxies for cost of issuance used in recent research include yield at issue (Flammer, 2021), gross spread (Dougal et al., 2019) of how much demand a bond receives (Painter, 2020). Investors expect higher yield to compensate for potential additional risks which results in higher search costs for bond underwriters (Painter, 2020). In other words, the higher the risk, the higher the yield and issuance cost. Figure 1 shows the Yield at issue of all the bonds in the selected dataset between 2014 and 2021.

**Figure 1: Average Yield at issue of green and non-green bonds between 2014 and 2021**




Bond underwriters are selected by bond issuers to price and sell the bond in the primary market. Their profit is the difference between their purchasing price from the issuer and selling price to the investor. This difference is what is known in the market as the gross spread or underwriter spread. In the Bloomberg database, gross spread is denoted as 'issuance discount spread' or 'fee gross spread'. The former is defined as the issuance cost which includes takedown and underwriting fees but excludes legal fees. The latter is defined as the price

difference in percentage between what an underwriter pays to buy the security and the price they sell it for (Bloomberg, 2023).

Although both identify the gross spread as it is commonly known, searching for data using both definitions yields very few if not no results. This highlights the challenge presented by banks' unique position in the market. Underwriters are generally external entities that buy then sell a bond which generates a gross spread. For banks, however, the selling and buying could be handled internally making the bank both the issuer and underwriter at the same time. Bloomberg (2023) and Becher (2021) classify banks as being both the issuer and underwriter if they identify as the "Lead Manager/Underwriter" of the bond. From a data availability point of view, no external entity involvement means the gross spread is disclosed as an internal bank payment (Becher et al., 2021) making it difficult to link these internal payments back to the bond issuance cost.

In this study, 65% of issuing banks identify as the Lead Underwriter. Only 12% or the remaining 35% banks, who use third party underwriters, have gross spread figures disclosed. Given the lack of gross spread data which is also a one-off payment compared to the yield at issue which is an annual cost, we use the yield at issue as proxy for cost of issuance following other papers (Caramichael & Rapp, 2022; Fatica et al., 2021; Flammer, 2021; Painter, 2020). As proxy for the credit quality of bond issuances, Bloomberg composite rating was used. The rating is an amalgamation of ratings from agencies including Standard & Poor's Fitch, Moody's and DBRS (Bloomberg, 2023). Following Painter (2020), the rating was converted into numeric form. Starting with the value of "1" for the highest ratings (AAA or Aaa), "2" for AA+ or Aa1 and so forth. The higher the numeric value the lower the credit rating. Therefore, the credit rating for the bonds in the set range from 1 to 22. The sample median rating is 1.98 indicating the average bond credit rating in this sample is AA+ or Aa1.

The data set consists of bonds with maturity terms as short as 2 years and as long as 70 with an average of 8 years maturity. All bonds maturity types with data available remained in the set including 69% 'At Maturity' type, 29% 'Callable', 1% 'Sinkable', and the remaining 1% consists of 'Convertible', 'Call-Put', 'Call/Ext', 'Putable' and 'Pass-Thru'. In terms of coupon type, 75% are 'Fixed',

while 9% are ‘Variable’, 9% ‘Zero Coupon’ and the rest is a combination of ‘Defaulted’, ‘Flat Trading’, ‘Floating’ and ‘Step CPN’ with details in Table 1 and Table 4. Since bond yield and bond price have an invert relationship, the higher the yield the lower the bond price.

### 1.3.3 Macroprudential Policies

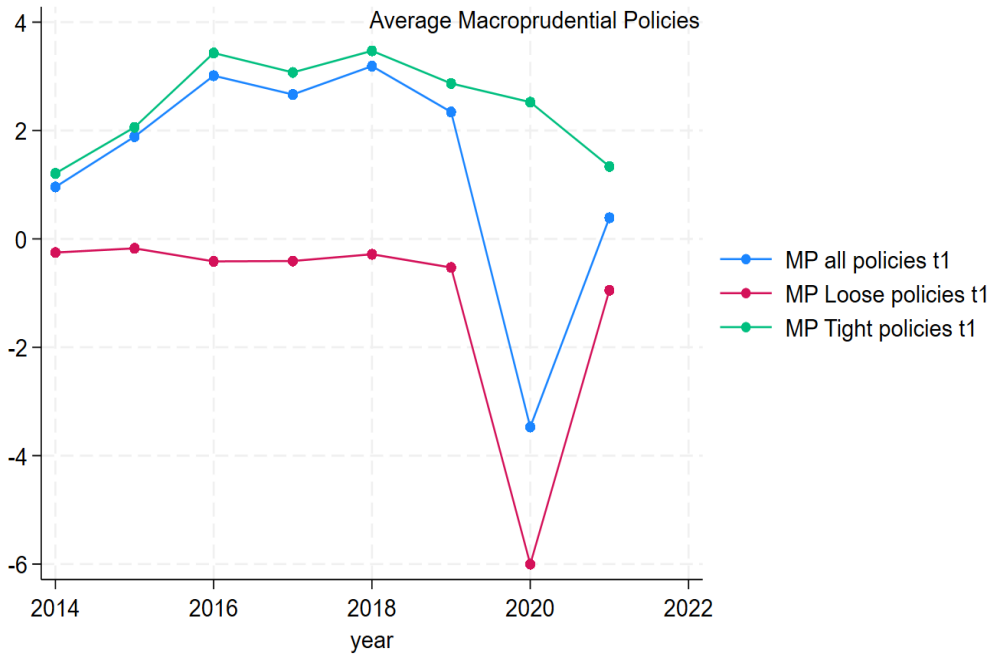
Different indicators of macroprudential policies have emerged in recent years as the policies’ usage increased across countries. One of the most comprehensive databases is Alam et al (2019) also known as the IMF iMaPP database. Used in other studies such as Chen at al (2022) and Bhargava et al (2021), the database reports the policies by their targeted sectors such as corporate sector, household sector and broad based. The 17 macroprudential policies measures are documented across 134 countries from 1990 until 2021 and they include: (1) capital conservation buffer, (2) countercyclical capital buffer, (3) other capital requirements, (4) limits on credit growth, (5) limits to the loan-to-value ratios, (6) limits to the debt-service-to-income ratios and the loan-to income ratios, (7) limits to the loan-to-deposit ratios, (8) limits on the leverage of banks, (9) liquidity requirements, (10) dynamic loan loss provisions, (11) taxes and levies applied to specified transactions, assets, or liabilities, (12) other loan restrictions, (13) limits on foreign currency lending, (14) limits on foreign exchange positions, (15) reserve requirements, (16) measures to mitigate risks from global and domestic systemically important financial institutions, (17) other macroprudential policies.

To assess the effect of macroprudential policies when more than one policy is triggered, an aggregate index is constructed through the following steps. Since Alam et al. (2019) report monthly as well as quarterly policy changes, we follow Chen et al. (2022) by converting the monthly series into annual data as well as using dummy variables where a +1 indicates a tightening policy action, a -1 a loosening policy action and a zero for no change in policy. The aggregate index is then sums up all macroprudential policies dummies reflective of policy actions taken within the same year. In other words, the index would measure the overall direction of the policies for each country in each year. For example, in 2014

China took three tightening actions and a one loosening one coded by Alam et al (2019) as +1-1+1+1 which when summed up equals 2. The latter is then used as the proxy for China's overall macroprudential policies that year, 2014. A positive value indicates more tightening actions were taken relative to the loosening ones which is indicative of the country's general policy direction.

The policies were further split into household sector targeting indicators and broad-based corporate sector indicators as per Bhargava et al (2021) and Chen et al (2022) methodologies. The broad-based corporate sector indicators are the ones retained being the most relevant to this research (Bhargava et al., 2021). These include: Capital Requirements corporate sector targeted (CapitalCorp) , Capital Conservation Buffers (Conservation), Countercyclical Buffers (CCB), Limits on Credit Growth corporate sector targeted (LCGCorp), Loan Restrictions corporate sector targeted (LoanRCorp), Leverage Limits (LVR), Loan Loss Provisions (LLP), Restrictions on Foreign Currency Loans (FCL), Tax measures for macroprudential purposes (Tax), Liquidity requirements (Liquidity), Limits on the Foreign Exchange positions (LFX) and Reserve Requirements (RR). Figure 2 illustrates the average use of macroprudential policies over the sample period.

**Figure 2: Average use of macroprudential policies in 52 countries between 2014 and 2021**



In addition to the possible immediate effect of these policies, research has shown that lagged effects are also possible given that these policies might not be binding immediately after introduction (Chen et al., 2022; Akinci & Olmstead-Rumsey, 2017). To account for possible lagged effects, we follow previous research (Chen et al., 2022; Zhang & Zoli, 2014) in using a 3-year window by summing up macroprudential policies in years t, t-1 and t-2 with the result referred to as MP t3. Throughout the analysis, annual macroprudential policies will be denoted as MP t1 which would indicate the short-term effect of the policies, whereas MP t3 indicates the long-term effects of these policies.

### 1.3.4 Banks Characteristics

As the dataset contains 504 banks from 52 countries, bank level data was obtained from Bloomberg to add bank controls to our regression. Out of the 504 banks, 249 issued both green and non-green bonds, 92 issued green bonds only and 163 banks issued non-green bonds only. Previous studies investigated the yield difference between green and non-bonds using a strict firm matching process. Flammer (2021) and Larcker and Watts (2020), for instance, reduced their sets to only firms which issued both green and non-green bonds. This resulted in comparing a green with a quasi-identical non-green bond issued by the same firm. While their approach is plausible, their studies incorporate firms from various industries and different types of bonds including municipal bonds. The latter have a far greater market share compared to corporate bonds in general and green corporate bonds in particular.

In terms of issuing banks, we add the natural logarithm of bank's total assets (millions of US dollars) as proxy for bank size. Larger banks are more likely to issue bonds due to having lower costs attached to their venture in the bond market (Rancan et al., 2023). Larger banks could afford to offer higher yield at issue due to their economies of scale and risk-taking abilities which absorb the cost of their issuances compared to smaller banks. The choice of underwriter for banks is also critical as it affects the cost of issuance as self-underwriting is found to increase the cost of issuance due to banks' size, information sharing

and reputation (Carbo-Valverde et al., 2021). A self-underwriting dummy variable is used to control for whether the bank is itself the underwriter, reported as the Lead Manager, or uses 3rd party underwriters.

Bank's return on assets (ROA) is also included as a measure of bank's profitability. As proxy for banks' ability to offer collateral for debt financing, we use property, plant and equipment to total assets ratio denoted as Tangibility (Mizen et al., 2013). Another credit constraint measure is total debt to total equity ratio known as Leverage which is used to indicate banks' general indebtedness (Dyck et al., 2019; Mizen et al., 2013). Non-performing loans to total assets ratio is used as a measure of banks' credit risk (Davis et al., 2022). Tier1 to risk weighted assets denoted as Capital Ratio and ratio of the market value of total assets referred to as TobinsQ capture the impact of banks' efficiency and performance respectively (Flammer, 2021; Park et al., 2020). ESG disclosure scores, on the other hand, are used as proxy for companies' commitment to sustainability (García et al., 2023; Bedendo et al., 2022; Flammer, 2021). Therefore, in line with the signalling theory, the higher the score the more likely the bank would tap into the green bond market. All ratios were winsorized at the 1st and 99th percentile of their empirical distribution to mitigate the impact of outliers (Flammer, 2021; Painter, 2020)

### 1.3.5 Country Characteristics

Since this study focuses on one industry only and due to limited green bank bonds' data availability, the primary matching criteria would be the country of issuance. In other words, bonds would be classified by country of issuance to ensure both type of bonds were subjected to the same regulatory requirements and changes as well as economic conditions. In addition to the standard macroeconomic conditions variables such as GDP growth rate, inflation rate and unemployment rate, we use Supervisory Power and Capital Stringency indices. Following Barth et al. (2004, 2008, 2013, 2018), we construct time series measures for each country whereby the higher the indicator, the stricter the country's supervisory requirements (Chen et al., 2022).

Given the complementary nature of macroprudential policies to monetary policies, we include a measure of the latter to control for its effects on banks' funding interest rates (Chen et al., 2022; Vollmer, 2021). Macroprudential policies are viewed as tools used to moderate the effects of monetary policies on banks' risk-taking incentives (Altunbas et al., 2017). Therefore, we follow Chen et al (2022) by constructing a measure of monetary policy for each country in the dataset to incorporate in the estimations. They use five macroeconomic variables to build a structural Vector Auto Regression (VAR) model for each country in the sample. The variables employed are foreign exchange depreciation rate, banking credit growth rate, first differenced short-term interest rate, inflation rate and GDP growth rate. The residuals of the equation are used as the value of monetary policy where a higher value means a tightening direction of monetary policy and vice versa (Chen et al., 2022).

In the context of this chapter, a tightened monetary policy increases banks' funding interest rate. Increased interest rates would result in lower bond prices which in turn leads to higher bond yields due to the inverse relationship between the latter two.

### 1.3.6 Empirical Model

To assess both the short-term and long-term effects of macroprudential policies on the cost of bank bond issuance, we follow Painter (2020) and Chen et al (2022) by estimating the following regression model:

$$Yield_{ijt} = \alpha + \beta \cdot MP_{jt} + \lambda \cdot Bond\_controls_{ijt} + \sigma \cdot Bank\_controls_{ijt} + \eta \cdot Country\_controls_{jt} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{ijt} \quad (1.1)$$

Where $Yield_{ijt}$ represents yield at issue and $MP_{jt}$ denotes macroprudential policies. $Bond\_controls_{ijt}$, $Bank\_controls_{ijt}$ and $Country\_controls_{jt}$ are vectors of bond, bank and country control variables respectively. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity. Year-country fixed effects to control for

unobserved heterogeneity accounting for any differences in our data that are constant over time within each country. $\beta$, $\lambda$, $\sigma$, $\eta$ are the coefficients to be estimated. $\varepsilon_{ijt}$ is the error term and $\alpha$ is the constant. Subscripts *i* , *j* and *t* represent bank, country and year respectively. The main sample was split into green and non-green bonds to produce results to compare both subgroups. To account for the possibility that the regression residuals could be correlated within countries, all standard errors are clustered by bank.

We use the within regression to estimate the fixed effects in Eq (1.1). First, we run a simple Ordinary Least Square (OLS) regression and after confirming the presence of unobserved heterogeneity, we run a Least Squares Dummy variable (LSDV) regression and conduct an F-test. The latter showed fixed effects model is more appropriate than OLS model. Hausman test is carried out to confirm the fixed effects within estimator is more robust than the random effects one. As we confirm the presence of heteroskedasticity using Breusch-Pagan test, we use robust estimations of the standard errors clustered at bank level.

$$Yield_{ijt} = \alpha + \beta \cdot MP\_Tight_{jt} + \lambda \cdot Bond\_controls_{ijt} + \sigma \cdot Bank\_controls_{ijt} + \eta \cdot Country\_controls_{jt} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{ijt} \quad (1.2)$$

$$Yield_{ijt} = \alpha + \beta \cdot MP\_Loose_{jt} + \lambda \cdot Bond\_controls_{ijt} + \sigma \cdot Bank\_controls_{ijt} + \eta \cdot Country\_controls_{jt} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{ijt} \quad (1.3)$$

Same steps were followed with Eq (1.2) and Eq (1.3) as the main explanatory variable was amended to MP t1 tightening and MP t1 loosening respectively. The aim is to study the effect of both types of policies on bonds' issuance cost. Further analysis was conducted by looking at the long-term effect of macroprudential policies by replacing $MP_{jt}$ in Eq (1.1) with MP t3 (3-year window), MP t3 tightening, MP t3 loosening. Results of all equations are in tables 6 to 9 reported for green bonds in columns 1 to 6 and for non-green bonds in columns 7 to 12. Control variables are added gradually where column 6 for green bonds and 12 for non-green bonds reporting the results.

## 1.4 Empirical Results

### 1.4.1 Main Results

Table 5 presents the results of short-term effect of the overall macroprudential policies (MP t1) measure on all bonds' cost of issuance. The control variables were added progressively to assess macroprudential policies' coefficient. The dependent variable is yield at issue and a positive value in MP t1 reflects tightening macroprudential policies as opposed to loosening ones. The results show that macroprudential policies have a positive relationship with bonds' yield at issue meaning the more policies used, the high the bond yields.

Table 6, on the other hand, shows the regression results by bond type where columns 1 to 6 represent regression results for green bonds and 7 to 12 for non-green bonds. Despite a positive relationship, macroprudential policies appear to have no significant short-term effect on green bonds' cost of issuance but the opposite is true for non-green bonds. Column 12, for example, shows that a one standard deviation increase in macroprudential policies overall measure (2.841) would lead to an increase in issuance cost by around 5.11 % (calculated as 2.841 x 0.018). The results suggest that the already existing difference between green and non-green bonds in terms of issuance cost is exacerbated by macroprudential policies. This leads to the questions of what type of policies are affecting the cost of issuance more?

The macroprudential policies overall indicator MP t1 so far was built using a combination of tightening and loosening policy measures. To address the likelihood that the results might be attributed to one policy offsetting the effect of the other, a separate tightening and loosening variables were constructed using Alam et al (2019) database following Chen et al (2022). To assess the short-term effect of the policies, MP t1_tightning was constructed representing aggregated tightening policies recorded by Alam et al (2019) as +1 for each country each year. MP t1_loosening, on the other hand, represents aggregated loosening policies recorded by Alam et al (2019) as -1 for each country each year.

In Table 1 summary statistics, it is noted that for short-term MP t1_tightning the mean value of 2.26 is different to that of the loosening policies (-1.86). This

suggests that the countries in the set resorted to tightening policies more than the loosening ones over the sample period. Column 12 in Table 7, shows a result significant at 1% level as tighter macroprudential policies appear to have a positive relationship with yield at issue. Furthermore, a one standard deviation increase in tighter macroprudential policies (1.553) would lead to an increase in issuance cost by around 7 % (calculated as 1.553 x 0.046). Table 8, presents the results of loosening macroprudential policies and they appear to have no short-term effect on bonds' yield at issue. The results are also in line with the argument that tighter macroprudential policies restrict firms' decisions and borrowing compared to looser policies (Biljanovska et al., 2023).

To explore whether macroprudential policies have long term effects on bonds' cost of issuance, we follow Chen et al (2022) and Akinci & Olmstead-Rumsey (2017) in calculating a 3-year rolling window. This would account for possible lagged effects using Alam et al (2019) macroprudential policies indices. Results shown in Table 9, suggest no long-term effects of macroprudential policies' overall measure on neither green nor non-green bonds' yield.

**Table 5: Short term effects of Macroprudential policies overall measure (MP t1) on cost of issuance of all bonds**

| *Dependent Variable* | **Yield at issue** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| MP t1 (short term) | 0.051*** | 0.049*** | 0.015*** | 0.013* | 0.026** | 0.025** |
| | (0.015) | (0.014) | (0.006) | (0.007) | (0.010) | (0.010) |
| ***Bonds characteristics*** | | | | | | |
| Amount Issued | | -0.114** | 0.014 | 0.013 | 0.022 | 0.022 |
| | | (0.047) | (0.020) | (0.020) | (0.024) | (0.028) |
| Maturity years | | 0.048*** | 0.061*** | 0.060*** | 0.051*** | 0.048*** |
| | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.027 | -0.032*** | -0.032*** | -0.033** | -0.04*** |
| | | (0.021) | (0.012) | (0.012) | (0.014) | (0.016) |
| Maturity Type | | | 0.033 | 0.025 | 0.054 | 0.061 |
| | | | (0.057) | (0.056) | (0.046) | (0.048) |
| Self-Underwriting | | | -0.143*** | -0.148*** | -0.155** | -0.160** |
| | | | (0.052) | (0.053) | (0.064) | (0.067) |
| Coupon rate (%) | | | 0.753*** | 0.755*** | 0.735*** | 0.742*** |
| | | | (0.033) | (0.032) | (0.037) | (0.037) |
| Coupon Type | | | 0.328*** | 0.343*** | 0.341** | 0.384*** |
| | | | (0.126) | (0.121) | (0.132) | (0.144) |
| Price at issue diff | | | -0.030* | -0.031* | -0.026* | -0.026 |
| | | | (0.018) | (0.018) | (0.016) | (0.016) |
| ***Bank characteristics*** | | | | | | |
| Total Assets | | | | -0.149* | -0.029 | 0.044 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | (0.087) | (0.095) | (0.137) |
| Return on Assets | | | | -0.024 | 0.017 | -0.022 |
| | | | | (0.077) | (0.114) | (0.193) |
| Tangibility | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoan | | | | 0.000 | -0.002 | -0.001 |
| | | | | (0.002) | (0.003) | (0.003) |
| Capital ratio | | | | -0.001 | -0.002 | -0.000 |
| | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | 0.001 | 0.019 | 0.008 |
| | | | | (0.016) | (0.015) | (0.015) |
| Leverage | | | | -0.002 | 0.003 | 0.002 |
| | | | | (0.003) | (0.004) | (0.005) |
| ESG disclosure | | | | 0.008** | 0.009** | 0.010** |
| | | | | (0.003) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | |
| GDP growth rate | | | | | -0.011 | -0.009 |
| | | | | | (0.008) | (0.009) |
| Monetary policy | | | | | -0.007 | -0.004 |
| | | | | | (0.012) | (0.015) |
| Inflation rate | | | | | 0.053* | 0.052* |
| | | | | | (0.029) | (0.031) |
| Unemployment | | | | | 0.085 | 0.084 |
| | | | | | (0.061) | (0.070) |
| Supervisory Power | | | | | | -0.334** |
| | | | | | | (0.144) |
| Capital Stringency | | | | | | 0.007 |
| | | | | | | (0.038) |
| Constant | 8.567*** | 7.820*** | 0.864* | 0.393 | -2.269 | 4.192 |
| | (2.333) | (2.194) | (0.492) | (1.935) | (1.711) | (3.449) |
| Adj R-sq | 0.0382 | 0.0859 | 0.6607 | 0.6618 | 0.6214 | 0.6245 |
| Observations | 5,015 | 5,015 | 5,015 | 5,015 | 5,015 | 5,015 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the short-term effect of Macroprudential policies on all bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is MP t1 which is the measure of macroprudential policies in year t1 (short term) calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022 Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1). Hausman test provided results favorable to the fixed effects estimator. Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 6: Short term effects of Macroprudential policies overall measure (MP t1) on bonds' Yield at issue**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| MP t1 (short term) | 0.041* | 0.020 | 0.002 | -0.023 | 0.076 | 0.165 | 0.051*** | 0.049*** | 0.014** | 0.012* | 0.024** | 0.018* |
| | (0.022) | (0.033) | (0.022) | (0.024) | (0.068) | (0.141) | (0.015) | (0.015) | (0.005) | (0.007) | (0.010) | (0.010) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.535 | -0.156 | -0.162 | -0.163 | -0.174 | | -0.091** | 0.024 | 0.024 | 0.035 | 0.033 |
| | | (0.409) | (0.113) | (0.108) | (0.139) | (0.150) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.060** | 0.086*** | 0.084*** | 0.052* | 0.049* | | 0.047*** | 0.058*** | 0.058*** | 0.049*** | 0.048*** |
| | | (0.024) | (0.028) | (0.028) | (0.031) | (0.029) | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.114** | 0.030 | 0.023 | 0.035 | 0.043 | | 0.018 | -0.039*** | -0.038*** | -0.040*** | -0.040*** |
| | | (0.047) | (0.033) | (0.035) | (0.051) | (0.055) | | (0.022) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.129 | -0.246 | -0.428 | -0.473 | | | 0.035 | 0.027 | 0.060 | 0.057 |
| | | | (0.328) | (0.312) | (0.402) | (0.441) | | | (0.059) | (0.057) | (0.046) | (0.046) |
| Self-Underwriting | | | 0.391 | 0.439 | 0.628 | 0.669 | | | -0.177*** | -0.182*** | -0.193*** | -0.197*** |
| | | | (0.386) | (0.403) | (0.563) | (0.589) | | | (0.045) | (0.046) | (0.053) | (0.054) |
| Coupon rate (%) | | | 0.750*** | 0.752*** | 0.743*** | 0.738*** | | | 0.754*** | 0.755*** | 0.732*** | 0.732*** |
| | | | (0.026) | (0.033) | (0.054) | (0.059) | | | (0.035) | (0.035) | (0.041) | (0.041) |
| Coupon Type | | | 0.127 | 0.121 | 0.094 | 0.094 | | | 0.355** | 0.369*** | 0.372** | 0.367** |
| | | | (0.117) | (0.116) | (0.114) | (0.115) | | | (0.147) | (0.138) | (0.152) | (0.152) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.014) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.316 | -0.175 | -0.357 | | | | -0.139 | -0.051 | -0.032 |
| | | | | (0.342) | (0.159) | (0.350) | | | | (0.089) | (0.117) | (0.119) |
| Return on Assets | | | | 0.300 | -0.433 | -0.178 | | | | -0.032 | 0.027 | 0.005 |
| | | | | (0.450) | (0.724) | (0.764) | | | | (0.077) | (0.119) | (0.130) |
| Tangibility | | | | 0.135 | -1.414 | -1.624 | | | | 0.001 | -0.001 | -0.001 |
| | | | | (0.465) | (0.944) | (1.035) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoans | | | | -0.000 | 0.008 | 0.008 | | | | 0.001 | -0.001 | -0.000 |
| | | | | (0.003) | (0.006) | (0.006) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.148*** | 0.159 | 0.219 | | | | -0.001 | -0.002 | -0.001 |
| | | | | (0.054) | (0.164) | (0.191) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.257*** | -0.136 | -0.218 | | | | 0.007 | 0.026* | 0.020 |
| | | | | (0.056) | (0.218) | (0.246) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.011 | -0.051 | -0.051 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.009) | (0.036) | (0.036) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.011 | 0.008 | 0.009 | | | | 0.008* | 0.011*** | 0.012*** |
| | | | | (0.007) | (0.011) | (0.012) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.080 | -0.162 | | | | | -0.009 | -0.005 |
| | | | | | (0.055) | (0.131) | | | | | (0.008) | (0.008) |
| Monetary policy | | | | | -0.017 | 0.082 | | | | | -0.013 | -0.014 |
| | | | | | (0.142) | (0.179) | | | | | (0.012) | (0.012) |
| Inflation rate | | | | | 0.173 | 0.177 | | | | | 0.052* | 0.048 |
| | | | | | (0.159) | (0.164) | | | | | (0.030) | (0.034) |
| Unemployment | | | | | 0.345* | 0.535 | | | | | 0.101 | 0.107 |
| | | | | | (0.181) | (0.356) | | | | | (0.063) | (0.065) |
| Supervisory Power | | | | | | 0.000 | | | | | | -0.314** |
| | | | | | | (0.000) | | | | | | (0.123) |
| Capital Stringency | | | | | | -0.149 | | | | | | 0.030 |
| | | | | | | (0.197) | | | | | | (0.031) |
| Constant | 20.119*** | 13.420*** | -0.957 | 27.241*** | 11.217 | 14.159 | 8.619*** | 7.843*** | 0.927* | -0.183 | -3.201* | 2.464 |
| | (4.013) | (3.460) | (5.554) | (8.275) | (28.959) | (28.356) | (2.348) | (2.226) | (0.504) | (1.819) | (1.711) | (2.922) |
| Adj R-sq | 0.0333 | 0.1615 | 0.6813 | 0.6941 | 0.6917 | 0.6900 | 0.0390 | 0.0832 | 0.6614 | 0.6624 | 0.6184 | 0.6189 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the short term effect of Macroprudential policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is MP t1 which is the measure of macroprudential policies in year t1 (short term) calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022 Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

#### *1.4.1.1 Do macroprudential policies increase bonds' cost of issuance?*

Our results show that macroprudential policies increase short-term non-green bonds' cost of issuance in the form of yield at issue. These results are consistent with the cost of regulation argument as they suggest that when macroprudential regulatory policies are introduced, the financial sector incurs additional costs (Claessens et al., 2013). Whilst there isn't a noted short-term effect on green bonds, there certainly exists an intangible effect due to the non-green bonds' cost of issuance increasing. In other words, an increase in non-green bonds' yield at issue enlarges the already existing bond yield discount known as greenium.

As discussed, greenium is a discount in a form of lower yield which an investor is willing to accept for an otherwise identical bond from the same issuer. Green bonds are inherently costlier than their non-green counterpart which is consistent with the presence of the greenium argument (CBI, 2022). Although our results show that tighter macroprudential policies short term do not affect the yield at issue of green bonds, they enlarge the gap between green and non-green bonds' yields creating a bigger discount (larger greenium). Since bond yield and bond price have an inverse relationship, a lower bond yield means a higher bond price.

While a bond issuer might benefit from a lower yield to offer for a higher price/borrowing on green bonds, investors will have other attractive options such as a non-green bond with higher returns for less investments. Since search for yield exists in primary markets too (Rajan, 2006), investors are known to move away from government bonds which are historically low-risk to higher-risk corporate bonds which offered higher-yields (Altunbas et al., 2017). Banks as investors themselves, are known to be more incentivised by investing in gambling assets with very high returns compared to prudent assets with average high return (Glass et al., 2014).

Therefore, a larger greenium will have implications on both bond issuers and investors. Bond issuer's risk-taking behaviour could be affected as they take more risk to offer more returns to attract investors (Rajan, 2006). Investors are still predominantly attracted to investments with competitive returns rejecting investments in low yield bonds (Chiang, 2017; Flammer, 2021). This could, in turn, lead to bond issuers steering away from supporting long term green

investments in favour of short term non-green investments. In fact, referred to as promoted 'short-termism', previous studies highlighted this unintended consequence of macroprudential policies following the financial crisis (D'Orazio & Popoyan, 2019; Haldane, 2013; Thanassoulis, 2014). Another implication is green bonds' maturity term being shortened to attract sustainability conscious investors as a compromise for lower yields at issue. Since green investments are known to be long term, issuing short term green bonds will not suit climate friendly investments which will worsen the green finance gap[6] (D'Orazio & Popoyan, 2019).

Long term, however, there appear to be no significant impact of macroprudential policies on bond's cost of issuance as shown in Table 9. This could be attributed to the fact that the issuances are singular and intermittent and, therefore, the effect is more imminent. One question remains unanswered though that is which macroprudential policy has the most effect on bonds' cost of issuance? This will be addressed in the following section.

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[6] Green finance gap is the amount of funds required to achieve sustainable development Goals (SDGs). The gap stood at US$2.5 trillion back in 2019 (Khoday, 2019).

**Table 7: Short term effects of Macroprudential tightening policies on green and non-green bonds**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| MP t1_tightening | -0.076* | -0.064 | -0.052* | -0.027 | 0.068 | 0.090 | 0.036 | 0.031 | 0.005 | 0.010 | 0.052*** | 0.046*** |
| | (0.044) | (0.050) | (0.031) | (0.067) | (0.122) | (0.138) | (0.030) | (0.029) | (0.015) | (0.011) | (0.014) | (0.014) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.534 | -0.155 | -0.164 | -0.160 | -0.168 | | -0.088* | 0.025 | 0.025 | 0.036 | 0.033 |
| | | (0.409) | (0.111) | (0.109) | (0.137) | (0.146) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.061*** | 0.085*** | 0.083*** | 0.052* | 0.049* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.048*** |
| | | (0.023) | (0.028) | (0.027) | (0.031) | (0.029) | | (0.011) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.118** | 0.031 | 0.023 | 0.032 | 0.037 | | 0.019 | -0.038*** | -0.038*** | -0.039*** | -0.04*** |
| | | (0.048) | (0.033) | (0.037) | (0.054) | (0.055) | | (0.023) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.112 | -0.234 | -0.436 | -0.480 | | | 0.032 | 0.025 | 0.056 | 0.054 |
| | | | (0.340) | (0.313) | (0.408) | (0.453) | | | (0.059) | (0.057) | (0.046) | (0.045) |
| Self-Underwriting | | | 0.381 | 0.432 | 0.630 | 0.669 | | | -0.180*** | -0.184*** | -0.193*** | -0.19*** |
| | | | (0.382) | (0.415) | (0.576) | (0.606) | | | (0.045) | (0.046) | (0.053) | (0.053) |
| Coupon rate (%) | | | 0.750*** | 0.752*** | 0.743*** | 0.738*** | | | 0.756*** | 0.756*** | 0.733*** | 0.732*** |
| | | | (0.025) | (0.033) | (0.054) | (0.060) | | | (0.036) | (0.035) | (0.041) | (0.041) |
| Coupon Type | | | 0.139 | 0.120 | 0.095 | 0.096 | | | 0.357** | 0.369*** | 0.371** | 0.366** |
| | | | (0.113) | (0.116) | (0.115) | (0.115) | | | (0.146) | (0.138) | (0.151) | (0.152) |
| Price at issue diff | | | 0.006 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.294 | -0.131 | -0.199 | | | | -0.165* | -0.112 | -0.076 |
| | | | | (0.329) | (0.123) | (0.202) | | | | (0.092) | (0.124) | (0.129) |
| Return on Assets | | | | 0.026 | -0.361 | -0.184 | | | | -0.001 | 0.028 | 0.004 |
| | | | | (0.461) | (0.929) | (0.775) | | | | (0.068) | (0.117) | (0.130) |
| Tangibility | | | | 0.221 | -1.174 | -1.147 | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.490) | (0.965) | (0.928) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoans | | | | 0.000 | 0.008 | 0.007 | | | | 0.001 | -0.000 | -0.000 |
| | | | | (0.004) | (0.006) | (0.006) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.154*** | 0.121 | 0.133 | | | | -0.001 | -0.002** | -0.002 |
| | | | | (0.051) | (0.157) | (0.167) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.260*** | -0.106 | -0.127 | | | | 0.010 | 0.034** | 0.027* |
| | | | | (0.054) | (0.218) | (0.248) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.004 | -0.045 | -0.043 | | | | -0.002 | 0.004 | 0.003 |
| | | | | (0.009) | (0.038) | (0.034) | | | | (0.003) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.006 | 0.008 | 0.008 | | | | 0.008* | 0.012*** | 0.013*** |
| | | | | (0.010) | (0.014) | (0.014) | | | | (0.004) | (0.004) | (0.005) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.028 | -0.038 | | | | | 0.007 | 0.007 |
| | | | | | (0.019) | (0.025) | | | | | (0.008) | (0.008) |
| Monetary policy | | | | | -0.039 | -0.013 | | | | | -0.011 | -0.012 |
| | | | | | (0.122) | (0.089) | | | | | (0.011) | (0.011) |
| Inflation rate | | | | | 0.200 | 0.215 | | | | | 0.056* | 0.052 |
| | | | | | (0.200) | (0.211) | | | | | (0.031) | (0.036) |
| Unemployment | | | | | 0.281 | 0.340 | | | | | 0.097 | 0.105 |
| | | | | | (0.182) | (0.253) | | | | | (0.061) | (0.064) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.302*** |
| | | | | | | (0.000) | | | | | | (0.112) |
| Capital Stringency | | | | | | -0.069 | | | | | | 0.034 |
| | | | | | | (0.134) | | | | | | (0.030) |
| Constant | 24.009*** | 15.892*** | 0.521 | 26.530*** | 11.911 | 13.359 | 9.119*** | 8.327*** | 1.054** | -0.469 | -4.338** | 1.210 |
| | (3.432) | (3.482) | (5.174) | (8.620) | (28.614) | (30.576) | (2.544) | (2.398) | (0.535) | (1.863) | (1.708) | (2.741) |
| Adj R-sq | 0.0330 | 0.1627 | 0.6825 | 0.6940 | 0.6917 | 0.6899 | 0.0309 | 0.0752 | 0.6608 | 0.6620 | 0.6192 | 0.6197 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential tightening policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is MP t1_tightening which is the measure of macroprudential tightening policies in year t1 (short term) calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022 Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 8: Short term effects of Macroprudential loosening policies on green and non-green bonds**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| MP t1_loosening | 0.033* | 0.020 | 0.009 | -0.010 | -0.023 | -0.021 | 0.051** | 0.051*** | 0.015** | 0.011 | 0.011 | 0.001 |
| | (0.017) | (0.022) | (0.013) | (0.026) | (0.145) | (0.153) | (0.020) | (0.019) | (0.006) | (0.008) | (0.019) | (0.019) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.535 | -0.156 | -0.164 | -0.161 | -0.170 | | -0.092** | 0.024 | 0.024 | 0.036 | 0.033 |
| | | (0.409) | (0.112) | (0.108) | (0.136) | (0.146) | | (0.044) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.060** | 0.085*** | 0.083*** | 0.052* | 0.049* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.05*** |
| | | (0.023) | (0.028) | (0.028) | (0.031) | (0.029) | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.114** | 0.029 | 0.022 | 0.033 | 0.038 | | 0.018 | -0.039*** | -0.038*** | -0.039*** | -0.04*** |
| | | (0.048) | (0.033) | (0.035) | (0.056) | (0.059) | | (0.022) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.117 | -0.241 | -0.432 | -0.470 | | | 0.034 | 0.027 | 0.058 | 0.055 |
| | | | (0.330) | (0.316) | (0.412) | (0.447) | | | (0.059) | (0.057) | (0.045) | (0.045) |
| Self-Underwriting | | | 0.390 | 0.443 | 0.624 | 0.662 | | | -0.177*** | -0.182*** | -0.187*** | -0.19*** |
| | | | (0.385) | (0.405) | (0.571) | (0.599) | | | (0.045) | (0.046) | (0.053) | (0.054) |
| Coupon rate (%) | | | 0.750*** | 0.752*** | 0.744*** | 0.738*** | | | 0.754*** | 0.755*** | 0.735*** | 0.734*** |
| | | | (0.026) | (0.033) | (0.055) | (0.059) | | | (0.036) | (0.035) | (0.041) | (0.041) |
| Coupon Type | | | 0.132 | 0.121 | 0.095 | 0.096 | | | 0.359** | 0.371*** | 0.373** | 0.369** |
| | | | (0.117) | (0.116) | (0.115) | (0.116) | | | (0.147) | (0.139) | (0.152) | (0.151) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.306 | -0.092 | -0.121 | | | | -0.145* | -0.093 | -0.081 |
| | | | | (0.327) | (0.180) | (0.239) | | | | (0.088) | (0.117) | (0.116) |
| Return on Assets | | | | 0.234 | -0.194 | -0.190 | | | | -0.024 | 0.050 | 0.018 |
| | | | | (0.515) | (0.676) | (0.780) | | | | (0.079) | (0.127) | (0.135) |
| Tangibility | | | | 0.121 | -1.063 | -1.087 | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.451) | (0.646) | (0.659) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoans | | | | 0.000 | 0.007 | 0.007 | | | | 0.001 | -0.000 | -0.000 |
| | | | | (0.003) | (0.005) | (0.005) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.154*** | 0.114 | 0.123 | | | | -0.001 | -0.002* | -0.001 |
| | | | | (0.054) | (0.115) | (0.125) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.259*** | -0.100 | -0.101 | | | | 0.006 | 0.026* | 0.020 |
| | | | | (0.054) | (0.178) | (0.186) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.009 | -0.041 | -0.043 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.010) | (0.031) | (0.032) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.010 | 0.006 | 0.006 | | | | 0.007* | 0.010*** | 0.012*** |
| | | | | (0.009) | (0.012) | (0.012) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.013 | -0.014 | | | | | 0.001 | 0.007 |
| | | | | | (0.104) | (0.119) | | | | | (0.011) | (0.011) |
| Monetary policy | | | | | -0.057 | -0.064 | | | | | -0.023** | -0.024* |
| | | | | | (0.158) | (0.180) | | | | | (0.012) | (0.012) |
| Inflation rate | | | | | 0.176 | 0.185 | | | | | 0.041 | 0.041 |
| | | | | | (0.204) | (0.214) | | | | | (0.029) | (0.033) |
| Unemployment | | | | | 0.239 | 0.262 | | | | | 0.091 | 0.098 |
| | | | | | (0.144) | (0.201) | | | | | (0.063) | (0.065) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.374** |
| | | | | | | (0.000) | | | | | | (0.151) |
| CapitalStringency | | | | | | -0.009 | | | | | | 0.032 |
| | | | | | | (0.129) | | | | | | (0.033) |
| Constant | 21.383*** | 13.977*** | -0.929 | 26.837*** | 12.331 | 12.012 | 8.840*** | 8.050*** | 0.976* | -0.041 | -3.008* | 3.578 |
| | (3.849) | (3.248) | (5.369) | (8.406) | (30.045) | (29.091) | (2.348) | (2.237) | (0.499) | (1.798) | (1.732) | (3.324) |
| Adj R-sq | 0.0339 | 0.1621 | 0.6815 | 0.6939 | 0.6916 | 0.6898 | 0.0374 | 0.0820 | 0.6614 | 0.6623 | 0.6175 | 0.6184 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential loosening policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is MP t1_loosening which is the measure of macroprudential loosening policies in year t1 (short term) calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 9: Long term effects of Macroprudential policies overall measure as well as tightening and loosening policies on bonds' Yield at issue**

| *Dependent Variable* | **Yield at Issue** | | | | | |
|---|---|---|---|---|---|---|
| | **Green Bonds** | | | **Non-green bonds** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| MP t3 | -0.012 | | | 0.001 | | |
| | (0.012) | | | (0.003) | | |
| MP t3 tightening | | 0.004 | | | 0.007 | |
| | | (0.008) | | | (0.005) | |
| MP t3 loosening | | | -0.006 | | | 0.003 |
| | | | (0.006) | | | (0.004) |
| Constant | 11.179 | 12.059 | 13.422 | 3.560 | 3.177 | 3.642 |
| | (28.294) | (28.770) | (29.298) | (3.231) | (3.170) | (3.228) |
| Adj R-sq | 0.6908 | 0.6898 | 0.6900 | 0.6184 | 0.6185 | 0.6184 |
| Observations | 365 | 365 | 365 | 3,385 | 3,385 | 3,385 |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for long-term effect of overall Macroprudential policies as well as tightening and loosening policies separately on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variables of interest are MP t3 (3-year), MP t3_tightening and MP t3_loosening calculated using Alam et al (2019) macroprudential policies indices. The latter were aggregated over 3 year rolling window as suggested by Chen et al (2022). Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Hausman test provided results favorable to the fixed effects estimator. Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### 1.4.2 Robustness Checks

In this section, we run a number of tests to check the robustness of the results to: (1) five different categories of macroprudential policies and (2) effectiveness of macroprudential policies across different jurisdictions.

#### *1.4.2.1 Macroprudential policies categories*

It is also recognised that macroprudential policies include a variety of policy indicators. Therefore, we split them into five categories to establish which macroprudential policies are driving the bond yield at issuance to increase. Following other papers' similar methodology (Chen et al., 2022; Bhargava et al.,

2021; Altunbas et al., 2017), we categorise macroprudential policies into Capital related MP, Liquidity related MP, Asset related MP, FX related MP and Reserves related MP.

For the results to be comparable, we also follow the same strategy of assessing the short term and long term lagged effects of macroprudential policies as before. Therefore, Table 10 to Table 14 show the results of the five macroprudential policy categories short-term denoted by MP t1 after each category name. Table 15 presents long-term effect of macroprudential policies long term of all five categories denoted by MP t3 at the end of each category name.

In terms of short-term effect, the results demonstrate that liquidity related macroprudential policies are the ones with an effect on non-green bonds' yield at issue. The positive and statistically significant result at 5% in Table 11, shows that a one standard deviation increase in macroprudential policies overall measure (2.841) would lead to an increase in non-green bonds' issuance cost by around 21% (calculated as 2.841 x 0.074). Intuitively, any measure aimed at mitigating liquidity risk would be expected to affect banks' liquidity. Considering bond issuance to be motivated by the need for stable sources of funding to minimise funding liquidity risk, macroprudential liquidity policies would have an effect on banks yield at issue which is what the results above highlights.

From a lending to green projects perspective, previous studies have demonstrated the negative effect of liquidity requirements (Spencer and Stevenson. 2013; D'Orazio and Popoyan. 2019). Our results also demonstrate the negative effect of liquidity requirements on borrowing in the form of green and non-green bond issuances. Although, the liquidity related macroprudential policies exhibit no effect on green bonds yield at issue, they create a larger greenium through increasing non-green bonds yield at issue. This in turn makes non-green bonds more appealing to investors searching for yield compared to green bonds.

Similar results are seen in Table 15 as liquidity related policies appear to have a prolonged effect on non-green bonds' cost of issuance. Column (7) shows that a one standard deviation increase in macroprudential policies index (2.841) would

lead to an increase in non-green bonds' issuance cost by around 6.82 % (calculated as 2.841 x 0.024). Although the short-term effect is more pronounced than long term (21 and 6.82 respectively), it is clear that macroprudential liquidity measures have the strongest effect on bonds' issuance cost compared to the other policies. Reserve requirements macroprudential related policies also appear to have an effect on non-green bonds' cost of issuance long term. Table 15, shows that a one standard deviation increase in macroprudential policies index (2.841) would lead to an increase in non-green bonds' issuance cost by around 16.76 % (calculated as 2.841 x 0.059).

**Table 10: Short-term effect of Capital related Macroprudential policies on green and non-green bonds' cost of issuance**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Capital related | 0.080** | 0.034 | 0.009 | -0.043 | 0.012 | 0.017 | 0.073** | 0.077** | 0.024* | 0.018 | 0.027 | 0.022 |
| MP t1 | (0.037) | (0.046) | (0.031) | (0.039) | (0.064) | (0.078) | (0.032) | (0.031) | (0.013) | (0.014) | (0.029) | (0.030) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.533 | -0.155 | -0.165 | -0.162 | -0.171 | | -0.092** | 0.024 | 0.024 | 0.035 | 0.033 |
| | | (0.407) | (0.111) | (0.109) | (0.139) | (0.149) | | (0.044) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.060** | 0.086*** | 0.084*** | 0.052* | 0.049* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.048*** |
| | | (0.023) | (0.028) | (0.028) | (0.031) | (0.029) | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.113** | 0.029 | 0.024 | 0.034 | 0.039 | | 0.019 | -0.039*** | -0.038*** | -0.039*** | -0.040*** |
| | | (0.047) | (0.033) | (0.035) | (0.051) | (0.053) | | (0.022) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.124 | -0.246 | -0.431 | -0.469 | | | 0.036 | 0.028 | 0.060 | 0.057 |
| | | | (0.330) | (0.314) | (0.401) | (0.440) | | | (0.059) | (0.057) | (0.045) | (0.045) |
| Self-Underwriting | | | 0.391 | 0.443 | 0.623 | 0.661 | | | -0.174*** | -0.180*** | -0.187*** | -0.193*** |
| | | | (0.385) | (0.402) | (0.565) | (0.593) | | | (0.045) | (0.047) | (0.052) | (0.053) |
| Coupon rate (%) | | | 0.750*** | 0.751*** | 0.744*** | 0.738*** | | | 0.754*** | 0.756*** | 0.734*** | 0.733*** |
| | | | (0.026) | (0.033) | (0.054) | (0.059) | | | (0.035) | (0.034) | (0.041) | (0.041) |
| Coupon Type | | | 0.129 | 0.121 | 0.095 | 0.095 | | | 0.357** | 0.370*** | 0.373** | 0.369** |
| | | | (0.116) | (0.116) | (0.114) | (0.115) | | | (0.147) | (0.139) | (0.152) | (0.152) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.343 | -0.106 | -0.140 | | | | -0.141* | -0.080 | -0.050 |
| | | | | (0.354) | (0.131) | (0.192) | | | | (0.083) | (0.102) | (0.104) |
| Return on Assets | | | | 0.373 | -0.216 | -0.167 | | | | -0.024 | 0.054 | 0.013 |
| | | | | (0.449) | (0.745) | (0.762) | | | | (0.076) | (0.122) | (0.129) |
| Tangibility | | | | 0.093 | -1.178 | -1.203 | | | | 0.001 | -0.001 | -0.001 |
| | | | | (0.454) | (0.984) | (1.002) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoan | | | | -0.000 | 0.007 | 0.007 | | | | 0.001 | -0.000 | 0.000 |
| | | | | (0.003) | (0.006) | (0.006) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.149*** | 0.131 | 0.141 | | | | -0.001 | -0.002** | -0.001 |
| | | | | (0.052) | (0.172) | (0.185) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.255*** | -0.117 | -0.126 | | | | 0.007 | 0.026* | 0.019 |
| | | | | (0.057) | (0.235) | (0.259) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.014 | -0.043 | -0.044 | | | | -0.001 | 0.004 | 0.002 |
| | | | | (0.010) | (0.035) | (0.035) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.011 | 0.006 | 0.006 | | | | 0.007* | 0.010*** | 0.012*** |
| | | | | (0.008) | (0.012) | (0.012) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.033 | -0.038 | | | | | -0.003 | -0.002 |
| | | | | | (0.029) | (0.048) | | | | | (0.013) | (0.013) |
| Monetary policy | | | | | -0.049 | -0.049 | | | | | -0.020 | -0.019 |
| | | | | | (0.132) | (0.135) | | | | | (0.015) | (0.015) |
| Inflation rate | | | | | 0.168 | 0.178 | | | | | 0.047 | 0.047 |
| | | | | | (0.162) | (0.168) | | | | | (0.030) | (0.034) |
| Unemployment | | | | | 0.266 | 0.298 | | | | | 0.096 | 0.105* |
| | | | | | (0.169) | (0.235) | | | | | (0.060) | (0.064) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.359** |
| | | | | | | (0.000) | | | | | | (0.139) |
| Capital Stringency | | | | | | -0.022 | | | | | | 0.032 |
| | | | | | | (0.136) | | | | | | (0.032) |
| Constant | 21.611*** | 14.198*** | -0.860 | 26.239*** | 12.943 | 13.356 | 8.936*** | 8.115*** | 0.986* | -0.142 | -3.135* | 3.372 |
| | (3.687) | (3.127) | (5.250) | (8.847) | (30.379) | (31.386) | (2.413) | (2.283) | (0.515) | (1.797) | (1.708) | (3.190) |
| Adj R-sq | 0.0352 | 0.1616 | 0.6813 | 0.6942 | 0.6916 | 0.6898 | 0.0355 | 0.0807 | 0.6614 | 0.6623 | 0.6177 | 0.6185 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential Capital related policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is Capital related MP t1 which is the measure of macroprudential capital policies including counter-cyclical capital buffer, capital conservation requirements, other capital requirements, and the restrictions on bank leverage in year t1 (short term). Measure is calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables. GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1%

**Table 11: Short-term effect of Liquidity related Macroprudential policies on green and non-green bonds' cost of issuance**

| ***Dependent variable*** | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Liquidity related | 0.082* | 0.049 | 0.039 | -0.010 | 0.010 | 0.023 | 0.084** | 0.069* | 0.069*** | 0.058** | 0.084** | 0.074** |
| MP t1 | (0.043) | (0.062) | (0.046) | (0.047) | (0.105) | (0.148) | (0.042) | (0.036) | (0.023) | (0.028) | (0.035) | (0.032) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.535 | -0.156 | -0.164 | -0.163 | -0.171 | | -0.090** | 0.024 | 0.024 | 0.035 | 0.033 |
| | | (0.409) | (0.112) | (0.109) | (0.140) | (0.149) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.060** | 0.085*** | 0.083*** | 0.052* | 0.049* | | 0.046*** | 0.058*** | 0.058*** | 0.049*** | 0.047*** |
| | | (0.023) | (0.027) | (0.027) | (0.031) | (0.029) | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.114** | 0.028 | 0.022 | 0.034 | 0.039 | | 0.018 | -0.039*** | -0.039*** | -0.041*** | -0.04*** |
| | | (0.048) | (0.033) | (0.035) | (0.051) | (0.053) | | (0.023) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.119 | -0.236 | -0.430 | -0.467 | | | 0.029 | 0.024 | 0.061 | 0.058 |
| | | | (0.333) | (0.309) | (0.403) | (0.438) | | | (0.058) | (0.057) | (0.046) | (0.046) |
| Self-Underwriting | | | 0.394 | 0.440 | 0.624 | 0.662 | | | -0.180*** | -0.184*** | -0.197*** | -0.20*** |
| | | | (0.389) | (0.403) | (0.566) | (0.597) | | | (0.045) | (0.046) | (0.054) | (0.055) |
| Coupon rate (%) | | | 0.750*** | 0.752*** | 0.744*** | 0.738*** | | | 0.755*** | 0.756*** | 0.734*** | 0.733*** |
| | | | (0.025) | (0.033) | (0.054) | (0.059) | | | (0.035) | (0.034) | (0.041) | (0.041) |
| Coupon Type | | | 0.138 | 0.120 | 0.095 | 0.095 | | | 0.362** | 0.372*** | 0.372** | 0.367** |
| | | | (0.121) | (0.116) | (0.114) | (0.115) | | | (0.144) | (0.139) | (0.151) | (0.151) |
| Price at issue diff | | | 0.006 | 0.006 | 0.004 | 0.004 | | | -0.034* | -0.034* | -0.031 | -0.031 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.019) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.302 | -0.108 | -0.136 | | | | -0.133 | -0.061 | -0.025 |
| | | | | (0.341) | (0.157) | (0.188) | | | | (0.095) | (0.129) | (0.131) |
| Return on Assets | | | | 0.142 | -0.204 | -0.221 | | | | -0.039 | 0.043 | 0.028 |
| | | | | (0.424) | (0.706) | (0.872) | | | | (0.073) | (0.111) | (0.122) |
| Tangibility | | | | 0.149 | -1.125 | -1.142 | | | | 0.001 | -0.002 | -0.002 |
| | | | | (0.476) | (0.873) | (0.893) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoan | | | | 0.000 | 0.007 | 0.007 | | | | 0.001 | -0.001 | -0.001 |
| | | | | (0.004) | (0.006) | (0.007) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.156*** | 0.124 | 0.129 | | | | -0.001 | -0.002* | -0.001 |
| | | | | (0.053) | (0.156) | (0.156) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.261*** | -0.106 | -0.101 | | | | 0.008 | 0.025* | 0.019 |
| | | | | (0.053) | (0.212) | (0.212) | | | | (0.015) | (0.015) | (0.014) |
| Leverage | | | | -0.007 | -0.042 | -0.045 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.009) | (0.035) | (0.040) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.009 | 0.006 | 0.006 | | | | 0.006* | 0.009** | 0.010** |
| | | | | (0.007) | (0.011) | (0.012) | | | | (0.003) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.029 | -0.030 | | | | | -0.007 | -0.004 |
| | | | | | (0.023) | (0.029) | | | | | (0.009) | (0.009) |
| Monetary policy | | | | | -0.051 | -0.062 | | | | | -0.021** | -0.020** |
| | | | | | (0.133) | (0.167) | | | | | (0.009) | (0.009) |
| Inflation rate | | | | | 0.159 | 0.160 | | | | | 0.032 | 0.028 |
| | | | | | (0.134) | (0.145) | | | | | (0.028) | (0.031) |
| Unemployment | | | | | 0.256 | 0.275 | | | | | 0.073 | 0.083 |
| | | | | | (0.158) | (0.183) | | | | | (0.058) | (0.061) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.29*** |
| | | | | | | (0.000) | | | | | | (0.110) |
| Capital Stringency | | | | | | -0.001 | | | | | | 0.026 |
| | | | | | | (0.149) | | | | | | (0.032) |
| Constant | 21.442*** | 14.011*** | -1.026 | 26.759*** | 11.417 | 9.993 | 9.106*** | 8.342*** | 0.957* | -0.211 | -2.857 | 2.432 |
| | (3.749) | (3.246) | (5.498) | (8.157) | (27.757) | (27.135) | (2.495) | (2.387) | (0.498) | (1.803) | (1.740) | (2.662) |
| Adj R-sq | 0.0333 | 0.1618 | 0.6819 | 0.6939 | 0.6916 | 0.6898 | 0.0323 | 0.0761 | 0.6625 | 0.6630 | 0.6188 | 0.6193 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential Liquidity related policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is Liquidity related MP t1 which is the measure of macroprudential liquidity policies including the requirements on bank liquidity in year t1 (short term). Measure is calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1). Hausman test provided results favorable to the fixed effects estimator. Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 12: Short-term effect of Assets related Macroprudential policies on green and non-green bonds' cost of issuance**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Asset related | 0.124* | 0.098 | 0.041 | 0.057 | 0.075 | 0.110 | 0.087* | 0.078* | 0.026 | 0.019 | 0.031 | 0.025 |
| MP t1 | (0.071) | (0.087) | (0.054) | (0.053) | (0.091) | (0.118) | (0.046) | (0.040) | (0.018) | (0.018) | (0.019) | (0.018) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.536 | -0.157 | -0.168 | -0.162 | -0.171 | | -0.091** | 0.024 | 0.024 | 0.035 | 0.033 |
| | | (0.410) | (0.114) | (0.108) | (0.140) | (0.149) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.059** | 0.085*** | 0.082*** | 0.052* | 0.049* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.048*** |
| | | (0.023) | (0.027) | (0.027) | (0.031) | (0.029) | | (0.010) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.116** | 0.030 | 0.022 | 0.035 | 0.042 | | 0.019 | -0.039*** | -0.038*** | -0.039*** | -0.04*** |
| | | (0.047) | (0.033) | (0.034) | (0.051) | (0.054) | | (0.023) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.115 | -0.228 | -0.422 | -0.461 | | | 0.032 | 0.025 | 0.057 | 0.055 |
| | | | (0.328) | (0.309) | (0.403) | (0.439) | | | (0.059) | (0.057) | (0.046) | (0.046) |
| Self-Underwriting | | | 0.400 | 0.450 | 0.629 | 0.668 | | | -0.179*** | -0.184*** | -0.186*** | -0.19*** |
| | | | (0.394) | (0.403) | (0.561) | (0.589) | | | (0.045) | (0.046) | (0.052) | (0.053) |
| Coupon rate (%) | | | 0.750*** | 0.751*** | 0.744*** | 0.739*** | | | 0.755*** | 0.756*** | 0.735*** | 0.733*** |
| | | | (0.026) | (0.033) | (0.054) | (0.059) | | | (0.036) | (0.035) | (0.041) | (0.041) |
| Coupon Type | | | 0.133 | 0.120 | 0.096 | 0.096 | | | 0.358** | 0.371*** | 0.373** | 0.368** |
| | | | (0.116) | (0.117) | (0.115) | (0.115) | | | (0.147) | (0.138) | (0.152) | (0.152) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.259 | -0.098 | -0.159 | | | | -0.160* | -0.112 | -0.075 |
| | | | | (0.326) | (0.136) | (0.193) | | | | (0.090) | (0.124) | (0.127) |
| Return on Assets | | | | 0.004 | -0.196 | 0.073 | | | | -0.007 | 0.048 | 0.008 |
| | | | | (0.401) | (0.733) | (0.842) | | | | (0.070) | (0.124) | (0.131) |
| Tangibility | | | | 0.196 | -0.936 | -0.794 | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.476) | (0.944) | (0.999) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLn | | | | 0.000 | 0.004 | 0.003 | | | | 0.001 | -0.001 | -0.000 |
| | | | | (0.003) | (0.006) | (0.006) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.170*** | 0.120 | 0.132 | | | | -0.001 | -0.002** | -0.001 |
| | | | | (0.056) | (0.165) | (0.168) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.266*** | -0.084 | -0.098 | | | | 0.008 | 0.026* | 0.019 |
| | | | | (0.053) | (0.226) | (0.224) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.001 | -0.041 | -0.036 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.011) | (0.036) | (0.037) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.006 | 0.006 | 0.006 | | | | 0.008** | 0.011*** | 0.012*** |
| | | | | (0.007) | (0.012) | (0.012) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.044 | -0.063 | | | | | 0.004 | 0.004 |
| | | | | | (0.028) | (0.048) | | | | | (0.009) | (0.009) |
| Monetary policy | | | | | -0.032 | 0.004 | | | | | -0.027*** | -0.024** |
| | | | | | (0.140) | (0.158) | | | | | (0.010) | (0.010) |
| Inflation rate | | | | | 0.153 | 0.149 | | | | | 0.042 | 0.042 |
| | | | | | (0.168) | (0.175) | | | | | (0.029) | (0.034) |
| Unemployment | | | | | 0.221 | 0.260 | | | | | 0.089 | 0.100 |
| | | | | | (0.164) | (0.188) | | | | | (0.062) | (0.065) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.357*** |
| | | | | | | (0.000) | | | | | | (0.133) |
| Capital Stringency | | | | | | -0.080 | | | | | | 0.030 |
| | | | | | | (0.123) | | | | | | (0.031) |
| Constant | 20.700*** | 13.318*** | -1.157 | 26.424*** | 9.192 | 9.668 | 9.056*** | 8.286*** | 1.025** | -0.234 | -3.157* | 3.335 |
| | (3.758) | (3.345) | (5.488) | (8.245) | (29.550) | (28.825) | (2.487) | (2.375) | (0.518) | (1.838) | (1.769) | (3.129) |
| Adj R-sq | 0.0340 | 0.1631 | 0.6817 | 0.6941 | 0.6917 | 0.6899 | 0.0323 | 0.0764 | 0.6610 | 0.6621 | 0.6177 | 0.6185 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential Assets related policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is Assets related MP t1 which is the measure of macroprudential assets policies including limits on credit growth, other loan restrictions, the limits to the loan-to-value ratios, the limits to the debt service-to-income ratios and the loan-to-income ratios, taxes and levies applied to specified assets, the limits to the loan-to-deposit ratios and the dynamic loan loss provisions in year t1 (short term). Measure is calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 13: Short-term effect of FX related Macroprudential policies on green and non-green bonds' cost of issuance**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| FX related MP t1 | -0.388 | 0.008 | 0.155 | -0.111 | -0.547 | -0.579 | 0.369** | 0.342** | 0.161 | 0.154 | 0.087 | 0.085 |
| | (0.334) | (0.313) | (0.175) | (0.211) | (1.089) | (1.174) | (0.162) | (0.159) | (0.118) | (0.118) | (0.088) | (0.086) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.535 | -0.156 | -0.164 | -0.160 | -0.169 | | -0.088* | 0.026 | 0.025 | 0.036 | 0.034 |
| | | (0.410) | (0.112) | (0.108) | (0.136) | (0.146) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.061*** | 0.087*** | 0.083*** | 0.052* | 0.048* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.048*** |
| | | (0.022) | (0.028) | (0.027) | (0.031) | (0.028) | | (0.011) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.117** | 0.031 | 0.021 | 0.030 | 0.035 | | 0.019 | -0.038*** | -0.038*** | -0.039*** | -0.04*** |
| | | (0.048) | (0.033) | (0.036) | (0.057) | (0.060) | | (0.023) | (0.012) | (0.012) | (0.014) | (0.015) |
| Maturity Type | | | -0.126 | -0.240 | -0.443 | -0.480 | | | 0.033 | 0.026 | 0.056 | 0.055 |
| | | | (0.349) | (0.313) | (0.420) | (0.457) | | | (0.058) | (0.056) | (0.046) | (0.046) |
| Self-Underwriting | | | 0.389 | 0.443 | 0.632 | 0.671 | | | -0.182*** | -0.186*** | -0.187*** | -0.19*** |
| | | | (0.382) | (0.406) | (0.582) | (0.613) | | | (0.045) | (0.046) | (0.052) | (0.053) |
| Coupon rate (%) | | | 0.750*** | 0.752*** | 0.743*** | 0.738*** | | | 0.756*** | 0.756*** | 0.735*** | 0.734*** |
| | | | (0.026) | (0.033) | (0.055) | (0.060) | | | (0.036) | (0.035) | (0.041) | (0.042) |
| Coupon Type | | | 0.125 | 0.121 | 0.095 | 0.095 | | | 0.358** | 0.371*** | 0.374** | 0.369** |
| | | | (0.112) | (0.117) | (0.114) | (0.115) | | | (0.147) | (0.138) | (0.151) | (0.151) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.013) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.289 | -0.085 | -0.101 | | | | -0.160* | -0.117 | -0.076 |
| | | | | (0.323) | (0.145) | (0.208) | | | | (0.091) | (0.126) | (0.129) |
| Return on Assets | | | | 0.141 | -0.281 | -0.358 | | | | 0.003 | 0.059 | 0.020 |
| | | | | (0.397) | (0.830) | (1.056) | | | | (0.069) | (0.124) | (0.131) |
| Tangibility | | | | 0.145 | -1.173 | -1.217 | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.496) | (0.981) | (1.049) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLn | | | | 0.001 | 0.007 | 0.008 | | | | 0.001 | -0.000 | -0.000 |
| | | | | (0.004) | (0.006) | (0.007) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.156*** | 0.118 | 0.123 | | | | -0.001 | -0.002** | -0.001 |
| | | | | (0.051) | (0.147) | (0.149) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.266*** | -0.131 | -0.125 | | | | 0.010 | 0.028* | 0.020 |
| | | | | (0.058) | (0.261) | (0.250) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.007 | -0.040 | -0.044 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.007) | (0.031) | (0.035) | | | | (0.004) | (0.004) | (0.004) |
| ESG disclosure | | | | 0.008 | 0.007 | 0.008 | | | | 0.008* | 0.011*** | 0.012*** |
| | | | | (0.007) | (0.014) | (0.015) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.016 | -0.013 | | | | | 0.008 | 0.007 |
| | | | | | (0.035) | (0.051) | | | | | (0.008) | (0.008) |
| Monetary policy | | | | | -0.063 | -0.081 | | | | | -0.026** | -0.024** |
| | | | | | (0.150) | (0.182) | | | | | (0.010) | (0.011) |
| Inflation rate | | | | | 0.127 | 0.137 | | | | | 0.040 | 0.042 |
| | | | | | (0.110) | (0.115) | | | | | (0.028) | (0.034) |
| Unemployment | | | | | 0.238* | 0.250 | | | | | 0.087 | 0.099 |
| | | | | | (0.137) | (0.173) | | | | | (0.062) | (0.065) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.376*** |
| | | | | | | (0.000) | | | | | | (0.141) |
| Capital Stringency | | | | | | 0.012 | | | | | | 0.032 |
| | | | | | | (0.133) | | | | | | (0.032) |
| Constant | 21.473*** | 14.167*** | -0.719 | 26.930*** | 13.832 | 12.970 | 9.254*** | 8.441*** | 1.071** | -0.450 | -3.320* | 3.546 |
| | (3.726) | (3.098) | (5.411) | (8.896) | (32.087) | (30.446) | (2.528) | (2.404) | (0.531) | (1.854) | (1.763) | (3.291) |
| Adj R-sq | 0.0310 | 0.1608 | 0.6814 | 0.6939 | 0.6918 | 0.6900 | 0.0306 | 0.0751 | 0.6609 | 0.6621 | 0.6175 | 0.6184 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574s |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential FX related policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is FX related MP t1 which is the measure of macroprudential foreign exchange policies including limits on foreign currency lending and the limits on foreign exchange positions in year t1 (short term). Measure is calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 14: Short-term effect of Reserves related Macroprudential policies on green and non-green bonds' cost of issuance**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Green Bonds** | | | | | | **Non-Green Bonds** | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Reserves related | -1.128*** | -0.707*** | -0.076 | -0.265 | -0.273 | -0.289 | 0.027 | 0.007 | 0.002 | 0.003 | 0.177 | 0.121 |
| MP t1 | (0.017) | (0.191) | (0.299) | (0.331) | (0.544) | (0.587) | (0.063) | (0.061) | (0.037) | (0.036) | (0.116) | (0.122) |
| ***Bonds characteristics*** | | | | | | | | | | | | |
| Amount Issued | | -0.534 | -0.156 | -0.164 | -0.160 | -0.169 | | -0.089* | 0.025 | 0.025 | 0.037 | 0.034 |
| | | (0.409) | (0.112) | (0.107) | (0.136) | (0.146) | | (0.045) | (0.020) | (0.020) | (0.025) | (0.025) |
| Maturity years | | 0.060*** | 0.086*** | 0.083*** | 0.052* | 0.048* | | 0.047*** | 0.058*** | 0.058*** | 0.050*** | 0.048*** |
| | | (0.022) | (0.028) | (0.027) | (0.031) | (0.028) | | (0.011) | (0.006) | (0.006) | (0.006) | (0.006) |
| Bloomberg Rating | | 0.112** | 0.030 | 0.020 | 0.030 | 0.035 | | 0.019 | -0.04*** | -0.04*** | -0.04*** | -0.04*** |
| | | (0.047) | (0.033) | (0.037) | (0.057) | (0.060) | | (0.023) | (0.012) | (0.012) | (0.015) | (0.015) |
| Maturity Type | | | -0.134 | -0.246 | -0.443 | -0.480 | | | 0.032 | 0.025 | 0.057 | 0.055 |
| | | | (0.355) | (0.320) | (0.420) | (0.457) | | | (0.059) | (0.057) | (0.046) | (0.046) |
| Self-Underwriting | | | 0.391 | 0.446 | 0.632 | 0.671 | | | -0.18*** | -0.18*** | -0.18*** | -0.19*** |
| | | | (0.387) | (0.411) | (0.582) | (0.613) | | | (0.045) | (0.046) | (0.052) | (0.053) |
| Coupon rate (%) | | | 0.750*** | 0.751*** | 0.743*** | 0.738*** | | | 0.756*** | 0.756*** | 0.736*** | 0.734*** |
| | | | (0.026) | (0.033) | (0.055) | (0.060) | | | (0.036) | (0.035) | (0.041) | (0.042) |
| Coupon Type | | | 0.126 | 0.122 | 0.095 | 0.095 | | | 0.358** | 0.371*** | 0.374** | 0.369** |
| | | | (0.113) | (0.118) | (0.114) | (0.115) | | | (0.147) | (0.138) | (0.151) | (0.152) |
| Price at issue diff | | | 0.007 | 0.006 | 0.004 | 0.004 | | | -0.035* | -0.035* | -0.032 | -0.032 |
| | | | (0.014) | (0.013) | (0.009) | (0.009) | | | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets | | | | -0.292 | -0.085 | -0.101 | | | | -0.169* | -0.128 | -0.087 |
| | | | | (0.321) | (0.145) | (0.208) | | | | (0.092) | (0.125) | (0.127) |
| Return on Assets | | | | 0.124 | -0.281 | -0.358 | | | | 0.004 | 0.031 | 0.015 |
| | | | | (0.400) | (0.830) | (1.056) | | | | (0.071) | (0.124) | (0.130) |
| Tangibility | | | | 0.134 | -1.173 | -1.217 | | | | 0.000 | -0.001 | -0.001 |
| | | | | (0.501) | (0.981) | (1.049) | | | | (0.002) | (0.001) | (0.001) |
| NonPerformingLoan | | | | 0.001 | 0.007 | 0.008 | | | | 0.001 | -0.000 | -0.000 |
| | | | | (0.003) | (0.006) | (0.007) | | | | (0.002) | (0.003) | (0.003) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Capital ratio | | | | 0.156*** | 0.118 | 0.123 | | | | -0.001 | -0.002** | -0.001 |
| | | | | (0.051) | (0.147) | (0.149) | | | | (0.001) | (0.001) | (0.001) |
| TobinsQ | | | | -0.265*** | -0.131 | -0.125 | | | | 0.009 | 0.028* | 0.020 |
| | | | | (0.055) | (0.261) | (0.250) | | | | (0.015) | (0.015) | (0.015) |
| Leverage | | | | -0.007 | -0.040 | -0.044 | | | | -0.001 | 0.004 | 0.003 |
| | | | | (0.007) | (0.031) | (0.035) | | | | (0.004) | (0.005) | (0.004) |
| ESG disclosure | | | | 0.008 | 0.007 | 0.008 | | | | 0.008* | 0.010*** | 0.012*** |
| | | | | (0.007) | (0.014) | (0.015) | | | | (0.004) | (0.004) | (0.004) |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate | | | | | -0.016 | -0.013 | | | | | 0.008 | 0.007 |
| | | | | | (0.035) | (0.051) | | | | | (0.008) | (0.008) |
| Monetary policy | | | | | -0.063 | -0.081 | | | | | -0.026** | -0.024** |
| | | | | | (0.150) | (0.182) | | | | | (0.010) | (0.010) |
| Inflation rate | | | | | 0.127 | 0.137 | | | | | 0.044 | 0.045 |
| | | | | | (0.110) | (0.115) | | | | | (0.028) | (0.033) |
| Unemployment | | | | | 0.238* | 0.250 | | | | | 0.088 | 0.098 |
| | | | | | (0.137) | (0.173) | | | | | (0.062) | (0.065) |
| SupervisoryPower | | | | | | 0.000 | | | | | | -0.380*** |
| | | | | | | (0.000) | | | | | | (0.143) |
| Capital Stringency | | | | | | 0.012 | | | | | | 0.031 |
| | | | | | | (0.133) | | | | | | (0.032) |
| Constant | 21.769*** | 14.232*** | -0.921 | 27.011*** | 13.819 | 12.956 | 9.284*** | 8.466*** | 1.078** | -0.335 | -3.264* | 3.682 |
| | (3.633) | (3.086) | (5.324) | (8.797) | (32.062) | (30.420) | (2.541) | (2.415) | (0.534) | (1.880) | (1.794) | (3.326) |
| Adj R-sq | 0.0342 | 0.1623 | 0.6813 | 0.6941 | 0.6918 | 0.6900 | 0.0297 | 0.0743 | 0.6607 | 0.6619 | 0.6178 | 0.6185 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 | 4,574 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of Macroprudential Reserve related policies on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variable of interest is Reserve related MP t1 which is the measure of macroprudential reserve requirements policies including all reserve requirements in year t1 (short term). Measure is calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 15: Long-term effect of Macroprudential policies five categories on green and non-green bonds' cost of issuance**

| *Dependent variable* | **Yield at Issue** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Green Bonds | | | | | Non-Green Bonds | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Capital related MP t3 | -0.029 | | | | | -0.002 | | | | |
| | (0.029) | | | | | (0.005) | | | | |
| Liquidity related MP t3 | | -0.057 | | | | | 0.024** | | | |
| | | (0.063) | | | | | (0.012) | | | |
| Asset related MP t3 | | | -0.107 | | | | | 0.003 | | |
| | | | (0.095) | | | | | (0.008) | | |
| FX related MP t3 | | | | -0.298 | | | | | 0.017 | |
| | | | | (0.439) | | | | | (0.034) | |
| Reserves related MP t3 | | | | | -0.106 | | | | | 0.059** |
| | | | | | (0.189) | | | | | (0.029) |
| Constant | 8.021 | 14.027 | 14.139 | 12.930 | 12.481 | 3.613 | 3.235 | 3.551 | 3.626 | 4.504 |
| | (26.043) | (30.662) | (31.037) | (29.907) | (29.481) | (3.297) | (3.054) | (3.236) | (3.287) | (3.195) |
| Adj R-sq | 0.6918 | 0.6924 | 0.6953 | 0.6901 | 0.6900 | 0.6184 | 0.6189 | 0.6184 | 0.6184 | 0.6185 |
| Observations | 365 | 365 | 365 | 365 | 365 | 3,385 | 3,385 | 3,385 | 3,385 | 3,385 |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for long-term effect of Macroprudential policies five categories separately on green and non-green bonds' cost of issuance. The dependent variable is yield at issue which is the proxy for cost of issuance. The variables of interest are Capital related MP t3, Liquidity related MP t3, Asset related MP t3, FX related MP t3 and Reserves related MP t3 calculated using Alam et al (2019) macroprudential policies indices. The latter were aggregated over 3 year rolling window as suggested by Chen et al (2022). Bond variables include: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables include: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables include: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1). Hausman test provided results favorable to the fixed effects estimator. Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### *1.4.2.2 Emerging Vs Advanced*

To check macroprudential policies effects on green and non-green bonds' cost of issuance from different jurisdictions, the sample is further split into advanced and emerging economies following Claessens et al. (2013) and Altunbas et al. (2017) . Advanced economies constitute of 31 countries and Emerging economies, however, account for 20 countries. Figure 3 demonstrates the use by each type of economy over the sample period. In terms of bond issuances, 424 green bonds and 4,101 non-green bonds are bank issuances during the sample period in advanced economies. However, only 17 green bonds and 473 non-green bonds bank issuances during the sample period are linked to emerging economies.

**Figure 3: Macroprudential Policies usage by Advanced and Emerging Economies**


Therefore, advanced economies appear to have issued more bonds compared to emerging economies while emerging economies employed slightly more macroprudential policies than their advanced counterparts as seen in Figure 3. It is argued that the nature of emerging markets being exposed more to external

shocks with imperfect financial markets are what necessitate greater use of macroprudential policies (Claessens et al., 2013). On the other hand, advanced markets have taken the lead in regulating and encouraging the issuance of green bonds such as the introduction of the European Green Bond Standard[7].

Therefore, an empirical challenge might arise which is that the yield at issue of a bond is endogenous with respect to macroprudential policies of different economies. In other words, unobservables might drive a forged relationship between the cost of issuing bonds and macroprudential policies or emerging and advanced economies. To address this, we follow several steps by first splitting the set into emerging economies with 490 observations and advanced economies with 4,525 observations. Considering the latter subset is larger than the former and to balance the scales we follow Zerbib (2019) and Painter (2020) using propensity score matching. Countries in the advanced and emerging economies where matched to the nearest two neighbours using size of issuances, total number of issuances and bonds' credit rating. Table 16, shows summary statistics of the matched set containing 1,197 observations where emerging economies have a share of 342 observations, whereas advanced economies have 855.

Table 17 shows the results of rerunning equation (1) with fixed effects on the matched subsets of advanced and emerging economies. The tables demonstrate that non-green bonds' yield at issue is affected by the use of macroprudential polices reaffirming our main initial results. For advanced economies, the overall MP t1 index shows no significant result. However, digging deeper into tight versus loose policies shows that tighter macroprudential policies have a positive and statistically significant relationship with green and non-green bonds' cost of issuance. In other words, a one standard deviation increase in macroprudential policies, leads to around 8.8 % (calculated as 1.909 x 0.046) increase in non-green bonds' yield at issue which is consistent with our initial results.

[7] "European Green Bonds" was announced as a voluntary standard back in 2020. Issuers wishing to label their green bond issuances as "European Green Bonds" are required to adhere to a set of criteria such as the use of 85% of their bond proceeds in activities in line with the EU taxonomy (European Commission, 2024).

**Table 16: Summary statistics for matched Emerging Economies and Advanced Economies sets**

| | Emerging Economies | | | | | | Advanced Economies | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Mean | SD | Min | Median | Max | Obs | Mean | SD | Min | Median | Max | Obs |
| ***Bond Characteristics*** | | | | | | | | | | | | |
| Yield at issue (%) | 4.37 | 2.77 | 0.98 | 3.80 | 8.80 | 342 | 2.26 | 1.91 | 0.28 | 1.85 | 4.67 | 855 |
| Amount Issued (m $) | 204.61 | 321.22 | 16.00 | 91.26 | 500.00 | 342 | 286.83 | 433.17 | 10.00 | 90.60 | 1000.00 | 855 |
| Maturity years | 8.82 | 6.55 | 4.00 | 7.00 | 11.00 | 342 | 11.05 | 7.63 | 5.00 | 10.00 | 20.00 | 855 |
| Bloomberg Rating | 1.44 | 2.98 | 0.00 | 0.00 | 6.00 | 342 | 2.07 | 3.12 | 0.00 | 0.00 | 7.00 | 855 |
| Maturity Type | 0.26 | 0.64 | 0.00 | 0.00 | 1.00 | 342 | 0.38 | 0.67 | 0.00 | 0.00 | 1.00 | 855 |
| Self-Underwriting | 0.33 | 0.47 | 0.00 | 0.00 | 1.00 | 342 | 0.57 | 0.50 | 0.00 | 1.00 | 1.00 | 855 |
| Coupon rate (%) | 4.25 | 3.23 | 0.58 | 3.64 | 8.80 | 342 | 1.90 | 1.88 | 0.00 | 1.31 | 4.38 | 855 |
| Coupon Type | 0.17 | 0.59 | 0.00 | 0.00 | 0.00 | 342 | 0.46 | 0.91 | 0.00 | 0.00 | 2.00 | 855 |
| Price at issue difference | -0.08 | 0.30 | -0.17 | 0.00 | 0.00 | 342 | -0.12 | 1.59 | -0.31 | 0.00 | 0.00 | 855 |
| ***Macroprudential Policies*** | | | | | | | | | | | | |
| MP t1 (short term) | 0.17 | 3.78 | -7.00 | 2.00 | 3.00 | 342 | 0.88 | 2.78 | -4.00 | 1.00 | 4.00 | 855 |
| MP t1_tightening | 2.12 | 1.73 | 0.00 | 2.00 | 4.00 | 342 | 2.31 | 1.61 | 0.00 | 2.00 | 5.00 | 855 |
| MP t1_loosening | -1.94 | 2.85 | -7.00 | 0.00 | 0.00 | 342 | -1.43 | 2.48 | -6.00 | 0.00 | 0.00 | 855 |
| Capital related MP t1 | 0.24 | 1.08 | -1.00 | 0.00 | 1.00 | 342 | 0.14 | 1.50 | -2.00 | 0.00 | 2.00 | 855 |
| LiquidityrelatedMPt1 | 0.21 | 1.14 | -2.00 | 0.00 | 1.00 | 342 | 0.23 | 0.88 | -1.00 | 0.00 | 1.00 | 855 |
| Asset related MP t1 | -0.17 | 1.34 | -1.00 | 0.00 | 0.00 | 342 | -0.01 | 0.98 | -1.00 | 0.00 | 1.00 | 855 |
| FX related MP t1 | 0.14 | 0.42 | 0.00 | 0.00 | 1.00 | 342 | -0.01 | 0.11 | 0.00 | 0.00 | 0.00 | 855 |
| ReservesrelatedMPt1 | -0.29 | 0.91 | -1.00 | 0.00 | 0.00 | 342 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 855 |
| MP t3 (3-year window) | 0.50 | 7.27 | -11.00 | 3.00 | 8.00 | 342 | 2.03 | 5.17 | -4.00 | 3.00 | 8.00 | 855 |
| MP t3_tightening | -6.04 | 5.24 | -14.00 | -6.00 | 0.00 | 342 | -4.74 | 4.94 | -12.00 | -3.00 | 0.00 | 855 |
| MP t3_loosening | 6.49 | 4.09 | 2.00 | 6.00 | 12.00 | 342 | 6.86 | 3.16 | 3.00 | 7.00 | 11.00 | 855 |
| Capital related MP t3 | 0.81 | 2.10 | -2.00 | 1.00 | 3.00 | 342 | 0.15 | 2.79 | -4.00 | 0.00 | 3.00 | 855 |
| LiquidityrelatedMPt3 | 0.65 | 2.22 | -3.00 | 1.00 | 3.00 | 342 | 0.48 | 1.81 | -2.00 | 1.00 | 3.00 | 855 |
| Asset related MP t3 | -0.60 | 2.88 | -5.00 | 0.00 | 2.00 | 342 | -0.08 | 1.98 | -2.00 | 0.00 | 2.00 | 855 |
| FX related MP t3 | 0.39 | 0.97 | 0.00 | 0.00 | 2.00 | 342 | -0.05 | 0.25 | 0.00 | 0.00 | 0.00 | 855 |
| ReservesrelatedMPt3 | -0.96 | 1.90 | -3.00 | 0.00 | 0.00 | 342 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 855 |
| ***Bank characteristics*** | | | | | | | | | | | | |
| Total Assets (m $) | 452.00 | 11.62 | 140.00 | 112.00 | 400.00 | 342 | 527.00 | 67.70 | 160.00 | 334.00 | 1119.00 | 855 |
| Return on Assets (%) | 1.04 | 0.91 | 0.43 | 1.07 | 1.87 | 342 | 0.47 | 0.52 | 0.02 | 0.42 | 1.04 | 855 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tangibility ratio (%) | 0.96 | 1.32 | 0.37 | 0.63 | 1.73 | 342 | 1.33 | 8.29 | 0.13 | 0.48 | 1.31 | 855 |
| NonPerformingLoan% | 3.42 | 9.42 | 0.66 | 1.78 | 4.48 | 342 | 8.92 | 36.16 | 0.18 | 0.76 | 14.67 | 855 |
| Capital ratio (%) | 26.81 | 68.49 | 9.87 | 14.95 | 19.28 | 342 | 18.71 | 44.25 | 11.26 | 15.01 | 19.22 | 855 |
| TobinsQ (%) | 1.02 | 0.78 | 0.96 | 1.01 | 1.10 | 342 | 1.01 | 0.34 | 0.97 | 1.01 | 1.04 | 855 |
| Leverage (%) | 17.86 | 9.19 | 9.46 | 16.02 | 27.92 | 342 | 29.49 | 18.84 | 10.25 | 24.13 | 56.85 | 855 |
| ESG disclosure Index | 42.88 | 10.25 | 28.37 | 42.61 | 54.55 | 342 | 44.37 | 12.70 | 30.78 | 42.61 | 61.81 | 855 |
| ***Country characteristics*** | | | | | | | | | | | | |
| GDP growth rate % | 3.29 | 5.15 | -5.53 | 3.95 | 8.26 | 342 | 1.39 | 3.18 | -3.70 | 2.17 | 4.56 | 855 |
| Monetary policy | -0.02 | 0.22 | -0.14 | 0.00 | 0.25 | 342 | 0.17 | 1.80 | -0.34 | 0.04 | 0.86 | 855 |
| Inflation rate % | 2.51 | 3.37 | -1.93 | 2.44 | 6.67 | 342 | 1.43 | 1.03 | 0.38 | 1.28 | 2.77 | 855 |
| Unemployment (%) | 4.80 | 2.73 | 2.33 | 4.25 | 9.28 | 342 | 5.32 | 2.00 | 3.38 | 4.98 | 8.05 | 855 |
| SupervisoryPower indx | 12.38 | 1.75 | 9.00 | 13.00 | 14.00 | 342 | 11.49 | 1.70 | 10.00 | 12.00 | 13.00 | 855 |
| Capital Stringency Indx | 5.31 | 1.60 | 3.00 | 6.00 | 7.00 | 342 | 5.25 | 1.33 | 3.00 | 5.00 | 7.00 | 855 |
| FEX Depreciation % | 6.44 | 10.74 | -4.30 | 1.81 | 23.91 | 342 | 1.03 | 6.52 | -4.36 | 0.30 | 6.56 | 855 |
| Short term interest % | -0.84 | 4.30 | -3.00 | -0.36 | 1.63 | 342 | -0.14 | 0.31 | -0.51 | -0.07 | 0.04 | 855 |
| Credit growth % | 0.04 | 0.07 | -0.04 | 0.02 | 0.16 | 342 | 0.03 | 0.05 | -0.03 | 0.02 | 0.11 | 855 |

**Table 17: short term Effects of Macroprudential policies on green and non-green bonds' yield at issue for advanced and emerging economies**

| | Advanced Economies | | | | | | Emerging Economies | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Green bonds | | | Non-green Bonds | | | Green bonds | | | Non-green Bonds | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| MP t1 | -0.086 | | | 0.002 | | | -0.350 | | | 0.012 | | |
| | (0.063) | | | (0.017) | | | (0.418) | | | (0.023) | | |
| MP t1tightening | | -0.151 | | | 0.046* | | | 0.050 | | | 0.149*** | |
| | | (0.103) | | | (0.027) | | | (0.157) | | | (0.042) | |
| MP t1loosening | | | -0.081 | | | -0.033 | | | -0.028 | | | -0.050* |
| | | | (0.104) | | | (0.024) | | | (0.088) | | | (0.029) |
| Constant | 9.883** | 9.635** | 9.589* | -0.277 | -0.482 | -0.664 | 4.988 | 2.380 | 1.907 | -2.532*** | -2.551*** | -2.686*** |
| | (4.695) | (4.655) | (4.803) | (1.373) | (1.368) | (1.393) | (3.635) | (3.976) | (2.749) | (0.886) | (0.866) | (0.883) |
| Adj R-sq | 0.9747 | 0.9749 | 0.9735 | 0.7648 | 0.7661 | 0.7656 | 0.9929 | 0.9929 | 0.9929 | 0.8961 | 0.9002 | 0.8970 |
| Observations | 316 | 316 | 316 | 539 | 539 | 539 | 14 | 14 | 14 | 328 | 328 | 328 |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank-year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for short-term effect of overall Macroprudential policies as well as tightening and loosening policies separately on green and non-green bonds' cost of issuance in advanced and emerging economies. The dependent variable is yield at issue which is the proxy for cost of issuance. The variables of interest are MP t1, MP t1_tightening and MP t1_loosening calculated using Alam et al (2019) macroprudential policies indices as suggested by Chen et al (2022). Bond variables: Amount Issued, Maturity years, Bloomberg Rating, Maturity Type, Self-Underwriting, Coupon rate, Coupon Type, Price at issue minus Par. Bank variables: Total Assets, Return on Assets, Tangibility, Non Performing Loan, Capital ratio, TobinsQ, Leverage, ESG disclosure Index. Country variables: GDP growth rate, Monetary policy, Inflation rate, Unemployment, Supervisory Power, Capital Stringency. This table reports estimates of the fixed effects specification in equation (1). Hausman test provided results favourable to the fixed effects estimator. Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

## 1.5 Conclusion

This paper sheds light on the impact of macroprudential policies on the cost of green bonds issued by banks using a global sample. We examine whether the effects are contemporaneous or lagged, which macroprudential policies are the most influential and which economy is most affected. Through a comparative study between green and non-green bonds, the paper's results show that macroprudential policies have different long and short-term effects on bonds' cost of issuance proxied by yield at issue. Short-term, non-green bonds' yield at issue increased following tighter macroprudential policies while green bonds' yield at issue remained unaffected. Long term effect of the policies was not significant for either bond type. Loosening macroprudential policies also appear to have had no long or short-term effects on bonds' yield at issue according to our results. The same results were noted when the sample was split into advanced and emerging economies.

Digging deeper into the category of macroprudential policies that influenced non-green bonds' yield at issue, our results show a positive relationship between liquidity related policies and bond's yield at issue. Whilst higher yield might be welcomed by investors due to its bigger yield and lower price, it is costlier for issuers as they promise higher returns for lower borrowing. Despite the effect being significant on non-green bonds' yield at issue only, liquidity policies appear to create a larger greenium which renders green bonds less appealing and competitive to their non-green counterparts. Consequently, issuers would become restricted to climate change conscious investors and this in turn limits their sources of funding. This would further enhance the inherent bias towards non-green investments which forms barriers for green projects and sustainable economies' transition strategies.

The paradoxical nature of macroprudential policies and their effects on bonds' issuance cost is concerning. Green bonds are seen as a potential driver of large-scale investments in climate change projects. At the same time, profit maximising is still at the forefront of investor's priorities despite the surge in impact investing and sustainable financing over the recent years. Reaching for yield, as investors' propensity to buy riskier assets to achieve higher yield is also

a well-known fact documented in literature. Yet, regulations such as macroprudential policies appear to prevent the flow of credit to useful economic activities. This would present a challenge to the transition to low carbon economies to achieve the climate change targets set by the 2015 Paris agreement. It is evident that current macroprudential policies do not go far to protect green investments' growth and competitiveness.

Therefore, this study lends support to calls for greening the existing macroprudential policies suggesting special incentives to be offered especially for green bonds issuances. This would encourage issuers to offer more green bonds and investors to gain more competitive returns.

# Chapter 2

# Does Economic Policy Uncertainty Hamper the Sustainability of Banking Activities? International Evidence

## 2.1 Introduction

Covid-19 Pandemic shed-light once again on sustainability as the way forward for future economic development. This came as the third of the global population was in lockdown as of May 2020 (Kaplan et al., 2020) with growing calls for governments' stimulus money then to be invested in sustainable industries such as renewable energy (Bruce-Lockhart, 2020). Facts such as China's CO2 emissions reducing by 25% (Ekberg, 2020) or Italy's improved air quality as a result of fallen levels of Nitrogen dioxide (Green, 2020) during lockdown revived hopes that the Sustainable Development Goals (SDG) target of 2030 could still be achieved. The 17 SDG goals including no poverty, climate action and gender equality were launched in 2015 and adopted by all United Nations member states (UN, 2023).

Although the recent coronavirus outbreak accelerated talks on sustainability, institutions and governments around the world have been, for decades, looking for ways to make the planet a better place. For instance, the Principles for Responsible Banking (PRB) is an international initiative in the financial sector. It was launched in September 2019 during the annual United Nation's general assembly in New York. With 130 banks on board from 49 countries, PRB is supported by over a third of the global banking industry with more than $47 trillion in assets (Dettling, 2019). It aims at making the banking sector more sustainable by supporting its signatory banks align their strategies with their societies' objectives.

As the backbone of economies, banks are better positioned to help achieve the Sustainable Development Goals as well as Paris Climate Agreement. A sustainable economy requires lending to target environmental and social activities (Dettling, 2019). Therefore, banks - digital or traditional - are in a unique position to provide and influence their credit provisions (EBRD, 2020). This unique position was recognized by the ex-UN Secretary General, Kofi Anan when he wrote to financial institutions back in 2004. He requested them to join the initiative which resulted in the release of the "Who Cares Wins" report by the Global Impact Initiative. The report contains a set of recommendations to

financial institutions inviting them to integrate Environmental Social and Governance (ESG) criteria into their research and practices (IFC, 2004).

ESG is synonymous with sustainable investing, socially responsible investing and impact investing. Companies use ESG criteria to set standards for their operations which are likely to attract socially mindful investors. Environmental criteria reflect how firms care about the environment by, for instance, presenting their climate change action record. Social criteria show how firms treat their staff, clients, suppliers and the wider community with, for example, a firm's community spending as an area to report on. Governance criteria demonstrate firms' shareholders' rights, executive pay, audit and their leadership as a whole by demonstrating how many women they have in their board of directors for example. Therefore, with Corporate Social Responsibility (CSR) as the image of businesses' endeavours to positively impact on its employees, clients and community, ESG comes as the measure by which firms' activities are assessed and signalled to the market (O'Neill, 2024).

With calls to incorporate climate change and sustainability into banks' risk framework, reports such us the University of Cambridge Institute for Sustainability Leadership (CISL, 2020), suggest that it could take until 2050 before this could be achieved. Many still view climate change as a short-term risk and sustainability reputational issue (CISL, 2020). Indeed, the global financial crisis exposed risk management practices and measurements' deficiencies (Dent et al., 2016) enhanced by fiscal and monetary policy uncertainty which all contributed to the sharp economic decline in the 2008 financial crisis (H. Cheng et al., 2021). Some studies attempted to investigate how economic uncertainty influences financial firms' behaviour through reduced bank lending (Bordo et al., 2016) and banking services supply (Berger et al., 2022). Other studies showed how corporates' policies, activities and decision making are more conservative during high uncertainty (Al-Thaqeb & Algharabali, 2019). However, no study has investigated the impact of economic uncertainty on banks' sustainability activities, a gap this study aims to fill in.

We examine whether there is a relationship between the overall as well as categorical Environmental, Social and Governance banks' activities and

economic uncertainty. To test this empirically, we use a sample of 530 global banks from 27 countries between the years of 2015 and 2021. Economic uncertainty is measured by the Economic Policy Uncertainty (EPU) index developed by Baker, Bloom and Davis (2016), while banks' sustainability is proxied by Environmental, Social and Governance (ESG) disclosure Bloomberg scores. We also explore whether banks' characteristics such as their size or Principles for Responsible Investment (PRI) signatory status changes the effect or economic uncertainty on their ESG activities. We further investigate from a macroeconomic perspective if countries' economy type, in the form of developed or developing, along with their Sustainable Development Goals (SDG) rating influence banks' ESG activities during economic uncertainty.

In line with previous research, we find that banks are more conservative during economic uncertainty. Economically, a one percent increase in uncertainty reduces banks' sustainability in the form of Governance scores by 3%. What is new and interesting is that not all banks' ESG activities are equally affected indicating that banks do not fully suspend investment decisions during high uncertainty but rather prioritise activities in line with the resource allocation theory. We also note that the effect of economic uncertainty is greater on big and PRI signatory banks compared to their small and non-PRI signatory counterparts.

We then conduct robustness checks to validate our findings. First, we replace the ESG disclosure scores with an ESG performance measure to address the potential endogeneity concern that our results might vary if a different ESG measure is used. Although both measures are provided by Bloomberg, the ESG performance scores represent an evaluation of companies' ESG activities based on issues that are deemed financially relevant to their industry (Bloomberg, 2022). In another robustness check, we replace the EPU index by (Baker et al., 2016) with the World Uncertainty Index (WUI) developed by Ahir et al. (2022). The findings of both checks are statistically and economically similar to our initial results.

We further verify our findings by examining how macroeconomic differences such as economy type and SDG rating affect banks' ESG activities during

economic uncertainty. First, we split the sample into developing and developed countries and the rational is that corporates operating in the former have stronger governance profiles. Therefore, the effect of economic uncertainty would be greater for banks operating in developing countries which is in line with our findings. Second, countries' SDG activities have varied over the past years indicating country commitments to sustainability development. To gauge the effect of different levels of countries' SDG ratings on banks' ESG activities, we split the sample into high and low SDG ratings. The reasoning behind this is that firms are influenced by the system they operate in, so banks operating in countries with high SDG ratings could be shielded from economic uncertainty. Indeed, our results show no significant effect of economic uncertainty on banks' ESG activities in countries with high SDG rating.

Our paper contributes to two strands of literature. The first is research on how banks' Environmental, Social and Governance activities are affected by economic disturbances. Previous research has focused on the impact of ESG disclosure on firm's performance and investment efficiency (Liu & Tian, 2021; Ghoul et al., 2020; Xie et al., 2019; Chen et al., 2018; Cornett et al., 2016; McGuire et al., 1988) or on shareholders' interest and ownership (Dyck et al., 2019; Bhagat & Bolton, 2013; Barnea & Rubin, 2010) as well as various other internal factors. However, there is a clear lack of research quantifying the effects of external events on financial institutions' sustainability activities. Our paper fills this gap by focussing on the banking sector demonstrating how banks' ESG activities change during economic insecurity in line with resource allocation and banking behaviour theories.

Second, we contribute to the literature on the wider impact of economic uncertainty on banks' operations beyond loan and credit supplies (Chi & Li, 2017; Bordo et al., 2016) or banks performance (Berger et al., 2022; Killins et al., 2020; Tran, 2020). The study highlights a new line of negative effects of economic uncertainty stressing that no bank activity is shielded from economic insecurity as our findings show.

Although policy makers already recognise the detrimental effects of economic uncertainty as they continuously update their legislative processes to reduce its

intensity, this paper presents a new challenge that would be of relevance to them. We show in this study that banks' ESG activities are affected differently by economic uncertainty with governance scores being the most negatively impacted. Since banks' governance was partially blamed for the 2008 financial crisis, policy makers need to review the post crisis reforms and introduce protective measures to mitigate the effects of economic uncertainty on banks' governance.

The Chapter proceeds as follows: section 2 presents a review of literature and developed hypothesis. Section 3 describes the sample and methodology. Section 4 shows the empirical results. Section 5 concludes.

## 2.2 Literature Review

With banks' Environment, Social and Governance (ESG) data emerging from 2005, ample studies have taken place to analyse various aspects of this information. Data providers, such as Thomson Reuters and Bloomberg have developed different indices for researchers, investors and the wider community to enable sense making of this published data. Researchers have been looking at different aspects of ESG although CSR appears in several studies as the theme under investigation.

From shareholders' perspective, Dyck et al (2019), for example, looked at shareholders' influence on firm's environmental and social performance. Their sample consists of 3277 firms from 41 countries examined from 2004 until 2013. They concluded that investors boost companies' Environmental and Social performance (E&S) when they belong to countries with a strong commitment to E&S issues. Although the study is thorough, there is no mention of uncertainty or how it might impact investors' behaviour or firms' E&S performance. Added to this the sample period ends in 2013, therefore, the results do not reflect recent years' events and policy changes such as the 17 SDGs UN announcement.

To investigate the conflict between shareholders' relationship with Corporate Social responsibility, Barnea & Rubin (2010) examined 3000 US firms. They concluded that managers encourage overinvesting in Corporate Social

Responsibility (CSR) to promote their own reputation while also investing knowing that there is no cost for them to suffer. Institutional investors were also investigated with results showing the ones with higher sustainability have longer investment horizons (Brandon et al., 2017). A view shared by Bhaskaran et al (2020) as they analysed 4,887 global firms' ESG performance ESG. Their conclusion also highlights the importance of considering ESG resource allocation as an investment rather than an expense. This comes in response to voices calling ESG investments as waste of funds. Duygun et al (2022) go further in their study of US economy ESG complementarities. They analyse a set of 5,798 companies from 38 US industries over 12 years (2009 to 2020), and compute two elasticity types Antonelli Elasticity of Complementarity (AEC) and Allen-Uzawa Elasticity of Substitution (AES). They conclude that sustainability investments have multiplicative effects on different ESG factors.

Keen to address investors' concerns around profitability, many studies have investigated the relationship between Environmental, Social and Governance scores and firms' financial performance. Cornett et al (2016), for instance, examined the relationship between CSR and financial performance of 235 US banks before and after the 2008 financial crisis. Using MSCI ESG STATS database, they show that CSR scores are positively related to these banks' financial performance. In addition to higher involvement in socially responsible activities, bigger banks also demonstrate an increase in CSR strengths post financial crisis. Higher firm value was also found to be significantly linked higher CSR scores (Ferrell et al., 2016). Indeed, Daugaard (2020) in his review of literature highlighted that most research focus on the financial performance element of ESG investing.

Uncertainty, on the other hand, has publications dating back to the 1970s if not earlier. The most prominent book on this topic is by John Kenneth Galbraith released in 1977 entitled 'The Age of Uncertainty' (Al-Thaqeb & Algharabali, 2019). Since then, academics debated how to define uncertainty and how to measure it with numerous attempts to construct indices and theories. The most renowned uncertainty measure in recent years has been the Economic Policy Uncertainty (EPU) index developed by Baker, Bloom and Davis. Initially created in 2011 for the US only, the index became popular which led researchers

to expend it to 22 countries and make the data available for public use. Some of the research below has used the index as uncertainty proxy.

Several research have been published featuring uncertainty as a major issue facing financial industries globally. Baum et al (2020) for instance, examined the impact of economic policy uncertainty on financial institutions' credit availability and non-performing loans. Their study examined financial institutions in 18 countries from 1996 until 2015 and concluded that the higher the uncertainly the more lower credit availability and less stability. This in turn affects firm level investment decision making (Francis et al., 2014).

The impact of Economic Policy Uncertainty on stock markets was also investigated widely. Pástor and Veronesi (2013) developed a theoretical model then test it empirically to conclude that political uncertainty leads to a risk premium. They confirm that weak economies are more likely to have volatile stocks as a result of uncertainty. Whereas Kang et al. (2014) claim that political uncertainty impacts negatively real stock returns. A review of literature on economic uncertainty by Al-Thaqeb & Algharabali (2019) shows that consumer spending and companies' financial policies are substantially affected by policy uncertainty. They highlight a level of conservatism exercised by corporations during high levels of uncertainty which in turn reduces employment and investments. They also confirm that EPU's effects are felt across borders. A point argued by Istiak & Serletis (2018) as their study shows that economies' response to EPU shocks are country specific. Schieler (2017) on the other hand, presents developed economies as the main source of political uncertainty which in turn affects global growth.

More recently studies have been conducted looking at the effects of uncertainty on sustainability. Research have been led by two main theories, real options theory and stakeholder theory. Supporters of the real option theory argue that high uncertainty results in companies adopting a "wait and see" strategy putting large capital spending and investments on hold (Cassimon et al., 2016). Shareholder theory supporters, on the other hand, argue that companies benefit from their sustainability engagements especially during high uncertainty as their

investments in ESG projects send a positive signal of their performance to the market (Yuan et al., 2022).

Many recent studies focus primarily on the Chinese market highlighting how economic uncertainty affects negatively Chinese firms' cash flows (Chen et al., 2023), their corporate environmental practices (Hou et al., 2022) and their carbon emission intensity (Yu et al., 2021). Research focusing on Chinese firms' Corporate Social Responsibility (CSR) activities have also highlighted EPU's negative effects resulting in the reduction of CSR activities (Zeng et al., 2022; Zhao et al., 2021). Whilst Chen et al (2021) reach the same conclusion, they argue that state owned firms reduce their CSR activities during high uncertainty, but privately owned ones increase their CSR spending to obtain more government support in the form of subsidies. Other studies, however, argue that economic uncertainty has a positive effect on firm's CSR activities. Chinese firms, for instance, are viewed to increase their CSR activities during high uncertainty to send a positive signal to the market (Yuan et al., 2022). European firms appear to react the same to high uncertainty by improving their ESG performance, across all categories, as well as their stakeholder engagement (Vural-Yavaş, 2021).

Whilst previous studies' findings appear to swing between positive and negative effects of economic uncertainty focusing on certain markets and industries, research on how global banks' ESG activities are affected during economic insecurity are scarce. Chiaramonte et al. (2021) study is one of very few investigating banks' ESG during financial turmoil as they focus on how banks' ESG strategies enhance banks' stability in the EU region. Though their conclusion suggests the higher the ESG rating the stronger the stabilising effect, their research overlooks the actual effect of uncertainty on banks' ESG activities themselves. Similarly, a more recent study by (Alam et al., 2024) explores the effects of economic uncertainty on US banks' sustainability performance highlighting a positive relationship between the two. The authors argue that the positive effect is on all bank sizes and across all three ESG categories. Whilst the study examines banks' sustainability activities under high uncertainty, they focus on the US market only with no country control variables except GDP in their baseline model.

Therefore, our study has a different approach and objectives as it aims to evaluate the impact of Economic Political Uncertainty on Environmental, Social and Governance banks' activities. All three categories of ESG will be included in the study to try and understand how banks treat each category in response to uncertain times. We argue that it is known that firms' decision making and behaviours are impacted by high levels of uncertainty as they delay investments (Brand & Tripier, 2019; Caglayan & Xu, 2019; Pástor & Veronesi, 2013) and that banks suffer low or negative growth rates under high uncertainty (Al-Thaqeb & Algharabali, 2019). Therefore, we expect a negative relationship between banks' ESG activities and EPU in line with the real option theory as companies adopt a "wait and see" strategy. The higher the EPU the lower ESG scores.

To assess the effect of EPU on each category, we split ESG into its three main categories Environmental, Social and Governance activities. Knowing that corporations increase their cash holdings without changing their investments (Hankins et al., 2020); good sustainable firms have strong governance (Gocher, 2020); and EPU's greatly impact on firms' internal investment decisions (Francis et al, 2014), we expect ESG categories to receive different treatment by banks during uncertain times. Some categories will be affected by EPU more than others.

To test whether banks' size influences their ESG activities during uncertain times, we split banks into big banks representing the top 10% in our sample set and small to medium banks representing the remaining 90% in the set. Given that banks' size is found to influence its Corporate Social Responsibility strategies and practices (Cornett et al., 2016) and bigger banks take more risk compared to smaller banks (Baron et al., 2023), we expect that Banks' ESG activities to vary during high uncertainty depending on the size of the bank.

## 2.3 Methodology and Data

Our data set focuses on 27 countries which is based on the EPU index data availability. At the time of data collection, the EPU index data was available for the following countries only: Australia, Belgium, Brazil, Britain, Canada, Chile,

China, Colombia, Croatia, Denmark, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, Mexico, Netherlands, Pakistan, Russia, Singapore, South Korea, Spain, Sweden, United States. Based on this list, we proceed in collecting banks' ESG disclosure and later on ESG Performance scores.

Bloomberg is the primary sources of bank level as well as their ESG activities data. World bank, on the other hand, is the source of macroeconomic data. The study's data sample consist of 3,710 observations of 530 global banks from 27 countries over a period of 7 years (2015 - 2021). When the data was initially collected, it contained a total of 1392 international banks. They were sorted by total assets reported in US dollars, then selected by ESG scores and Key Performance Indicators data availability. The timeline started from 2015 onwards as the Bloomberg ESG performance sores are only available from 2015 onwards [8].

In early 2004, the then United Nations Secretary General, Kofi Annan wrote a letter to selected financial institutions CEOs. He invited them to join the initiative which resulted in the release of the 'Who Cares Wins' report by the Global Impact Initiative. Recommendation 'M' of the report invites financial organisations to focus on ESG issues as a potential source of impact on their financial value (IFC, 2004). Although ESG data started emerging few years after this letter, it wasn't until 2010 when most banks started consistently reporting their ESG activities' scores. We start out sample from 2015 to have an equal timeline between banks' ESG disclosure scores and ESG performance score.

### 2.3.1 ESG Disclosure Scores

Bloomberg ESG Disclosure scores have been used in previous studies and reports such as the Principles for Responsible Investment (2019) report entitled: 'Integration in Europe, the Middle East, and Africa: Markets, Practices and Data'

[8] In 2015, 195 United Nation member countries signed the Paris Climate Protection Agreement to limit global warming to 1.5, and the 17 Sustainable Development Goals (SDG) were also launched. (KPMG, 2021)

(CFA, 2019). According to Bloomberg (2020), the Bloomberg ESG Disclosure score represents data from over 11,000 firms in more than 100 countries.

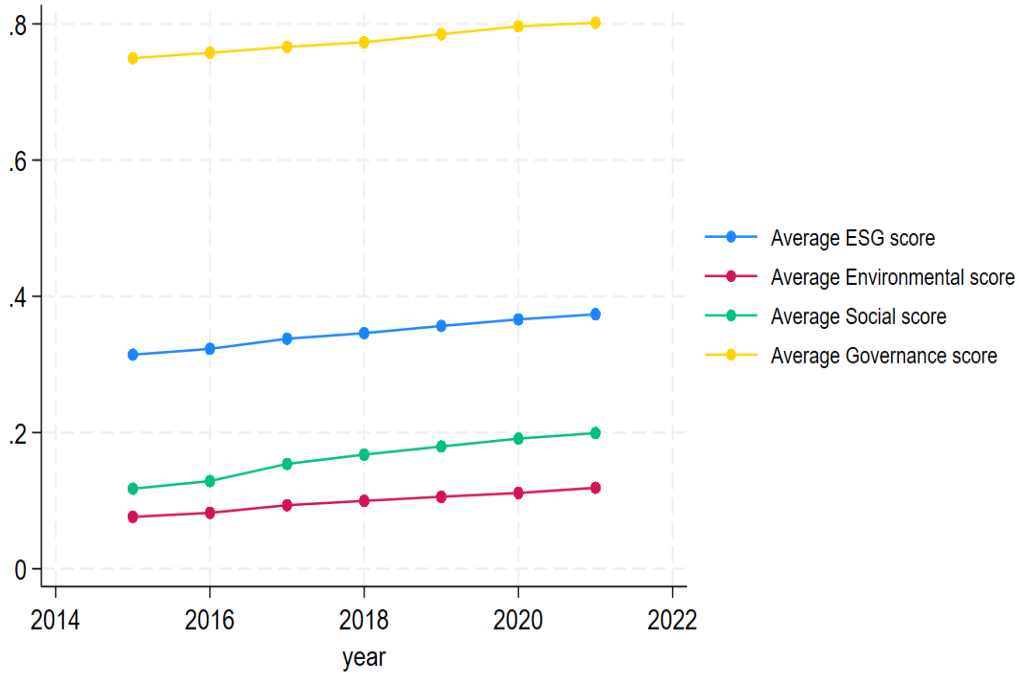
Bloomberg generates the scores using data obtained from companies' websites, annual reports, corporate social responsibility reports and a 'proprietary Bloomberg survey that requests corporate data directly' from firms (Bloomberg, 2020). Bloomberg ESG Disclosure Score is a percentage of aggregate points disclosed across all ESG Bloomberg fields reported in the last fiscal year, the higher the value, the fuller the disclosure (see Appendix 2). The ESG Bloomberg fields upon which the score is based are over 978 disclosure points (see Appendix 3). Each field is scored from 0 to 100 then aggregated to a single category either environmental, social or governance. Finally, the single category scores are aggregated again to a collective ESG score. Each company is assessed in accordance with its industry relevance and measures. According to Bloomberg (2020), industry-specific data is considered during the ESG score construction, for example, Bloomberg calculates greenhouse emissions and water use for every barrel of oil reported by oil and gas firms.

As seen above, ESG disclosure scores imply measures of environmental, social and governance investments, activities and policies taken by companies including banks. The aim of this paper is to examine the scores performance and changes throughout the sample period. There is no focus on one element i.e. only investments or only policies as they are integrated and any distinction between them would go beyond the scope of this paper. Therefore, throughout the paper, a reference to ESG scores is a reference to banks' ESG investments, activities and policies.

For this research, the ESG scores over the sample period are illustrated Figure 4. It shows a time series of the scores from 2015 to 2021 for all 530 global banks in the sample. It is noticeable that the average overall ESG disclosure score slightly increases from 2015. This highlights the gradual progress in ESG activity and disclosure following the United Nations' Sustainable Development Goals (SGDs) 2015-2030 target announcement made in 2015. Observing each category individually, shows that all three (Environmental, Social and Governance) have increased slightly over the sample period. However,

governance appears to have the highest scores which is not surprising given the reforms banks underwent following the 2008 financial crisis. Investigations into the crisis, showed poor governance being one of the major causes of the financial meltdown (Rajgopal et al., 2019).

**Figure 4: Banks' ESG Disclosure Scores**




Source: (Bloomberg, 2020)

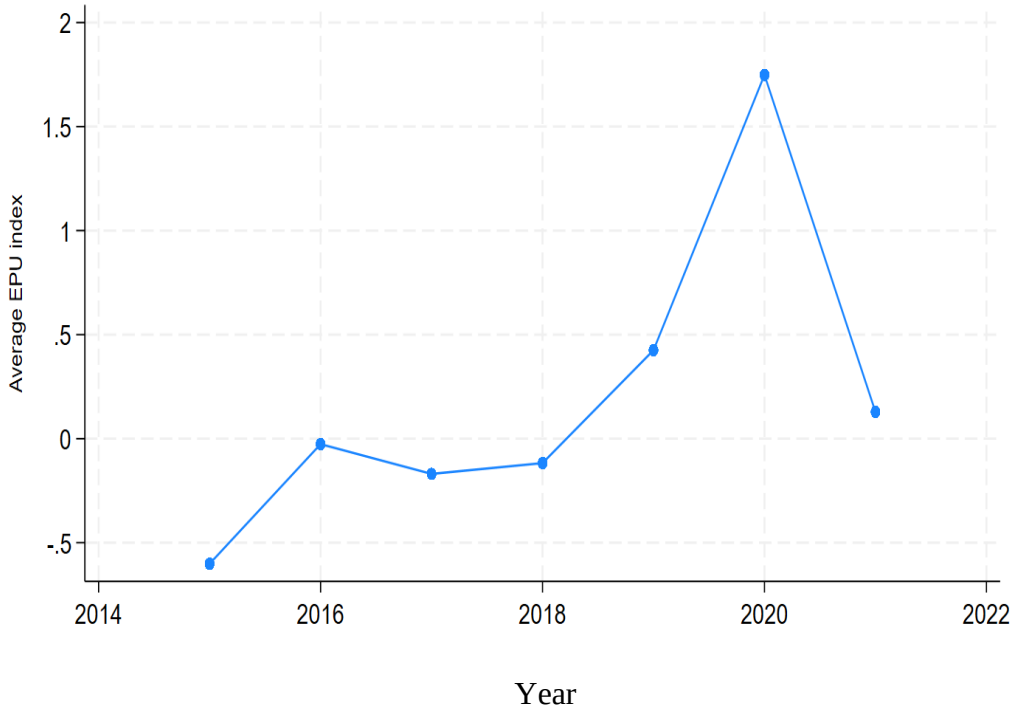
### 2.3.2 Economic Policy Uncertainty (EPU) Index

According to Banker, Bloom and Davis (2016), the creation of the Economic Policy Uncertainty (EPU) index was to measure the level of uncertainty in the United States and evaluate its evolution since 1985. Initially, the measure focused on leading US newspapers by tracking the frequency of some key words which are "uncertainty" or "uncertain", "economy" or "economic". Other key words such as "White House", "congress", "regulation", "deficit", "Federal Reserve", "legislation" are also considered in the measure.

In their methodology, Banker, Bloom and Davis (2016) explain that the index contains three elements. First element is newspapers coverage which searches

ten large newspapers such as Washington Post and New York Times to construct an index of the volume of articles covering the topic of uncertainty. Second element contains federal tax code provisions due to expire in the coming ten years. This measure shows the future uncertainty these codes will face. The third and last element includes uncertainty regarding macroeconomic variables. This is achieved by assessing the differences between forecasters' predictions on things like consumer price index and state and local expenditures. Figure 5 below, shows the mean of the EPU index for all 27 countries over the sample period (2015 - 2021).

**Figure 5: Average EPU Index of the sampled countries**




Source: Economic Policy Uncertainty Index

Figure 5 shows the EPU index peaking around three times throughout the sample period which is due to prominent global events that might have contributed to the index fluctuations. 2016, for instance, was a year after the Paris Agreement was signed by all UN member countries and the first international legally binding climate change agreement. Whilst it provided positivity about global action toward climate change, it also raised concerns about transition risks and costs attached (EBRD, 2020). In the US, the republican climate 'nihilist' Donald

Trump was elected raising concerns about his take on climate change (Cheung, 2020). The Dakota Access Pipeline Protest in the US also attracted international attention and costed the banks financing it a drop in their deposit growth rate and bad publicity (Homanen, 2018). In the UK, on the other hand, a historical referendum took place where 51,9% voted to leave the European Union raising uncertainty over the future of Europe.

After dropping slightly in 2017, the index peaks again in 2018 as changes happen globally. One of the global events taking place this year is the release of Global Warning of 1,5 ºC by United Nations Intergovernmental Panel on Climate Change (IPCC). The report presented scientific evidence that we have just over a decade to act on climate change or we go beyond the point of no return (Masson-Delmotte et al., 2019). The US leaves the Iran Nuclear deal and sets tariffs on imported steel and aluminium declaring a trade war with all its traders with no exceptions (Carson, 2018). According to the RobecoSAM 2018 Country Sustainability Ranking report, both US and Britain witnessed worsening social discontent and political stability which resulted in higher uncertainty. In the UK, the Brexit talks deadlines kept being extended with tensions rising. As for the US, new harsh policies such as immigration laws and trade war were introduced by Trump (Robeco, 2018).

After 2018, the index keeps increasing until it peaks in 2020 before it falls back in 2021. The increase in the EPU index in 2020 is largely attributed to the covid-19 pandemic which affected all the countries in this study's set.

### 2.3.3 Descriptive Statistics

Table 18 presents descriptive statistics of the selected variables for the entire sample of banks. The table shows the mean of the overall ESG disclosure score being 35% with a maximum score of 75%. Reviewing each score individually, shows that the Environmental Disclosure score has a lowest mean of 10% followed by 16% for Social Disclosure score and 78% for Governance Disclosure. This highlights banks priorities and focus which from an ESG perspective appears heavily focused on governance. Not surprising, given that

following the 2007/2008 financial crisis, banks underwent major reforms as their governance was blamed for causing the credit crunch (Stulz et al., 2021). Table 19 illustrates all variables including control ones and their definitions.

**Table 18: Descriptive Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ESG Disclosure Score | 3,710 | 35.00 | 11.00 | 2.00 | 75.00 |
| Environmental Disclosure | 3,710 | 10.00 | 16.00 | 0.00 | 77.00 |
| Social Disclosure | 3,710 | 16.00 | 13.00 | 0.00 | 69.00 |
| Governance Disclosure | 3,710 | 78.00 | 15.00 | 7.00 | 100.00 |
| ESG Performance Score | 3,710 | 1.00 | 2.00 | 0.00 | 6.00 |
| Environmental Performance | 3,710 | 1.00 | 1.00 | 0.00 | 8.00 |
| Social Performance | 3,710 | 2.00 | 2.00 | 0.00 | 9.00 |
| Governance Performance | 3,710 | 6.00 | 1.00 | 2.00 | 9.00 |
| EPU index | 3,710 | 166.00 | 79.00 | 33.00 | 543.00 |
| Total Assets (millions $) | 3,710 | 2.00 | 5.00 | 1.00 | 55.00 |
| Return on Assets (%) | 3,710 | 1.00 | 1.00 | -14.00 | 30.00 |
| Efficiency Ratio | 3,710 | 62.00 | 20.00 | -31.00 | 58.00 |
| TobinsQ | 3,710 | 1.00 | 0.00 | 0.30 | 13.00 |
| NonPerformingLoansratio | 3,710 | 2.00 | 10.00 | 0.04 | 52.00 |
| Leverage | 3,710 | 13.00 | 12.00 | 0.01 | 71.00 |
| Non-Interest Income ratio | 3,710 | 0.07 | 0.58 | -0.01 | 11.00 |
| Zscore | 3,710 | 4.00 | 3.00 | -3.00 | 20.00 |
| Customer Deposits ratio | 3,710 | 0.18 | 3.33 | 0.00 | 94.80 |
| Capital Ratio | 3,710 | 0.00 | 1.00 | 0.50 | 74.00 |
| SIB dummy | 3,710 | 0.15 | 0.36 | 0.00 | 1.00 |
| PRI Signatory | 3,710 | 0.09 | 0.29 | 0.00 | 1.00 |
| GDP ratio | 3,710 | 2.00 | 3.00 | -11.00 | 25.00 |
| Inflation rate | 3,710 | 2.00 | 2.00 | -2.00 | 16.00 |
| Unemployment rate | 3,710 | 5.00 | 3.00 | 2.00 | 25.00 |
| Population rate | 3,710 | 0.50 | 0.50 | -4.00 | 2.00 |
| GovernmentRegulationIndx | 3,710 | 1.00 | 1.00 | -1.00 | 2.00 |
| SDG country index | 3,710 | 1.00 | 0.00 | 0.00 | 1.00 |

For further scrutiny, banks are split by total assets into two groups as shown in Table 20. While larger banks are likely to take on more risk relying on their ‘too big to fail’ provision (Wu et al., 2020), they are found to be more affected by high uncertainty (Danisman & Tarazi, 2024) and reduce the level of risky projects during economic uncertainty (Berger & Bouwman, 2013). Therefore,

the Dodd Frank Act[9] classification of large banks was followed as the sample was split using Total Assets. This resulted in large banks group with an average Total Assets of $13 billion (top 10%); and small and medium banks group with an average Total Assets of $0.5 billion (remaining 90%)[10].

The table also shows that the mean of the ESG disclosure score of the big banks group is 20% higher than that of small to medium banks group with a total of 52% and 32% respectively. A significant different is noted at the category level where small and medium size banks disclose 7% of their Environmental activities compared to 34% reported by big banks. This highlights the role of banks' size in leading action on ESG investing and reporting. Bigger banks are found to be significantly greater in following socially responsible activities than smaller ones (Cornett et al., 2016).

Table 21. demonstrates the 27 countries in the sample highlighting their bank size, EPU index as well as ESG disclosure scores. Sample observations are dominated by United States with a total of around 51%, followed by Japan with 16%. Thus, the sample is unevenly spread as around 67% of the overall observations are concentrated in two countries (United States and Japan). Table 21 also shows that the top three countries with the highest uncertainty EPU index are Britain with a score of 359, followed by Canada at 295 then France at 274. However, the countries with the highest banks' ESG Disclosure scores are France with 56, Spain 54, Greece 53, Hong Kong 53 and Sweden 53 which highlights a near European dominance.

Europe has been at the forefront of climate change action and many of its countries take the top spots in global reports rankings. In a study conducted by HSBC ESG research team, they examined 67 countries on areas such as carbon intensity, dependence on fossil-fuel and potential response to climate change. They concluded that 12 out of the top 13 places are taken by European countries (Paun et al., 2019). The United States' average Banks ESG disclosure score of

[9] Dodd Frank Act 2010 set provisions for large banks in response to the 2008 financial crisis and the identified governance failures. Banks with $10 billion in Total Assets or more, are required to adhere to specific set or regulations to prevent potential government bailouts.

[10] Whilst Cheng et al (2022) identified their large banks using a 25% 75% split of their sample to, this categorisation would not possible in this study. A 25% 75% grouping would lead a larger banks group with a mean of $ 0.7 billion which is well below the threshold to identify a bank as large or 'too big to fail' according to the Dodd Frank Act.

32 which is just below the sample mean of 35 is not surprising given its government policies on climate change and immigration in recent years (Robeco, 2018).

It is also noted that around ten countries (Belgium, Brazil, Chile, Colombia, Croatia, Greece, Ireland, Mexico, Pakistan, Sweden) have no banks in the top 10% Big Banks group. Banks in these countries have an average ESG disclosure score of 40 and an EPU index mean of 143 which is below the sample's mean of 166. With a total number of 322 observations, the lack of banks in the top 10% category of these banks is unlikely to bias the results given that the total sample observations are 3,710.

With the aim to evaluate the impact of uncertainty on banks' ESG activities, we control for potential factors that might influence banks' ESG activities, specifically, bank characteristics, macroeconomic conditions and financial regulations. We obtain banks' accounting values from Bloomberg database including Total Assets, Return on Assets (ROA), Efficiency Ratio, TobinsQ, Non-Performing Loans (NPLs) Ratio, Leverage, Systematically Important Bank (SIB) dummy, PRI signatory dummy, Zscore, Customer Deposits, Capital Ratio and Non-Interest Income ratio. Macroeconomic conditions data, on the other hand, was collected from World Bank including GDP ratio, Inflation rate, Unemployment rate and Population rate. Government regulation alongside Covid country index and SDG country Index where also controlled for due to their potential influence on banks ESG activities. Correlation matrix is also presented in Table 22 where it is also evident that the sample is free from multicollinearity.

## Table 19 - Variables Definitions

| Variable name | Definition | Source |
|---|---|---|
| ***ESG disclosure and performance scores*** | | |
| Environmental, Social and Governance disclosure Scores (ESG) | Environmental, Social and Governance (ESG) Criteria is a set of standards for a company's operations that socially conscious investors use to screen potential investments. Environmental criteria look at how a company performs as a steward of the natural environment. Social criteria examine how a company manages relationships with its employees, suppliers, customers and the communities where it operates. Governance deals with a company's leadership, executive pay, audits, internal controls and shareholder rights. | Bloomberg |
| Environmental disclosure scores | Environmental criteria look at a company's energy use, waste, pollution, natural resource conservation and animal treatment. They also evaluate which environmental risks might affect a company's income and how the company is managing those risks. For example, a company might face environmental risks related to its ownership of contaminated land, its disposal of hazardous waste, its management of toxic emissions or its compliance with the government's environmental regulations. | Bloomberg |
| Social disclosure scores | Social criteria look at the company's business relationships. Does it work with suppliers that hold the same values that the company claims to hold? Does the company donate a percentage of its profits to the community or perform volunteer work? Do the company's working conditions show a high regard for its employees' health and safety? Are stakeholders' interests taken into consideration? | Bloomberg |
| Governance disclosure scores | With governance, investors want to know that a company uses accurate and transparent accounting methods, and they want to see that common stockholders are allowed to vote on important issues. They also want companies to avoid conflicts of interest in their choice of board members. Finally, they prefer not to invest in companies that engage in illegal behaviour or use political contributions to obtain favourable treatment. | Bloomberg |
| ESG Performance scores | Using proprietary and external sources, Bloomberg assess industry-specific sustainability issues by prioritizing and ranking the sets of issues. Issues are categorised and each category contains at least one sub-issue that aggregates associated qualitative and quantitative ESG data fields. | Bloomberg |
| Environmental Performance scores | Using proprietary and external sources, Bloomberg assess industry-specific sustainability issues by prioritizing and ranking the sets of issues. Issues are categorised and each category contains at least one sub-issue that aggregates associated qualitative and quantitative Environmental data fields. | Bloomberg |
| Social Performance scores | Using proprietary and external sources, Bloomberg assess industry-specific sustainability issues by prioritizing and ranking the sets of issues. Issues are categorised and each category contains at least one sub-issue that aggregates associated qualitative and quantitative Social data fields. | Bloomberg |

| | | |
|---|---|---|
| Governance Performance scores | Using proprietary and external sources, Bloomberg assess industry-specific sustainability issues by prioritizing and ranking the sets of issues. Issues are categorised and each category contains at least one sub-issue that aggregates associated qualitative and quantitative Governance data fields. | Bloomberg |
| ***Bank Characteristics*** | | |
| Total Assets | This is the sum of Cash & bank balances, Fed funds sold & resale agreements, Investments for Trade and Sale, Net loans, Investments held to maturity, Net fixed assets, Other assets, Customers' Acceptances and Liabilities. | Bloomberg |
| Cost to Income Ratio | Also known as Efficiency Ratio. Is inversely related to a bank's operating efficiency. | Bloomberg |
| Z score | Known as the main bank risk measure. Calculated as: (Return on Assets (ROA) + Capital Asset Ratio (CAR)) / Standard Deviation of the Return on Assets SDROA | Bloomberg |
| NPL ratio | Non-Performing Loans to Total Loans. | Bloomberg |
| Customer Deposit Ratio | Customer deposits to Total assets ratio | Bloomberg |
| TobinsQ | Tobins Q Ratio of the market value of a firm to the replacement cost of the firm's assets. | Bloomberg |
| SIB dummy | For banks recognised domestically as Systematically Important Banks or other Systematically Important Institution by their regional regulators based on systematic risk to their domestic economy. | Bloomberg |
| Capital ratio | Core Tier 1 capital ratio to risk weighted assets ratio | Bloomberg |
| Leverage Ratio | Also known as Total Debt to Total Assets ratio. Leverage ratio in percentage that defines the total amount of debt relative to assets. Calculated as: Total Debt *100 / Total Assets | Bloomberg |
| Non-Interest Income Ratio | Non-Interest Income ratio to capture the extent to which banks resort to riskier strategies. | Bloomberg |
| Return on Assets (ROA) | Indicator of how profitable a company is relative to its total assets, in percentage. Calculated as: (Trailing 12M Net Income / Average Total Assets) * 100 | Bloomberg |
| ***Country Characteristics*** | | |
| Economic Policy Uncertainty Index (EPU) | To measure policy-related economic uncertainty, we construct an index from three types of underlying components. One component quantifies newspaper coverage of policy-related economic uncertainty. A second component reflects the number of federal tax code provisions set to expire in future years. The third component uses disagreement among economic forecasters as a proxy for uncertainty. | Baker et al (2016) |
| GDP | GDP measures the monetary value of final goods and services – that is, those that are bought by the final user – produced in a country in each period of time. | World Bank |

| | | |
|---|---|---|
| Unemployment | Unemployment refers to the share of the labour force that is without work but available for and seeking employment. | World Bank |
| Inflation | Inflation measures how much more expensive a set of goods and services has become over a certain period, usually a year. | World Bank |
| Population rate | Population growth rate measures the growth of the population counting all residents irrespective of their citizenship. | World Bank |
| Government regulation index | Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. | World Bank |
| SDG county index | The SDG Index and Dashboards Report benchmarks the performance of countries on the Sustainable Development Goals (SDGs) adopted in September 2015 by the global community. In the 2018 edition, country profiles are generated for all 193 member states, but total country scores and ranks are available for 156 countries. | Sachs et al (2022) |

## Table 20: Descriptive Statistics by Bank Size

| | Small & Medium banks (remaining 90%) | | | | | Big Banks (top 10%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **Obs** | **Mean** | **SD** | **Min** | **Max** | **Obs** | **Mean** | **SD** | **Min** | **Max** |
| EPU index | 3,320 | 159.93 | 72.18 | 32.50 | 542.77 | 390 | 213.60 | 111.66 | 57.03 | 542.77 |
| ***Bank level variables*** | | | | | | | | | | |
| ESG Disclosure Score | 3,320 | 32.43 | 9.65 | 2.42 | 66.91 | 390 | 52.35 | 9.06 | 14.25 | 75.16 |
| Environmental Disclosure | 3,320 | 6.90 | 13.35 | 0.00 | 56.90 | 390 | 34.44 | 11.93 | 0.42 | 76.77 |
| Social Disclosure | 3,320 | 14.13 | 11.43 | 0.00 | 63.48 | 390 | 34.13 | 11.47 | 8.89 | 69.11 |
| Governance Disclosure | 3,320 | 76.30 | 14.71 | 7.26 | 100.00 | 390 | 88.28 | 10.73 | 28.36 | 100.00 |
| ESG Performance | 3,320 | 6.13 | 3.44 | 0.00 | 20.84 | 390 | 9.82 | 2.64 | 1.55 | 18.84 |
| EnvironmentalPerformance | 3,320 | 1.00 | 1.50 | 0.00 | 6.00 | 390 | 3.31 | 1.00 | 0.00 | 6.00 |
| Social Performance | 3,320 | 1.98 | 1.53 | 0.00 | 8.95 | 390 | 2.37 | 1.35 | 0.61 | 8.00 |
| Governance Performace | 3,320 | 6.06 | 1.46 | 2.32 | 8.86 | 390 | 6.43 | 1.25 | 2.17 | 8.60 |
| Total Assets (b $) | 3,320 | 0.46 | 0.83 | 0.10 | 4.00 | 390 | 13.00 | 9.00 | 4.00 | 55.00 |
| Return on Assets % | 3,320 | 0.99 | 1.49 | -14.33 | 30.44 | 390 | 0.65 | 0.48 | -1.37 | 3.24 |
| Efficiency Ratio | 3,320 | 6.24 | 1.97 | -31.07 | 58.18 | 390 | 5.79 | 1.75 | 2.63 | 12.67 |
| TobinsQ | 3,320 | 1.05 | 0.48 | 0.30 | 13.23 | 390 | 1.00 | 0.03 | 0.93 | 1.12 |
| NonPerformingLoans% | 3,320 | 4.09 | 3.15 | -2.88 | 52.50 | 390 | 2.09 | 2.25 | 0.11 | 17.49 |
| Leverage | 3,320 | 11.59 | 11.81 | 0.01 | 71.21 | 390 | 22.86 | 9.96 | 1.82 | 58.09 |
| Non-Interest Income ratio | 3,320 | 0.08 | 0.62 | -0.01 | 11.43 | 390 | 0.01 | 0.08 | 0.00 | 0.05 |
| Zscore | 3,320 | 4.09 | 3.15 | -2.88 | 20.43 | 390 | 4.52 | 3.75 | -2.56 | 18.99 |
| Customer Deposits ratio | 3,320 | 0.21 | 3.52 | 0.00 | 94.81 | 390 | 0.58 | 0.14 | 0.22 | 0.89 |
| Capital Ratio | 3,320 | 0.18 | 1.35 | 0.04 | 74.18 | 390 | 0.14 | 0.03 | 0.09 | 0.21 |
| SIB dummy | 3,320 | 0.08 | 0.28 | 0.00 | 1.00 | 390 | 0.72 | 0.45 | 0.00 | 1.00 |
| PRI signatory dummy | 3,320 | 0.05 | 0.21 | 0.00 | 1.00 | 390 | 0.48 | 0.50 | 0.00 | 1.00 |
| ***Macroeconomic variables*** | | | | | | | | | | |
| GDP ratio | 3,320 | 1.93 | 3.22 | -10.82 | 25.18 | 390 | 2.53 | 3.74 | -10.82 | 8.95 |
| Inflation rate | 3,320 | 1.96 | 1.85 | -1.74 | 15.53 | 390 | 1.60 | 1.12 | -0.50 | 6.69 |
| Unemployment rate | 3,320 | 4.85 | 2.36 | 2.35 | 24.90 | 390 | 5.62 | 3.75 | 2.35 | 24.90 |
| Population rate | 3,320 | 1.18 | 0.61 | -0.73 | 2.26 | 390 | 1.02 | 0.84 | -0.55 | 2.23 |
| Government Regulation index | 3,320 | 0.86 | 0.35 | 0.00 | 1.00 | 390 | 0.91 | 0.29 | 0.00 | 1.00 |

**Table 21: Bank Size and EPU Index by Country**

| | Bank Size | | EPU Index | | ESG Disclosure Scores | | |
|---|---|---|---|---|---|---|---|
| **Countries** | **Big Banks** | **Small & Medium** | **Mean** | **Std. dev.** | **Mean** | **Std. dev.** | **Obs** |
| AUSTRALIA | 28 | 49 | 114.49 | 33.71 | 47.09 | 13.09 | 77 |
| BELGIUM | 0 | 28 | 128.07 | 68.20 | 34.48 | 9.14 | 28 |
| BRAZIL | 0 | 63 | 238.93 | 67.50 | 41.17 | 13.21 | 63 |
| BRITAIN | 35 | 21 | 359.21 | 126.15 | 51.75 | 7.60 | 56 |
| CANADA | 33 | 23 | 295.82 | 85.07 | 51.67 | 10.54 | 56 |
| CHILE | 0 | 42 | 179.11 | 70.13 | 36.92 | 13.59 | 42 |
| CHINA | 93 | 61 | 248.56 | 104.27 | 43.39 | 8.53 | 154 |
| COLOMBIA | 0 | 28 | 147.54 | 34.91 | 41.14 | 11.23 | 28 |
| CROATIA | 0 | 14 | 184.91 | 45.08 | 22.10 | 10.91 | 14 |
| DENMARK | 7 | 14 | 159.96 | 45.91 | 40.44 | 7.19 | 21 |
| FRANCE | 21 | 0 | 273.81 | 35.13 | 55.76 | 3.69 | 21 |
| GERMANY | 21 | 21 | 224.41 | 61.72 | 31.52 | 17.57 | 42 |
| GREECE | 0 | 28 | 94.44 | 23.16 | 53.06 | 5.33 | 28 |
| HONG KONG | 1 | 27 | 163.75 | 44.26 | 52.97 | 7.45 | 28 |
| INDIA | 7 | 189 | 72.44 | 12.78 | 30.34 | 11.29 | 196 |
| IRELAND | 0 | 21 | 185.87 | 46.70 | 45.97 | 6.89 | 21 |
| ITALY | 14 | 56 | 120.11 | 26.76 | 50.06 | 15.75 | 70 |
| JAPAN | 33 | 555 | 113.96 | 21.20 | 26.20 | 7.07 | 588 |
| MEXICO | 0 | 35 | 67.85 | 20.82 | 39.36 | 10.51 | 35 |
| NETHERLANDS | 19 | 9 | 89.73 | 20.06 | 50.12 | 6.17 | 28 |
| PAKISTAN | 0 | 42 | 94.59 | 27.94 | 31.15 | 3.36 | 42 |
| RUSSIA | 5 | 30 | 273.07 | 103.33 | 32.81 | 18.24 | 35 |
| SINGAPORE | 2 | 19 | 212.13 | 63.54 | 44.35 | 5.99 | 21 |
| SOUTH KOREA | 6 | 64 | 180.26 | 39.92 | 49.33 | 9.11 | 70 |
| SPAIN | 19 | 16 | 135.90 | 27.59 | 54.09 | 5.04 | 35 |
| SWEDEN | 0 | 21 | 106.43 | 5.21 | 52.62 | 3.36 | 21 |
| UNITED STATES | 46 | 1844 | 177.70 | 64.73 | 32.08 | 7.02 | 1890 |
| Total | 390 | 3320 | 165.57 | 78.99 | 34.53 | 11.38 | 3,710 |

**Table 22: Correlation Matrix**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | 1.000 | | | | | | | | | | | | | | | |
| (2) | 0.868*** | 1.000 | | | | | | | | | | | | | | |
| (3) | 0.866*** | 0.827*** | 1.000 | | | | | | | | | | | | | |
| (4) | 0.621*** | 0.196*** | 0.224*** | 1.000 | | | | | | | | | | | | |
| (5) | 0.234*** | 0.115*** | 0.196*** | 0.242*** | 1.000 | | | | | | | | | | | |
| (6) | 0.480*** | 0.488*** | 0.416*** | 0.223*** | 0.207*** | 1.000 | | | | | | | | | | |
| (7) | 0.036** | -0.001 | 0.007 | 0.076*** | 0.060*** | -0.065*** | 1.000 | | | | | | | | | |
| (8) | 0.370*** | 0.487*** | 0.428*** | -0.033** | 0.032** | 0.248*** | -0.038** | 1.000 | | | | | | | | |
| (9) | 0.000 | -0.011 | -0.008 | 0.026 | -0.056*** | -0.040** | 0.421*** | -0.017 | 1.000 | | | | | | | |
| (10) | 0.038** | -0.074*** | -0.059*** | 0.212*** | 0.105*** | 0.041** | 0.178*** | -0.144*** | 0.021 | 1.000 | | | | | | |
| (11) | 0.047*** | 0.083*** | 0.107*** | -0.073*** | -0.072*** | -0.004 | -0.066*** | 0.081*** | -0.012 | -0.132*** | 1.000 | | | | | |
| (12) | -0.134*** | -0.099*** | -0.116*** | -0.102*** | -0.035** | -0.101*** | -0.240*** | -0.092*** | -0.013 | -0.231*** | 0.002 | 1.000 | | | | |
| (13) | -0.094*** | -0.008 | -0.035** | -0.106*** | -0.053*** | -0.020 | 0.056*** | 0.042** | 0.116*** | -0.024 | 0.001 | -0.031* | 1.000 | | | |
| (14) | 0.031* | 0.053*** | 0.046*** | -0.025 | 0.005 | -0.010 | 0.030* | 0.036** | 0.006 | -0.028* | 0.009 | -0.004 | -0.002 | 1.000 | | |
| (15) | -0.013 | 0.017 | -0.019 | -0.038** | -0.022 | -0.038** | 0.335*** | 0.013 | 0.509*** | -0.074*** | 0.003 | 0.006 | 0.091*** | -0.004 | 1.000 | |
| (16) | 0.496*** | 0.534*** | 0.524*** | 0.117*** | 0.132*** | 0.446*** | -0.109*** | 0.387*** | -0.042** | 0.023 | 0.087*** | -0.114*** | -0.023 | -0.010 | -0.045*** | 1.000 |

**** p<0.01, ** p<0.05, * p<0.1*

(1) ESG Disclosure scores, (2)Environmental Disclosure score, (3)Social Disclosure score, (4)Governance Disclosure score, (5)EPU, (6)Total Assets, (7)Return on Assets, (8)Leverage, (9)TobinsQ, (10)Zscore, (11)Non-Performing Loans, (12)Efficiency ratio, (13) Customer deposits, (14)Capital Ratio, (15)Non-Interest Income, (16) Systematically Important.

### 2.3.4 Empirical Model

Following Cheng et al (2021) and Dyck et al., (2019), we estimate the following fixed effects regression model:

$$Log\ (ESG)_{ijt} = \alpha + \beta \cdot EPU_{jt-1t} + \lambda \cdot Bond\_controls_{ijt-1} + \sigma \cdot Bank\_controls_{ijt-1} + \eta \cdot Country\_controls_{jt-1} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{ijt} \quad (2)$$

Where, the dependent variable is the log of one of banks' Environmental, Social and Governance disclosure scores (ESG scores) of bank $i$ in country j in year t. Logs are used to minimise the impact of outliers by attaining improved distributional properties consistent with other papers (Dyck et al., 2019). $EPU_{jt-1}$ is the Economic Policy Uncertainty index in year t-1. For ease of interpretation, we follow other studies by standardising the EPU index by subtracting its mean and dividing by its standard deviation (H. Cheng et al., 2021). $Bank\_controls_{ijt-1}$ and $Country\_controls_{jt-1}$ are vectors of bank and country control variables respectively. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity and Year-country fixed effects to control for unobserved heterogeneity accounting for any differences in our data that are constant over time within each country. $\beta$, $\lambda$, $\sigma$, $\eta$ are the coefficients to be estimated. $\varepsilon_{ijt}$ is the error term and $\alpha$ is the constant. We lag all right hand-side variables by one year to mitigate the problem of endogeneity. All variables are winsorized at the 1st and 99th percentiles. To account for the possibility that the regression residuals could be correlated within countries, all standard errors are clustered by bank.

Following the literature and for bank level control variables, we include total assets to control for bank size and two dummies to identify which bank is a Systematically Important Bank (SIB) and PRI signatory. To capture the impact of performance, we add Return on Assets (ROA) which indicates management efficiency in using assets to generate earnings; and TobinsQ as a market value measure (Bloomberg, 2023; Dyck et al., 2019). Also included is capital ratio as banks with higher level of capital have relatively more funds available to pursue sustainability activities than those with lower levels of capital (Cornett et al.

2016). To capture the impact of credit constraints and banks' riskiness, we include leverage, Zscore and non-performing loans ratio. Other included variables are cost to income ratio, customer deposits and Non-Interest Income ratio, (Cheng et al., 2021; Dyck et al., 2019; Homanen, 2018; Cornett et al., 2016). For country level control variables, we include GDP ratio, inflation rate, unemployment rate, population rate, government regulation and SDG country Index. These controls are to capture sampled countries' differences in economic conditions (Berger et al., 2022; Bitar & Tarazi, 2022; Wu et al., 2020).

## 2.4 Empirical Results

### 2.4.1 Main Results

**Is there a relationship between banks' ESG activities and uncertainty?**

Table 23 reports the estimation results of our baseline model in Eq (2) using ESG Disclosure score, Environmental score, Social score and Governance score as the dependent variable respectively. In column (1), (4), (7) and (10), we include lagged Economic Policy Uncertainty as the regressor, whilst in columns (2), (5), (8) and (11) with add bank characteristics as gradual incorporation of control variables. In columns (3), (6), (9) and (12), we further expend our specifications by adding macroeconomic controls.

We find that economic policy uncertainty's estimated coefficient in all regressions, apart from Social Scores, to be negative indicating a negative relationship between uncertainty and banks' Environmental and Governance activities. In particular, the results of banks' Governance scores are statistically significant and economically meaningful as shown in columns (10), (11) and (12). To illustrate, a 1% increase in uncertainty reduces banks' governance activities by 3%. The results are in line with the real option theory and previous studies that show how corporates are more conservative as they change their policies, activities and decision making in response to high levels of uncertainty (Al-Thaqeb & Algharabali, 2019; Bordo et al., 2016).

The results in Table 23, also indicate discrepancies in banks' ESG activities during economic uncertainty. Despite the negative relationship between the overall ESG scores and economic uncertainty, we note that Governance scores is the lone category significantly affected by uncertainty. Not surprising considering bank governance has been under scrutiny since the 2007/2008 financial crisis as reforms have been introduced to make banks less risky and more resilient (Stulz et al., 2021). In the US, for instance, governance and operational risk are the top focus of the Office of the Comptroller of the Currency (OCC) (Deloitte, 2018). The Major reforms are also mostly compulsory such as the introduction of a Risk Committee for Systematically Important Banks (SIBs) or any banks with substantial risk profile (KPMG, 2021). Studies have shown, however, that high economic uncertainty still affects Governance activities as firms delay investing and hire less staff as it costs more to fire them if need be (Baker et al., 2016).

Banks' sustainability in the form of Social and Environmental activities is emerging as a new type of challenge that would likely influence banks' reputation and success (KPMG, 2021). However, these activities appear to be lagging given the scale of disclosure. This is indeed highlighted in the study's data where banks' governance disclosure scores are around 60% higher than their Social and Environmental counterparts. Some argue that slow investments in Social and Environmental projects are attributed to their costs, especially Environmental projects, as they involve high capital costs (D'Orazio & Popoyan, 2019). Banks have not turned their backs to fossil fuels yet as a staggering $1.9 trillion was pumped into this industry by 33 global banks after the 2015 Paris Agreement (Kirsch et al., 2019).

Studies have also attributed slow investments to high uncertainty as banks adopt a "wait and see" strategy (Bordo et al., 2016; Wu et al., 2020) and delay investing in costly projects from which they cannot disengage (Baker et al., 2016). Therefore, our results add supportive evidence to the arguments that uncertainty affects banks' resource allocation efficiency (Wu et al., 2020), hence the results showing a negative relationship and discrepancy between ESG categories.

We look further into the effect of economic uncertainty by splitting the sample banks into Principles for Responsible Investments (PRI) signatories and non-signatories[11]. Table 24 presents the results highlighting a negative relationship between economic uncertainty and banks' ESG activities. The results are statistically significant for PRI signatory banks as a 1% increase in economic uncertainty (EPU) leads to a 3% decrease in banks overall ESG activities. This could be attributed to the scrutinised assessment of institutions' ESG reporting PRI signatory banks are required to adhere to. PRI assesses whether firms incorporate ESG in their investments and decisions making reducing potential greenwashing practices (Ndjwili-Potele et al., 2019).

[11] 10% of the sampled banks are Principles for Responsible Investments (PRI) signatories.

**Table 23: EPU and Banks' ESG activities: Baseline regression results**

| *Dependent Variable* | **ESG Disclosure Score** | | | **Environmental Disclosure Score** | | | **Social Disclosure Score** | | | **Governance Disclosure Score** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| EPU$t-1$ | -0.012 | -0.017* | -0.014 | -0.080 | -0.028 | -0.018 | 0.058*** | 0.047*** | 0.025 | -0.026*** | -0.025*** | -0.028* |
| | (0.010) | (0.009) | (0.013) | (0.056) | (0.045) | (0.072) | (0.015) | (0.013) | (0.022) | (0.007) | (0.008) | (0.016) |
| ***Banks Characteristics*** | | | | | | | | | | | | |
| TA $t-1$ | | 0.065*** | 0.062*** | | 0.548*** | 0.591*** | | 0.141*** | 0.138*** | | 0.022*** | 0.020*** |
| | | (0.004) | (0.004) | | (0.021) | (0.025) | | (0.006) | (0.008) | | (0.003) | (0.003) |
| ROA $t-1$ | | 0.068*** | 0.078*** | | 0.360*** | 0.492*** | | 0.077*** | 0.064*** | | 0.027** | 0.033** |
| | | (0.014) | (0.019) | | (0.061) | (0.101) | | (0.017) | (0.025) | | (0.011) | (0.015) |
| Leverage $t-1$ | | 0.006 | 0.001 | | 0.107*** | 0.130* | | 0.014* | 0.007 | | 0.000 | -0.001 |
| | | (0.004) | (0.007) | | (0.032) | (0.067) | | (0.008) | (0.014) | | (0.004) | (0.006) |
| TobinsQ $t-1$ | | 0.106** | 0.166*** | | 0.166 | 0.647** | | -0.022 | 0.012 | | 0.104*** | 0.127*** |
| | | (0.045) | (0.050) | | (0.210) | (0.264) | | (0.058) | (0.077) | | (0.026) | (0.032) |
| Zscore $t-1$ | | -0.023*** | -0.023** | | -0.208*** | -0.272*** | | -0.001 | 0.014 | | -0.010* | -0.008 |
| | | (0.007) | (0.009) | | (0.048) | (0.073) | | (0.012) | (0.016) | | (0.006) | (0.008) |
| NPL $t-1$ | | -0.032*** | -0.035*** | | 0.015 | 0.100* | | 0.006 | 0.007 | | -0.039*** | -0.042*** |
| | | (0.008) | (0.010) | | (0.040) | (0.055) | | (0.010) | (0.012) | | (0.009) | (0.010) |
| Efficiency $t-1$ | | 0.053** | 0.063*** | | -0.112 | -0.083 | | 0.146*** | 0.175*** | | 0.026 | 0.023 |
| | | (0.024) | (0.023) | | (0.128) | (0.148) | | (0.044) | (0.050) | | (0.019) | (0.015) |
| CustmDepo$t-1$ | | -0.024** | -0.033*** | | -0.097* | -0.107 | | 0.010 | 0.008 | | -0.017** | -0.019** |
| | | (0.010) | (0.011) | | (0.053) | (0.069) | | (0.017) | (0.021) | | (0.007) | (0.008) |
| CapitalRato$t-1$ | | -0.012 | -0.031 | | -0.072 | -0.243** | | -0.009 | -0.019 | | -0.009 | -0.018 |
| | | (0.016) | (0.020) | | (0.089) | (0.118) | | (0.023) | (0.037) | | (0.012) | (0.018) |
| NII $t-1$ | | 0.024*** | 0.005 | | 0.402*** | 0.268*** | | 0.052*** | 0.025* | | 0.008 | 0.001 |
| | | (0.008) | (0.009) | | (0.046) | (0.064) | | (0.012) | (0.014) | | (0.007) | (0.008) |
| PRI Signatory | | 0.232*** | 0.191*** | | 0.429*** | 0.381*** | | 0.251*** | 0.230*** | | 0.065*** | 0.010 |
| | | (0.018) | (0.022) | | (0.080) | (0.099) | | (0.030) | (0.039) | | (0.016) | (0.019) |
| SIB | | 0.060*** | 0.053*** | | -0.056 | -0.023 | | 0.053** | 0.047 | | 0.038*** | 0.022 |
| | | (0.016) | (0.019) | | (0.093) | (0.128) | | (0.026) | (0.031) | | (0.013) | (0.015) |
| ***Macroeconomic variables*** | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GDP $t-1$ | | | -0.033 | | | -0.017 | | | 0.013 | | | -0.028 |
| | | | (0.050) | | | (0.165) | | | (0.061) | | | (0.039) |
| Unemplym$t-1$ | | | -0.033 | | | -0.014 | | | -0.136 | | | 0.032 |
| | | | (0.063) | | | (0.350) | | | (0.119) | | | (0.048) |
| Population $t-1$ | | | -0.009 | | | -0.023 | | | -0.035 | | | -0.009 |
| | | | (0.041) | | | (0.178) | | | (0.050) | | | (0.030) |
| Inflation $t-1$ | | | -0.020 | | | 0.042 | | | 0.017 | | | -0.017* |
| | | | (0.015) | | | (0.100) | | | (0.022) | | | (0.010) |
| SDGindex $t-1$ | | | 3.111 | | | 5.667 | | | -3.024 | | | 2.443 |
| | | | (2.117) | | | (10.504) | | | (3.137) | | | (1.602) |
| Government | | | -0.586 | | | -3.709 | | | -1.501 | | | -0.346 |
| Regulation $t-1$ | | | (0.855) | | | (5.272) | | | (1.511) | | | (0.563) |
| Constant | -1.105*** | -1.870*** | -4.105*** | -2.653*** | -6.668*** | -12.063 | -1.956*** | -3.756*** | -1.369 | -0.274*** | -0.566*** | -2.330* |
| | (0.005) | (0.134) | (1.586) | (0.036) | (0.645) | (7.533) | (0.008) | (0.239) | (2.294) | (0.004) | (0.104) | (1.213) |
| Adj R-sq | 0.3589 | 0.5641 | 0.4983 | 0.3812 | 0.6577 | 0.6637 | 0.5573 | 0.7058 | 0.6832 | 0.3184 | 0.4008 | 0.2971 |
| Observations | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYear FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Disclosure scores. The dependent variables are ESG Disclosure score, Environmental score, Social score, Governance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index and Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 24: EPU and Banks' ESG activities: PRI signatory status**

| | Non-PRI signatories | | | | PRI Signatories | | | |
|---|---|---|---|---|---|---|---|---|
| | ESG Disclosure Scores | | | | | | | |
| *Dependent Variable* | ESG scores | Environment | Social | Governance | ESG scores | Environment | Social | Governance |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| EPU $t-1$ | -0.005 | -0.027 | 0.023 | -0.010 | -0.028* | -0.024 | 0.001 | -0.083 |
| | (0.017) | (0.096) | (0.029) | (0.010) | (0.016) | (0.025) | (0.027) | (0.064) |
| ***Bank level variables*** | | | | | | | | |
| TA $t-1$ | 0.049*** | 0.661*** | 0.140*** | 0.010*** | 0.079*** | 0.147*** | 0.088*** | 0.067*** |
| | (0.004) | (0.032) | (0.009) | (0.003) | (0.012) | (0.046) | (0.020) | (0.021) |
| ROA $t-1$ | 0.023 | 0.337** | 0.053* | 0.007 | 0.041* | 0.109 | 0.211*** | -0.110** |
| | (0.017) | (0.132) | (0.030) | (0.014) | (0.022) | (0.084) | (0.055) | (0.047) |
| Leverage $t-1$ | 0.006 | 0.183*** | 0.015 | 0.000 | -0.126*** | -0.164** | -0.249*** | -0.071*** |
| | (0.006) | (0.069) | (0.014) | (0.005) | (0.024) | (0.076) | (0.052) | (0.026) |
| TobinsQ $t-1$ | 0.240** | 1.881** | -0.360 | 0.303*** | -0.216 | 0.733 | -0.693 | -0.410 |
| | (0.105) | (0.742) | (0.258) | (0.080) | (0.305) | (1.022) | (0.587) | (0.567) |
| Zscore $t-1$ | -0.014* | -0.283*** | 0.018 | -0.011 | -0.074*** | -0.159*** | -0.156*** | -0.004 |
| | (0.008) | (0.090) | (0.018) | (0.007) | (0.015) | (0.050) | (0.037) | (0.026) |
| NPL $t-1$ | -0.025*** | 0.045 | 0.003 | -0.036*** | 0.034 | 0.051 | -0.003 | 0.095** |
| | (0.009) | (0.061) | (0.013) | (0.011) | (0.021) | (0.061) | (0.041) | (0.046) |
| Efficiency $t-1$ | 0.008 | -0.093 | 0.127*** | -0.001 | 0.052 | 0.213 | 0.148 | -0.086 |
| | (0.016) | (0.160) | (0.043) | (0.012) | (0.054) | (0.167) | (0.139) | (0.093) |
| CustomDeposits $t-1$ | -0.048*** | -0.540*** | -0.046 | -0.036*** | -0.021 | -0.117** | -0.055** | 0.009 |
| | (0.015) | (0.118) | (0.029) | (0.011) | (0.013) | (0.046) | (0.023) | (0.014) |
| Capital Ratio$t-1$ | -0.040* | -0.537*** | -0.014 | -0.036* | 0.020 | -0.043 | 0.342* | -0.249 |
| | (0.022) | (0.148) | (0.041) | (0.021) | (0.080) | (0.205) | (0.175) | (0.187) |
| NII $t-1$ | 0.013 | 0.145 | 0.010 | 0.011 | -0.022 | -0.103 | -0.067 | 0.028 |
| | (0.008) | (0.089) | (0.015) | (0.008) | (0.020) | (0.064) | (0.042) | (0.046) |
| SIB | 0.078*** | -0.140 | 0.032 | 0.030** | 0.040** | 0.055 | 0.106** | 0.025 |
| | (0.023) | (0.183) | (0.036) | (0.015) | (0.019) | (0.056) | (0.052) | (0.041) |
| ***Macroeconomic variables*** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GDP $t-1$ | -0.006 | 0.100 | 0.030 | -0.014 | -0.009 | -0.089 | 0.054 | 0.014 |
| | (0.051) | (0.242) | (0.087) | (0.034) | (0.022) | (0.061) | (0.054) | (0.050) |
| Unemployment $t-1$ | -0.013 | -0.074 | -0.125 | -0.050 | 0.088 | -0.021 | -0.145 | 0.274** |
| | (0.076) | (0.420) | (0.143) | (0.046) | (0.071) | (0.255) | (0.179) | (0.133) |
| Population $t-1$ | 0.025 | -0.036 | -0.052 | 0.011 | 0.050 | 0.123 | 0.215** | -0.103 |
| | (0.044) | (0.228) | (0.056) | (0.029) | (0.034) | (0.111) | (0.084) | (0.066) |
| Inflation $t-1$ | -0.001 | 0.113 | 0.034 | -0.008 | 0.021 | 0.030 | 0.050 | 0.004 |
| | (0.015) | (0.127) | (0.026) | (0.010) | (0.014) | (0.042) | (0.035) | (0.025) |
| SDG index $t-1$ | 3.248 | 12.382 | -0.928 | 3.037** | -0.254 | 0.084 | -9.191* | 5.543 |
| | (2.133) | (13.031) | (3.842) | (1.451) | (2.081) | (6.951) | (4.658) | (4.284) |
| Government Regulation$t-1$ | -1.600 | -7.644 | -1.866 | -0.784 | -0.805 | -0.213 | -0.447 | -1.903 |
| | (1.207) | (7.447) | (2.191) | (0.712) | (0.914) | (2.294) | (2.316) | (2.052) |
| Constant | -3.768** | -18.905** | -2.871 | -2.369** | -1.322 | -3.642 | 6.067 | -5.510 |
| | (1.564) | (9.333) | (2.800) | (1.056) | (1.675) | (5.395) | (3.872) | (3.472) |
| Adj R-sq | 0.4905 | 0.6622 | 0.6209 | 0.3139 | 0.7519 | 0.5654 | 0.6615 | 0.6466 |
| Observations | 3,339 | 3,339 | 3,339 | 3,339 | 371 | 371 | 371 | 371 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Disclosure scores by banks' PRI signatory status. The dependent variables are ESG Disclosure score, Environmental score, Social score, Governance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index, Government Regulation index. This table reports estimates of the fixed effects specification in equation (1.1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Does banks' size matter for ESG scores during high uncertainty?**

We consider the effect of economic uncertainty on banks' ESG activities depending on their size. Using their Total Assets, we split the sample into two groups where the top 10% represent the big banks' group, whereas the remaining 90% represent the medium to small banks group. Table 25 presents the regression results which are consistent with the main results highlighting the negative relationship between the overall banks' ESG disclosure scores and all categories except Social scores. However, the results also highlight a differential effect of economic uncertainty on big banks compared to their small to medium counterparts. For big banks (top 10%) the statistical and economic significance is noted at category level. To illustrate, a 1% increase in Economic Policy Uncertainty reduces their Governance scores by 3% and Environmental scores by 14%. For small to medium banks (90%), however, the effect is not significant which is a very interesting result but not surprising.

Big banks have more ESG activities disclosed compared to small banks as highlighted in Table 20.The overall ESG disclosure score for big banks is 52% compared to 32% for small banks. The difference is significant at categorical level where, for instance, Environmental scores for big banks are 34% compared to 7% only for small banks. This could reflect some countries' efforts such as the UK and European Union in regulating and requiring banks to report on their sustainability activities (Thomson Reuters, 2021). This leads to the risk of negative effects of non-compliance with ESG performance on the non-compliant bank's reputation (Galletta et al., 2023) which would be detrimental for big banks. In fact, big banks were heavily criticised for their irresponsible actions and faced reputational damage following the 2007/2008 credit crunch. Since then, they have focused more on improving their social responsibility engagements compared to smaller banks (Cornett et al., 2016). This also explains why banks' social activities are not significantly affected by economic uncertainty.

The results could also be explained in line with the theory that bigger banks take more risk compared to smaller banks (Baron et al., 2023). In the case of ESG activities, for instance, investing in these sustainable projects comes with new

risker complex challenges for banks and corporations (KPMG, 2021). Consequently, the results by bank size show that Economic Political Uncertainty affects banks' ESG activities differently depending on their size. Bigger banks' Environmental and Governance activities reduce during economic uncertainty, while those of small to medium banks are not significantly affected. The results are also in line with studies highlighting how corporates' size determines to what extent their investments are affected by high uncertainty (Al-Thaqeb & Algharabali, 2019; Kang et al., 2014).

To verify the results by bank size, we split the sample into Systematically Important Banks (SIBs) and non- Systematically Important Banks (non-SIBs) where observations are split 15% and 85% respectively. Consistent with the main results, Table 26 reports the results which show SIBs' activities to have a negative relationship with economic uncertainty. In particular, SIBs Governance is significantly affected by economic uncertainty where a 1% increase in the latter reduces the former by 3%. Non-SIBs results report no significant impact of economic uncertainty on their ESG activities.

**Table 25: EPU and Banks' ESG activities: Big banks versus Small & Medium banks**

| | **Big Banks (top 10%)** | | | | **Small & Medium Banks (90%)** | | | |
|---|---|---|---|---|---|---|---|---|
| | ESG Disclosure Scores | | | | | | | |
| *Dependent Variables* | ESG scores | Environment | Social | Governance | ESG scores | Environment | Social | Governance |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| EPU $t-1$ | -0.024 | -0.142** | 0.026 | -0.025* | -0.011 | 0.005 | 0.030 | -0.030 |
| | (0.017) | (0.058) | (0.030) | (0.014) | (0.017) | (0.111) | (0.028) | (0.024) |
| ***Bank level variables*** | | | | | | | | |
| TA $t-1$ | 0.049** | 0.154** | 0.046 | 0.035*** | 0.051*** | 0.669*** | 0.134*** | 0.012*** |
| | (0.019) | (0.065) | (0.034) | (0.012) | (0.005) | (0.044) | (0.010) | (0.004) |
| ROA $t-1$ | 0.030 | 0.135 | 0.064 | -0.024 | 0.100*** | 0.563*** | 0.074*** | 0.045** |
| | (0.025) | (0.094) | (0.043) | (0.021) | (0.022) | (0.134) | (0.028) | (0.018) |
| Leverage $t-1$ | 0.111** | 0.481*** | -0.014 | 0.101*** | 0.003 | 0.040 | 0.006 | 0.004 |
| | (0.053) | (0.182) | (0.078) | (0.036) | (0.008) | (0.077) | (0.014) | (0.006) |
| TobinsQ $t-1$ | 0.103 | 1.548 | 0.041 | -0.117 | 0.160*** | 0.449 | -0.010 | 0.130*** |
| | (0.511) | (1.353) | (0.909) | (0.329) | (0.053) | (0.281) | (0.079) | (0.034) |
| Zscore $t-1$ | -0.095*** | -0.322*** | -0.088 | -0.020 | -0.023** | -0.227*** | 0.022 | -0.009 |
| | (0.025) | (0.074) | (0.053) | (0.018) | (0.009) | (0.084) | (0.016) | (0.008) |
| NPL $t-1$ | -0.020 | -0.073 | 0.003 | -0.004 | -0.037*** | 0.136** | 0.006 | -0.044*** |
| | (0.025) | (0.082) | (0.078) | (0.019) | (0.010) | (0.062) | (0.012) | (0.011) |
| Efficiency $t-1$ | 0.149* | 0.098 | 0.144 | 0.197*** | 0.079*** | 0.024 | 0.216*** | 0.021 |
| | (0.085) | (0.274) | (0.161) | (0.054) | (0.027) | (0.172) | (0.054) | (0.016) |
| CustomDeposit$t-1$ | 0.410*** | 0.941** | 0.314* | 0.396*** | -0.042*** | -0.076 | 0.014 | -0.029*** |
| | (0.131) | (0.413) | (0.184) | (0.094) | (0.013) | (0.084) | (0.023) | (0.009) |
| Capital Ratio$t-1$ | -0.024 | -0.344 | -0.045 | 0.073 | -0.034 | -0.103 | 0.004 | -0.031 |
| | (0.131) | (0.357) | (0.226) | (0.082) | (0.022) | (0.135) | (0.038) | (0.020) |
| NII $t-1$ | -0.119*** | -0.296** | -0.083 | -0.108*** | 0.001 | 0.272*** | 0.016 | 0.003 |
| | (0.044) | (0.142) | (0.069) | (0.028) | (0.010) | (0.085) | (0.015) | (0.009) |
| SIB banks | -0.002 | -0.051 | 0.136 | -0.046 | 0.028 | 0.035 | 0.012 | 0.027 |
| | (0.054) | (0.133) | (0.094) | (0.034) | (0.024) | (0.175) | (0.040) | (0.020) |
| PRI Signatory | 0.047** | 0.143** | 0.005 | 0.026** | 0.341*** | 0.534*** | 0.435*** | 0.013 |
| | (0.021) | (0.058) | (0.043) | (0.013) | (0.040) | (0.199) | (0.067) | (0.038) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***Macroeconomic variables*** | | | | | | | | |
| GDP $t-1$ | -0.044 | -0.185* | 0.038 | -0.033 | -0.003 | 0.109 | 0.019 | -0.011 |
| | (0.035) | (0.103) | (0.064) | (0.026) | (0.063) | (0.224) | (0.078) | (0.049) |
| Unemploymnt$t-1$ | -0.071 | -0.277 | -0.092 | -0.069 | -0.025 | -0.050 | -0.078 | 0.030 |
| | (0.087) | (0.305) | (0.166) | (0.063) | (0.077) | (0.490) | (0.144) | (0.054) |
| Population $t-1$ | -0.069 | -0.387 | -0.031 | -0.084* | 0.015 | 0.176 | -0.032 | 0.016 |
| | (0.065) | (0.281) | (0.075) | (0.046) | (0.045) | (0.200) | (0.058) | (0.031) |
| Inflation $t-1$ | -0.026 | -0.110* | -0.013 | -0.022 | -0.017 | 0.091 | 0.021 | -0.013 |
| | (0.021) | (0.065) | (0.034) | (0.014) | (0.018) | (0.138) | (0.028) | (0.012) |
| SDG index $t-1$ | 3.306 | 23.638*** | -3.205 | 1.486 | 4.159 | 3.975 | -2.408 | 3.041 |
| | (2.551) | (8.811) | (4.757) | (1.854) | (2.657) | (13.470) | (3.809) | (1.981) |
| Government | -1.148 | -3.049 | -0.369 | -0.932 | -0.045 | -3.322 | -1.117 | -0.073 |
| Regulation $t-1$ | (1.258) | (3.393) | (2.743) | (0.852) | (1.016) | (6.743) | (1.830) | (0.645) |
| Constant | -4.716** | -23.108*** | 0.022 | -2.668* | -4.982** | -11.630 | -2.129 | -2.754* |
| | (2.050) | (6.737) | (3.670) | (1.450) | (2.012) | (9.827) | (2.797) | (1.508) |
| Adj R-sq | 0.6208 | 0.5035 | 0.4882 | 0.7216 | 0.3885 | 0.6269 | 0.6109 | 0.2847 |
| Observations | 390 | 390 | 390 | 390 | 3,320 | 3,320 | 3,320 | 3,320 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Disclosure scores by banks' size. Sample split into two groups, big banks (top 10%) and small to medium banks (90%). The dependent variables are ESG Disclosure score, Environmental score, Social score, Governance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index, Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 26: EPU and Banks' ESG activities: SIB versus non-SIB banks**

| | **SIB banks** | | | | **Non-SIB banks** | | | |
|---|---|---|---|---|---|---|---|---|
| | ESG Disclosure Scores | | | | | | | |
| | ESG scores | Environment | Social | Governance | ESG scores | Environment | Social | Governance |
| *Dependent Variables* | | | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| EPU $t-1$ | -0.014 | -0.088 | 0.000 | -0.030** | -0.010 | 0.038 | 0.033 | -0.029 |
| | (0.016) | (0.062) | (0.021) | (0.013) | (0.018) | (0.116) | (0.031) | (0.028) |
| ***Bank level variables*** | | | | | | | | |
| TA $t-1$ | 0.095*** | 0.221*** | 0.099*** | 0.044*** | 0.058*** | 0.677*** | 0.139*** | 0.015*** |
| | (0.015) | (0.048) | (0.022) | (0.012) | (0.005) | (0.031) | (0.009) | (0.004) |
| ROA $t-1$ | 0.046 | -0.046 | 0.064* | -0.075 | 0.091*** | 0.620*** | 0.058** | 0.053*** |
| | (0.048) | (0.117) | (0.033) | (0.049) | (0.022) | (0.128) | (0.028) | (0.017) |
| Leverage $t-1$ | 0.149** | 0.354* | 0.109 | 0.107** | 0.004 | 0.048 | 0.010 | 0.003 |
| | (0.062) | (0.191) | (0.079) | (0.048) | (0.008) | (0.081) | (0.014) | (0.006) |
| TobinsQ $t-1$ | 0.037 | 8.237*** | 0.890* | -0.423 | 0.158*** | 0.457 | -0.005 | 0.122*** |
| | (0.811) | (1.708) | (0.516) | (0.532) | (0.048) | (0.290) | (0.079) | (0.032) |
| Zscore $t-1$ | -0.055 | -0.359*** | -0.181*** | 0.070** | -0.024** | -0.303*** | 0.020 | -0.012 |
| | (0.054) | (0.103) | (0.035) | (0.033) | (0.009) | (0.085) | (0.017) | (0.008) |
| NPL $t-1$ | -0.130** | -0.105 | -0.062* | -0.050 | -0.034*** | 0.155** | 0.005 | -0.044*** |
| | (0.055) | (0.097) | (0.036) | (0.033) | (0.010) | (0.067) | (0.013) | (0.011) |
| Efficiency $t-1$ | 0.070 | -0.805*** | -0.224* | 0.008 | 0.066** | -0.004 | 0.156*** | 0.033* |
| | (0.129) | (0.306) | (0.121) | (0.095) | (0.026) | (0.194) | (0.058) | (0.017) |
| CustomDeposit $t-1$ | 0.718*** | 1.485*** | 0.621*** | 0.477*** | -0.040*** | -0.132* | 0.009 | -0.026*** |
| | (0.169) | (0.556) | (0.154) | (0.147) | (0.012) | (0.076) | (0.022) | (0.009) |
| Capital Ratio$t-1$ | 0.062 | 0.189 | 0.277** | 0.286*** | -0.046** | -0.336*** | -0.017 | -0.035* |
| | (0.100) | (0.339) | (0.138) | (0.084) | (0.021) | (0.126) | (0.040) | (0.020) |
| NII $t-1$ | 0.060 | -0.169 | -0.008 | 0.074** | 0.004 | 0.311*** | 0.027* | -0.002 |
| | (0.040) | (0.110) | (0.040) | (0.031) | (0.009) | (0.078) | (0.014) | (0.008) |
| PRI Signatory | 0.057 | 0.136 | 0.063 | -0.047 | 0.249*** | 0.076 | 0.282*** | 0.055** |
| | (0.037) | (0.087) | (0.045) | (0.029) | (0.029) | (0.151) | (0.058) | (0.027) |
| ***Macroeconomic variables*** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GDP $t-1$ | -0.067 | -0.219 | -0.009 | -0.041 | -0.028 | -0.111 | 0.000 | -0.026 |
| | (0.041) | (0.136) | (0.050) | (0.034) | (0.086) | (0.239) | (0.105) | (0.065) |
| Unemployment $t-1$ | -0.002 | -0.410 | -0.018 | -0.020 | -0.095 | -0.055 | -0.161 | 0.009 |
| | (0.088) | (0.363) | (0.112) | (0.077) | (0.094) | (0.606) | (0.172) | (0.068) |
| Population $t-1$ | 0.015 | 0.018 | 0.029 | -0.015 | -0.007 | 0.000 | -0.078 | 0.011 |
| | (0.051) | (0.148) | (0.036) | (0.039) | (0.046) | (0.274) | (0.083) | (0.026) |
| Inflation $t-1$ | -0.007 | 0.118 | -0.009 | -0.019* | -0.044* | -0.139 | 0.001 | -0.021 |
| | (0.019) | (0.106) | (0.024) | (0.012) | (0.025) | (0.122) | (0.043) | (0.018) |
| SDG index $t-1$ | 4.018 | 26.099* | 0.049 | 2.250 | 1.683 | -15.861 | -4.025 | 2.256 |
| | (3.043) | (14.585) | (2.695) | (2.869) | (3.526) | (13.637) | (4.953) | (2.716) |
| Government | -2.003 | -2.445 | -2.818 | -2.255* | 0.228 | -1.404 | -1.412 | 0.286 |
| Regulation $t-1$ | (1.554) | (6.012) | (2.049) | (1.164) | (1.189) | (6.558) | (2.300) | (0.717) |
| Constant | -4.526** | -19.877* | -0.484 | -1.424 | -3.079 | 2.561 | -0.599 | -2.264 |
| | (2.262) | (10.640) | (2.118) | (2.151) | (2.675) | (10.193) | (3.636) | (2.072) |
| Adj R-sq | 0.6201 | 0.4772 | 0.6509 | 0.6769 | 0.3711 | 0.6511 | 0.5695 | 0.2338 |
| Observations | 557 | 557 | 557 | 557 | 3153 | 3153 | 3153 | 3153 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Disclosure scores by banks' classification. Sample split into two groups, Systematically Important Banks (SIBs) and non-Systematically Important Banks (non-SIBs). The dependent variables are ESG Disclosure score, Environmental score, Social score, Governance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index, Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### 2.4.2 Robustness Checks

#### *2.4.2.1 Alternative measure of ESG scores*

In this section, we run a series of tests to verify the robustness of our results. Firstly, we replace our dependent variables (Environmental Social Governance Disclosure scores) with an alternative ESG measure which is ESG Performance scores. In the performance scores, Bloomberg evaluate companies based on issues that are deemed financially relevant to their industry (Bloomberg, 2022). Bloomberg ESG Performance scores do not rely on firm's disclosure of ESG activities but rather evaluate the disclosure against industry guidelines. To measure the scores, Bloomberg assess industry-specific sustainability issues by prioritizing and ranking the sets of issues using proprietary and external sources. Under each category is a series of issues which contain at least one sub-issue that aggregates associated qualitative and quantitative ESG data fields (Bloomberg, 2022).

The industry specific sustainability issues are prioritised using a three-part assessment. First, the probability of the issue materialising is ranked high, medium or low. Second, a similar ranking is given to the issue with regards to its magnitude highlighting the potential severity of financial cost. Third, the issue is classified short-term, medium-term or long-term based on the issue's financial impact occurrence if less than 2 years, 2 to 5 years or 5 to 10 years respectively. For instance, many banks in recent years declared funding cuts for activities that cause deforestation in the Amazon Forest. Therefore, an environmental incident of this nature has a high probability, high magnitude and medium timing (Bloomberg, 2022). Appendix 4 illustrates an example of how Environmental performance scores are measured with summary statistics of these scores in Table 18.

We re-estimate Eq (2) using the ESG Performance Scores as alternative ESG activities indicators and report the estimation results in Table 27. Columns (1), (2), (3) and (4) show a negative estimated coefficient of economic policy uncertainty indicating a negative relationship between Banks' ESG activities and economic uncertainty. We find the results do not change qualitatively as banks'

Governance scores are statistically significant and economically meaningful as shown in columns (4) where a 1% increase in uncertainty reduces banks' governance activities by 2%. These results are consistent with the main results and provide further evidence that banks ESG activities and Governance activities tend to decrease with economic uncertainty.

We further examine if our results are affected by bank size by splitting banks into Systemically Important Banks (SIBs) and non-Systematically Important Banks (non-SIBs) and re-estimating our baseline specifications. Results in Table 28 are consistent with the main results showing Systematically Important Banks' (SIBs) ESG activities to be negatively affected by economic uncertainty while no effect is noted for non-Systematically Important Banks (non-SIBs). Column (1) shows the overall ESG score to reduce by 5% when economic uncertainty increases by 1%. At category level, column (4) shows Governance Performance scores which are the most affected as a 1% increase in economic uncertainty reduces Governance activities by 3%, consistent with the main results.

**Table 27: ESG Performance scores as an alternative measure**

| | **ESG Performance Scores** | | | |
|---|---|---|---|---|
| *Dependent Variables* | ESG | Environmental | Social | Governance |
| | (1) | (2) | (3) | (4) |
| EPU$t-1$ | -0.042 | -0.054 | -0.003 | -0.017* |
| | (0.038) | (0.114) | (0.046) | (0.009) |
| ***Banks Characteristics*** | | | | |
| TA $t-1$ | 0.268*** | 0.394*** | 0.123*** | 0.012*** |
| | (0.016) | (0.057) | (0.014) | (0.003) |
| ROA $t-1$ | 0.123*** | 0.553*** | 0.011 | 0.024** |
| | (0.033) | (0.121) | (0.043) | (0.012) |
| Leverage $t-1$ | -0.074*** | -0.129 | -0.014 | -0.003 |
| | (0.027) | (0.105) | (0.030) | (0.006) |
| TobinsQ $t-1$ | 0.558*** | 0.627 | -0.290 | 0.093*** |
| | (0.148) | (0.836) | (0.344) | (0.035) |
| Zscore $t-1$ | -0.084*** | -0.366*** | 0.041 | -0.006 |
| | (0.027) | (0.109) | (0.030) | (0.006) |
| NPL $t-1$ | -0.057** | -0.110 | 0.072** | -0.010 |
| | (0.026) | (0.072) | (0.028) | (0.006) |
| Efficiency $t-1$ | 0.367*** | 0.235 | 0.246*** | -0.003 |
| | (0.065) | (0.477) | (0.058) | (0.029) |
| CustomDepst $t-1$ | 0.055 | 0.493*** | 0.199*** | -0.014 |
| | (0.035) | (0.115) | (0.038) | (0.011) |
| Capital Ratio$t-1$ | 0.005 | -0.040 | 0.102 | 0.039** |
| | (0.064) | (0.372) | (0.084) | (0.016) |
| NII $t-1$ | -0.001 | 0.182* | -0.034 | 0.002 |
| | (0.025) | (0.104) | (0.026) | (0.008) |
| PRI Signatory | -0.108** | 0.081 | -0.024 | 0.022 |

| | | | | |
|---|---|---|---|---|
| | (0.047) | (0.157) | (0.066) | (0.015) |
| SIB | -0.166*** | -0.051 | -0.007 | 0.056*** |
| | (0.050) | (0.184) | (0.069) | (0.015) |
| ***Macroeconomic variables*** | | | | |
| GDP $t-1$ | -0.018 | -0.185 | -0.044 | -0.015 |
| | (0.052) | (0.196) | (0.077) | (0.022) |
| Unemploymnt$t-1$ | 0.096 | 0.046 | 0.274 | 0.049 |
| | (0.152) | (0.447) | (0.199) | (0.058) |
| Population $t-1$ | -0.052 | 0.307 | -0.184* | -0.007 |
| | (0.065) | (0.235) | (0.098) | (0.027) |
| Inflation $t-1$ | -0.055* | -0.112 | -0.059 | -0.003 |
| | (0.032) | (0.116) | (0.040) | (0.009) |
| SDG index $t-1$ | 0.888 | -15.464 | -5.858 | 0.668 |
| | (4.292) | (14.114) | (5.343) | (1.414) |
| Government | -0.035 | -0.980 | 0.458 | -0.712 |
| Regulation $t-1$ | (2.034) | (7.232) | (2.556) | (0.618) |
| Constant | -5.252* | 5.099 | -0.169 | -1.008 |
| | (3.140) | (11.015) | (3.945) | (1.033) |
| Adj R-sq | 0.3667 | 0.3451 | 0.2539 | 0.7399 |
| Observations | 3,710 | 3,710 | 3,710 | 3,710 |
| Bank FE | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Performance scores by banks' size. Sample split into two groups, Systematically Important Banks (SIBs) and non-Systematically Important Banks (non-SIBs). The dependent variables are ESG Performance score, Environmental performance score, Social performance score, Governance performance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index, Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

**Table 28: ESG Performance scores by bank size**

| | SIB banks | | | | Non-SIB banks | | | |
|---|---|---|---|---|---|---|---|---|
| | ESG Performance Scores | | | | | | | |
| *Dependent Variable* | ESG | Environmental | Social | Governance | ESG | Environmental | Social | Governance |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| EPU$t-1$ | -0.045* | -0.064 | -0.025 | -0.027* | -0.045 | 0.016 | -0.014 | -0.010 |
| | (0.023) | (0.112) | (0.040) | (0.014) | (0.075) | (0.166) | (0.073) | (0.011) |
| ***Banks Characteristics*** | | | | | | | | |
| TA $t-1$ | 0.114*** | 0.593*** | -0.244*** | 0.005 | 0.311*** | 0.316*** | 0.148*** | 0.014*** |
| | (0.028) | (0.137) | (0.048) | (0.015) | (0.020) | (0.076) | (0.016) | (0.004) |
| ROA $t-1$ | -0.160 | 0.019 | -0.166* | 0.047 | 0.130*** | 0.568*** | 0.011 | 0.023* |
| | (0.098) | (0.202) | (0.086) | (0.042) | (0.039) | (0.143) | (0.050) | (0.013) |
| Leverage $t-1$ | 0.071 | -1.879*** | 0.139 | 0.191*** | -0.124*** | -0.029 | -0.080** | -0.006 |
| | (0.083) | (0.303) | (0.162) | (0.056) | (0.029) | (0.122) | (0.033) | (0.006) |
| TobinsQ $t-1$ | -1.125 | -7.032*** | -2.510** | 0.618 | 0.567*** | 0.380 | -0.718** | 0.097*** |
| | (0.990) | (2.409) | (1.095) | (0.487) | (0.136) | (0.993) | (0.346) | (0.037) |
| Zscore $t-1$ | 0.147** | 0.088 | 0.062 | -0.076** | -0.101*** | -0.362*** | -0.017 | -0.002 |
| | (0.070) | (0.219) | (0.073) | (0.030) | (0.027) | (0.130) | (0.033) | (0.006) |
| NPL $t-1$ | -0.189** | -0.741*** | -0.567*** | -0.031 | -0.045 | 0.030 | 0.140*** | -0.005 |
| | (0.078) | (0.177) | (0.096) | (0.035) | (0.028) | (0.067) | (0.034) | (0.006) |
| Efficiency $t-1$ | -0.081 | -1.310** | 0.297 | -0.064 | 0.373*** | 1.459* | -0.291** | 0.016 |
| | (0.161) | (0.657) | (0.226) | (0.074) | (0.123) | (0.777) | (0.130) | (0.037) |
| CustomDeposit$t-1$ | -0.270 | -4.730*** | 0.302 | 0.525*** | 0.063 | 0.574*** | 0.201*** | -0.019* |
| | (0.234) | (0.648) | (0.312) | (0.173) | (0.039) | (0.104) | (0.039) | (0.011) |
| Capital Ratio$t-1$ | 0.392*** | -1.608** | 0.707*** | 0.259** | 0.023 | 0.761 | 0.182** | 0.030* |
| | (0.138) | (0.687) | (0.257) | (0.102) | (0.070) | (0.529) | (0.085) | (0.018) |
| NII $t-1$ | 0.047 | 0.039 | 0.042 | -0.028 | 0.002 | 0.068 | 0.002 | 0.006 |
| | (0.063) | (0.209) | (0.072) | (0.033) | (0.027) | (0.113) | (0.026) | (0.008) |
| PRI Signatory | 0.103* | -0.055 | -0.003 | 0.024 | -0.347*** | 0.043 | -0.165 | 0.012 |
| | (0.055) | (0.162) | (0.064) | (0.023) | (0.080) | (0.238) | (0.117) | (0.020) |
| ***Macroeconomic variables*** | | | | | | | | |
| GDP $t-1$ | -0.028 | 0.004 | -0.012 | -0.017 | -0.020 | 0.080 | -0.123 | -0.024 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (0.059) | (0.198) | (0.096) | (0.035) | (0.078) | (0.407) | (0.120) | (0.020) |
| Unemployment$t-1$ | -0.114 | -1.637*** | -0.037 | 0.035 | 0.259 | 1.280* | 0.498* | 0.068 |
| | (0.134) | (0.443) | (0.218) | (0.103) | (0.219) | (0.764) | (0.279) | (0.069) |
| Population $t-1$ | -0.084 | 0.304 | -0.088 | -0.029 | -0.023 | 0.632* | -0.172 | 0.009 |
| | (0.075) | (0.189) | (0.107) | (0.039) | (0.093) | (0.341) | (0.120) | (0.026) |
| Inflation $t-1$ | -0.028 | -0.045 | -0.089* | -0.014 | -0.063 | -0.139 | -0.098 | -0.004 |
| | (0.030) | (0.121) | (0.047) | (0.018) | (0.056) | (0.157) | (0.068) | (0.016) |
| SDG index $t-1$ | 1.639 | -18.164 | 18.619*** | 0.972 | 2.063 | -3.417 | -10.851 | 0.532 |
| | (3.950) | (13.875) | (6.005) | (2.916) | (5.647) | (18.377) | (7.245) | (1.805) |
| Government | -3.435 | -20.263** | -7.402** | -2.205 | 1.022 | 10.975 | 3.191 | -0.510 |
| Regulation $t-1$ | (2.440) | (9.540) | (3.756) | (1.388) | (3.086) | (8.650) | (3.601) | (0.910) |
| Constant | -1.675 | 13.259 | -11.283** | -0.692 | -6.705 | -10.447 | 5.392 | -0.984 |
| | (3.030) | (10.769) | (4.547) | (2.094) | (4.209) | (15.490) | (5.448) | (1.314) |
| Adj R-sq | 0.6235 | 0.5414 | 0.5929 | 0.7214 | 0.3617 | 0.5128 | 0.2764 | 0.7657 |
| Observations | 557 | 557 | 557 | 557 | 3153 | 3153 | 3153 | 3153 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty on banks' ESG Performance scores by banks' classification. Sample split into two groups, Systematically Important Banks (SIBs) and non-Systematically Important Banks (non-SIBs). The dependent variables are ESG Disclosure score, Environmental score, Social score, Governance score which are proxies of banks' sustainable activities. The variable of interest is EPU index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index, Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

#### *2.4.2.2 Alternative measure of uncertainty*

We test if our results would be affected if a different measure of economic uncertainty is used. The next well-established measure of uncertainty in literature and research is the World Uncertainty Index (WUI) developed by Ahir, Bloom and Furceri in 2018. In 2022, the index was further enhanced as it tracks uncertainty across 143 countries from 1952 by way of text mining country reports of the Economist Intelligence Unit (Ahir et al., 2022)[12]. WUI has been used in numerous research and industry reports which highlights its credibility as an alternative measure of economic uncertainty (Adams et al., 2020; Adedoyin et al., 2021; Didier et al., 2021).

As the WUI index data is monthly, we annualise it for each of the 27 sample countries except for Croatia and Denmark. We noted that data for these countries which exists in the Economic Policy Uncertainty (EPU) index is not present in the World Uncertainty Index (WUI). Given that in the EPU index both countries have a total of 5 banks with 35 observations which is less than 1% of the total observations, excluding them in the robustness checks is unlikely to influence the results.

We re-estimate Eq (2) and present the results in Table 29 where ESG Disclosure Scores results are presented in columns (1) to (4), followed by ESG Performance Scores shown in columns (5) to (8). The results are consistent with our main findings indicating a negative relationship between economic uncertainty and banks' ESG activities. Despite the slight discrepancy between the ESG Disclosure scores results and those of the Performance scores, the coefficients of the overall ESG scores and that of Governance scores are negative and statistically significant in all estimations. This reaffirms our initial findings that an increase in economic uncertainty reduces banks' overall ESG activities affecting Governance activities the most.

[12] Given the size of the Economist Intelligence Unit (EIU) reports, the word "uncertain" or any of its variants are first counted in percentage, then rescaled by multiplying by 1,000,000 (Ahir et al., 2022). The data could access at: WUI

**Table 29: Alternative economic uncertainty measure**

| | ESG Disclosure Scores | | | | ESG Performance Scores | | | |
|---|---|---|---|---|---|---|---|---|
| *Dependent variable* | ESG | Environmental | Social | Governance | ESG | Environmental | Social | Governance |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| WUI $t-1$ | -0.072*** | -0.123 | 0.034 | -0.056*** | -0.132** | 0.054 | -0.178 | -0.043* |
| | (0.027) | (0.158) | (0.070) | (0.021) | (0.058) | (0.344) | (0.112) | (0.025) |
| ***Banks Characteristics*** | | | | | | | | |
| TA $t-1$ | 0.019 | 0.135 | 0.085* | -0.009 | 0.034 | 0.327 | 0.109* | -0.038 |
| | (0.014) | (0.133) | (0.047) | (0.009) | (0.055) | (0.513) | (0.065) | (0.030) |
| ROA $t-1$ | 0.033 | -0.127 | -0.047 | 0.021 | -0.084 | 0.129 | -0.119 | 0.027 |
| | (0.027) | (0.216) | (0.056) | (0.018) | (0.098) | (0.243) | (0.095) | (0.022) |
| Leverage $t-1$ | 0.004 | -0.119 | 0.010 | 0.001 | 0.018 | -0.253 | 0.019 | 0.000 |
| | (0.004) | (0.095) | (0.015) | (0.002) | (0.015) | (0.184) | (0.034) | (0.007) |
| TobinsQ $t-1$ | 0.077*** | 0.416 | -0.081 | 0.042** | 0.172 | 0.094 | 0.256 | -0.008 |
| | (0.021) | (0.356) | (0.149) | (0.017) | (0.150) | (0.748) | (0.270) | (0.049) |
| Zscore $t-1$ | -0.046 | 0.101 | 0.096 | -0.032 | 0.097 | -0.206 | 0.155 | -0.036 |
| | (0.038) | (0.308) | (0.084) | (0.024) | (0.122) | (0.383) | (0.134) | (0.030) |
| NPL $t-1$ | 0.007* | 0.075** | 0.005 | 0.003 | 0.005 | -0.110 | -0.006 | 0.007 |
| | (0.004) | (0.033) | (0.013) | (0.003) | (0.014) | (0.214) | (0.020) | (0.004) |
| Efficiency $t-1$ | -0.010 | -0.109 | -0.014 | 0.006 | 0.230** | 0.137 | 0.265* | 0.062* |
| | (0.009) | (0.109) | (0.037) | (0.009) | (0.096) | (0.669) | (0.154) | (0.038) |
| CustomDeps$t-1$ | -0.014 | 0.009 | -0.046 | -0.026** | -0.044* | 0.122* | 0.007 | -0.054*** |
| | (0.024) | (0.070) | (0.052) | (0.011) | (0.023) | (0.066) | (0.039) | (0.015) |
| Capital Ratio$t-1$ | 0.021 | 0.082 | 0.043 | 0.004 | -0.022 | -0.257 | 0.030 | 0.014 |
| | (0.021) | (0.251) | (0.060) | (0.011) | (0.053) | (0.462) | (0.113) | (0.018) |
| NII $t-1$ | 0.002 | -0.073 | 0.006 | 0.003 | 0.040 | 0.349 | 0.062 | -0.019 |
| | (0.005) | (0.115) | (0.015) | (0.003) | (0.041) | (0.277) | (0.048) | (0.014) |
| PRI Signatory | 0.003 | -0.062 | 0.001 | -0.004 | 0.031 | 0.181 | 0.088 | 0.025 |
| | (0.020) | (0.127) | (0.039) | (0.018) | (0.032) | (0.348) | (0.092) | (0.020) |
| ***Macroeconomic variables*** | | | | | | | | |
| GDP $t-1$ | -0.015 | 0.085 | 0.015 | -0.016 | -0.016 | -0.217* | -0.003 | -0.004 |
| | (0.012) | (0.082) | (0.021) | (0.010) | (0.022) | (0.110) | (0.051) | (0.008) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Unemploymt$t-1$ | -0.040 | -0.391* | -0.140** | -0.010 | 0.004 | -0.342 | 0.158 | -0.017 |
| | (0.026) | (0.213) | (0.065) | (0.020) | (0.054) | (0.306) | (0.138) | (0.028) |
| Population $t-1$ | 0.008 | -0.069 | -0.040 | 0.005 | -0.035 | 0.461*** | -0.161*** | -0.007 |
| | (0.019) | (0.131) | (0.030) | (0.015) | (0.029) | (0.149) | (0.060) | (0.013) |
| Inflation $t-1$ | -0.012** | -0.004 | 0.018* | -0.008** | -0.018* | -0.016 | -0.036 | 0.001 |
| | (0.005) | (0.056) | (0.010) | (0.004) | (0.010) | (0.099) | (0.028) | (0.005) |
| SDG index $t-1$ | 1.424** | 2.142 | -2.825* | 0.951 | -0.790 | -14.903 | -2.246 | 0.787 |
| | (0.695) | (6.600) | (1.683) | (0.623) | (1.263) | (10.669) | (3.543) | (0.677) |
| Government | -0.555* | -3.130 | -0.961 | -0.542* | -1.483** | -6.361 | -2.413* | -0.806** |
| Regulation $t-1$ | (0.324) | (2.489) | (0.700) | (0.300) | (0.709) | (5.277) | (1.416) | (0.323) |
| Constant | -2.066*** | -4.428 | -0.526 | -0.730 | -1.188 | 6.731 | -2.636 | -0.844 |
| | (0.519) | (4.360) | (1.208) | (0.444) | (1.242) | (7.764) | (2.816) | (0.540) |
| Adj R-sq | 0.3426 | 0.1501 | 0.3330 | 0.0750 | 0.2382 | 0.3095 | 0.3115 | 0.1820 |
| Observations | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 | 3,710 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country_year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of World Uncertainty Index (WUI) on banks' ESG activities. The dependent variables are ESG Disclosure and Performance scores and their categories Environmental score, Social score, Governance score. These are proxies of banks' sustainable activities. The variable of interest is WUI index. Bank level variables include one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB). Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index and Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

#### *2.4.2.3 Economy type & SDG Index*

Next, we address the potential endogeneity issue in our estimation that the results could be driven by banks more prone to uncertainty shocks due to the type of economy they operate in. Studies have shown that economies' response to EPU shocks are country specific (Istiak & Serletis, 2018). They also highlight the difference between developed and developing countries where the latter have lower governance, regulatory requirements and greater uncertainty compared to the former (Azmi et al., 2020). To address this, we sort countries into two groups of developed and developing countries using the United Nations and the World Bank country classification by income level data (Hamadeh et al., 2022). This results in two groups of 16 and 11 developed and developing countries respectively as seen in Table 30. We expect greater effect of economic uncertainty on banks operating in developing countries.

**Table 30: Summary statistics by economy type and SDG country ranking**

| Countries | Economy type | SDG Ranking | Obs |
|---|---|---|---|
| AUSTRALIA | Developed | High | 77 |
| BELGIUM | Developed | High | 28 |
| BRITAIN | Developed | High | 56 |
| CANADA | Developed | High | 56 |
| CROATIA | Developed | High | 14 |
| DENMARK | Developed | High | 21 |
| FRANCE | Developed | High | 21 |
| GERMANY | Developed | High | 42 |
| GREECE | Developed | High | 28 |
| IRELAND | Developed | High | 21 |
| ITALY | Developed | High | 70 |
| JAPAN | Developed | High | 588 |
| NETHERLANDS | Developed | High | 28 |
| SPAIN | Developed | High | 35 |
| SWEDEN | Developed | High | 21 |
| UNITED STATES | Developed | High | 1890 |
| CHILE | Developing | High | 42 |
| RUSSIA | Developing | High | 35 |
| SOUTH KOREA | Developing | High | 70 |
| BRAZIL | Developing | Low | 63 |
| CHINA | Developing | Low | 154 |
| COLOMBIA | Developing | Low | 28 |
| HONG KONG | Developing | Low | 28 |
| INDIA | Developing | Low | 196 |
| MEXICO | Developing | Low | 35 |
| PAKISTAN | Developing | Low | 42 |
| SINGAPORE | Developing | Low | 21 |
| Total | | | 3,710 |

We also include a measure of country's sustainability activities given that countries' SDG ratings effect firms' ESG reporting (Hong et al., 2023). We use the SDG index produced by Cambridge University which assesses the performance of all United Nations member states against the 17 Sustainable Development Goals (SDGs). The index tracks their progress and identifies gaps to close by 2030 (Sachs et al., 2022). Following other studies, we split countries by SDG index into above and below medium resulting into two groups. For an above medium score, the country's SDG index is assigned "High" indicating high sustainability, whereas for a below median score, the country's SDG index is assigned "Low" indicating low sustainability (Dyck et al., 2019). We expect greater effect of economic uncertainty on banks operating in countries with low SDG index.

We re-estimate Eq (2) by economy type and SDG ranking and report the estimation results in Table 31. Panel A demonstrates results by economy type where results in columns (1) to (4) show a negative effect of economic uncertainty on banks' ESG activities. These results go further in highlighting the effect to be greater for developing countries with a difference in coefficients which is statistically significant at 5% level for governance scores. It is known that firms operating in countries with stronger rule of law and regulatory institutions, which are characteristics of developed countries, have stronger profiles (Oberoi & Rao, 2019). This in turn implies a lesser effect of economic uncertainty on such firms' activities which is consistent with our results.

Panel B of Table 31, on the other hand, shows the results by SDG index rating. The results for Low SDG countries are presented in columns (1) to (4), whereas High SDG ranking results are reported in columns (5) to (8). As expected, economic uncertainty has greater effect on banks operating in Low SDG rating countries compared to their High SDG rating counterparts. Consistent with the main results, the overall ESG score shows a negative coefficient alongside Governance Score which is statistically significant at a 1% level. To illustrate, a 1% increase in Economic Policy Uncertainty (EPU) leads to a 4% decrease in banks' Governance activities if they operate in countries with low SDG rating. The findings are in line with previous studies showing how companies' activities are swayed by the system they operate in (Hong et al., 2023); and how nurturing

regulations encouraging ESG adoption could lead to higher economic growth (Zhou et al., 2020). Therefore, countries' higher macroeconomic sustainability activities in the form of higher SDG ratings appear to reduce the effect of economic uncertainty for their banks' ESG activities. This is consistent with our non-significant results for the High SDG group findings.

**Table 31: ESG Performance scores by economy type and SDG country ranking**

| *Dependent Variables* | ESG | Environmental | Social | Governance | ESG | Environmental | Social | Governance |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| ***Panel A- Countries split by Economy Type*** | | | | | | | | |
| | **Developing Countries** | | | | **Developed Countries** | | | |
| EPU$t-1$ | -0.058 | -0.029 | -0.003 | -0.028** | -0.057 | -0.089 | 0.004 | 0.015 |
| | (0.044) | (0.171) | (0.063) | (0.013) | (0.084) | (0.233) | (0.082) | (0.014) |
| Adj R-sq | 0.4213 | 0.2736 | 0.3380 | 0.4029 | 0.4991 | 0.3947 | 0.1745 | 0.7366 |
| Observations | 791 | 791 | 791 | 791 | 2919 | 2919 | 2919 | 2919 |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ***Panel B- Countries split by SDG index rating*** | | | | | | | | |
| | **Low SDG Index** | | | | **High SDG Index** | | | |
| EPU$t-1$ | -0.087* | 0.028 | 0.008 | -0.042*** | -0.043 | 0.037 | -0.004 | 0.001 |
| | (0.047) | (0.189) | (0.066) | (0.016) | (0.071) | (0.170) | (0.075) | (0.014) |
| Adj R-sq | 0.4088 | 0.3197 | 0.3391 | 0.6588 | 0.4088 | 0.3197 | 0.3391 | 0.6588 |
| Observations | 567 | 567 | 567 | 567 | 3143 | 3143 | 3143 | 3143 |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of Economic Policy Uncertainty (EPU) on banks' ESG activities. The dependent variables are ESG Disclosure scores, Environmental score, Social score, Governance score. These are proxies of banks' sustainable activities. The variable of interest is EPU index. Panel A reports the results for the effect of EPU on banks' ESG activities by economy type, developing and developed economies. Panel B reports the results for the effects of EPU on banks' ESG activities using above and below median SDG ranking. Control variables include (1) Bank level variables which are one year lag of Total Assets, Return on Assets, Leverage (Total debt to Total equity), TobinsQ, Zscore, Non-Performing Loans to Total Loans ratio, Efficiency ratio, Customer deposits to Total Assets ratio, Capital Ratio (Tier1 capital/Risk Weighted Assets), Non-Interest Income to Total Assets ratio (NII). PRI signatory dummy variable indicates whether a bank is a signatory of the Principles for Responsible Investments (PRI) or not, and SIB dummy variable indicates whether a bank is recognized as a Systematically Important Bank (SIB); (2) Macroeconomic variables include one year lag of GDP ratio, Unemployment rate, Population rate, Inflation rate, Sustainable Development Goals Country (SDG) Index and Government Regulation index. This table reports estimates of the fixed effects specification in equation (1). Standard errors are adjusted for clusters in banks and are reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

## 2.5 Conclusion

This study examines the relationship between economic uncertainty and banks' sustainability activities. Although sustainability has been increasingly perceived by banks as a mean to build credibility and increase reputation (Park et al., 2014; Schultz et al., 2013), its resilience in the face of financial turmoil was not extensively explored in the banking literature. The study aims to address the gap.

Using a sample of 530 global banks across 27 countries observed between 2015 and 2021, we find that Economic Policy Uncertainty (EPU) negatively affects banks' Environmental, Social and Governance (ESG) activities. At category level, banks' governance activities are significantly affected as they reduce with increased uncertainty. We also find that banks' characteristics such as size and PRI signatory status influence their ESG activities response to uncertainty. PRI signatory banks' governance activities appear to reduce during economic uncertainty, while non-PRI signatories see no significant effect on their activities. Similar but more significant result is seen from bigger banks as both their governance and environmental activities reduce during high uncertainty, while smaller banks' results are not significant.

We further validate our results by using alternative measures of sustainability and uncertainty where the results hold. We extend the analysis by splitting the banks by the type of economy their headquarter operate in. We find that the effect of economic uncertainty is stronger on banks operating in developing countries as see by their ESG activities reducing, particularly governance, compared to the ones operating in developed countries. A similar difference is noticed when the sample is split by countries' level of Sustainability Development Goals (SDG) ranking. Higher SDG ratings appear to reduce the effect of economic uncertainty on banks' ESG activities.

There is room, however, for research to address some of the limitations we faced including a longer time frame. As the ESG performance scores are calculated by Bloomberg from 2015 onwards, our sample period is limited to seven years to be able to compare the performance results with the disclosure ones. Added to this, whilst the EPU measure by Baker et al (2016) is widely used, it could be considered as vague and missing some unreported issues.

# Chapter 3

# How has Fintech Adoption Impacted upon Islamic Banks' Performance, Risks and Sustainability?

## 3.1 Introduction

Since the 2015 Paris agreement which was signed by 196 United Nations member states declaring their commitment to sustainable development, corporations have been under pressure to follow suit. Consumer awareness and climate change have also accelerated discussions on the role of corporates in achieving the Sustainability Development Goals (SDGs)[13]. Extreme weather events such as hurricanes and floods increased in intensity leaving no sector immune to disruption or destruction. According to Ritchie (2020), contributors to global emissions come from various sectors and to focus only on transport or electricity to tackle climate change is not enough. Therefore, finding tools and avenues to improve sustainable activities and reduce emissions are as relevant to a bank as they are to any other company. In fact, technological advancements have helped highly carbon emitting sectors such as manufacturing to reduce their environmental impact by minimising resource extraction (Berg et al., 2021).

Given that the financial sector also underwent technological advancements leading to revolutionised operations, this chapter aims to evaluate the impact of these advancements on banks' sustainability and performance. More specifically, the study focuses on Islamic banks operating in Muslim countries given that these are under researched. To assess the level of impact, a bank level Fintech Adoption Index was created to track the technological advancements in recent years. These advancements are known as Financial Technology, or Fintech.

According to Dubai Islamic Economy Development Centre report, well established financial institutions are on board through the fourth industrial revolution, with "74% of financial institutions investing in data analytics, 34% in Artificial Intelligence (AI), and with 77% expecting to adopt blockchain by 2020" (DIEDC, 2018, p4). Martino (2017) also confirm that by 2021, three billion global users would have access to banking services through digital devices such as phones and watches.

[13] SDG goals were signed by all United Nations member states

With all today's information technology revolution, however, a considerable number of adults around the world are financially excluded. The former IMF Managing Director, Christine Lagarde highlighted that "There are an estimated 1.7 billion adults in the world without access to financial services" (IMF, 2018, p1). She argues that Fintech (Financial Technology) could be the possible force that would impact the unbanked socially and economically. Fintech is a catch-all phrase with a cornucopia of meanings. Fintech, according to Navaretti et al (2017, p12) is considered as "the novel process and products that become available for financial services thanks to digital technological advancements". As the influence of fintech covers all aspects and segments of financial services, industries such as Islamic finance are also affected.

Before we explore Islamic fintech as the focus of this study, it is crucial to first define Islamic finance (IF) and Islamic fintech on their own merits. Islamic Finance is a method of managing and handling finances in accordance with the religion of Islam (Sharia Law). Although it has been in existence for the last 1500 years, it is no longer mainstream in the past century due to most Muslim countries being colonised. However, Islamic finance started to revive in the 1970s, as most Muslim countries gained their independence from colonialism, and the industry has been gaining momentum ever since. Islamic finance is based around certain values and in this essay the focus will be on the main three only. First is prohibition of interest where no interest is to be paid or earned on income or savings. Money is only a mean to trade and buy goods and services, it doesn't hold value. The objective of this ban is to prevent wealth concentration and create a fairer society.

A second value is social investment where investing is permissible in any sector except the ones that could cause harm to individual's physical or mental health; or indeed the whole society. Sectors like pornography, drugs, arms, alcohol and gambling are all classed as destructive to individuals and societies thus they should not attract investments. The third value of importance to this study is uncertainty. All transactions, goods or services should be clearly defined and stated to all parties involved to prevent confusion and mis-selling. The buyer should be crystal clear about what he/she is buying and the same applies to the seller. Uncertainty prevention is the board of scholars (shariah board) prime role.

Within Islamic financial institutions, the Shariah board is imperative to oversee and validate the compliance of products and services with Islamic law (shariah law). This is one element that many critics believe slows Islamic finance development and global reach.

Islamic Finance has made a strong comeback following the recent global financial crisis. The IFSB (2018, p3) report confirms that "the Islamic financial services industry (IFSI) returned to strong (8.3%) growth, and its total worth slightly surpassed the USD 2 trillion mark". The DIEDC (2018, p34) confirms that the Islamic Finance Industry assets are anticipated to reach $3.9 trillion by 2023 and defines Islamic Fintech as "technologies exponentially enhancing and disrupting 21st century Islamic financial services, operations, business models, and customer engagement".

Interest in Islamic Fintech is growing globally and particularly amongst the Organisation of Islamic Countries (OIC) members. According to a report by EY (2018), an investment fund of US$100m was launched in 2017 by the Dubai International Financial Centre (DIFC) aiming to invest in fintech start-ups. Another major fund announcement was made by Bahrain Development Bank (BDB) to back local and regional fintech start-ups. Many Islamic Fintech hubs have been created, for instance in Bahrain, Malaysia and UAE.

Islamic Banking is also recording significant growth in some OIC member countries. For instance, Islamic Banking penetration in the GCC (Gulf Cooperation Council) countries has reached 45% in 2017 compared to 31% in 2008 (DIEDC, 2018). This region also continues to adopt digitalisation of financial services and payments. However, despite the growth in Islamic Fintech adoption, its real influence on different aspects of Islamic banks' operations has not yet been captured.

The fundamental differences between Islamic banks and their conventional counter parts have been highlighted in literature (Hassan & Aliyu, 2018; Shaban et al., 2016; Abedifar et al., 2013). As a result, this chapter focusses solely on Islamic banks to ensure the results are not driven by the acknowledged structural difference between Islamic banks and their conventional counterparts.

Therefore, the study aims to answer the following research questions: How has fintech adoption impacted upon Islamic banks' performance, risks and environmental activities? The objectives will be to realise the following: 1) Create a bank level Fintech Adoption Index to identify and track fintech services offered by selected Islamic banks, 2) Measure and evaluate these banks' performance, risks and environmental activities post Fintech adoption, and 3) Empirically assess Islamic Banks uniquely compiled data from eight out of the top 10 OIC (Organisation of Islamic Cooperation) countries as ranked by IFID (Islamic Finance Development Indicator) 2018 report (Thomson Reuters, 2018). A quantitative method approach will be adopted to analyse the data in this study.

The contributions of this chapter are summarised as follows. First, we add to the growing Fintech adoption literature by constructing a novel index. The Fintech Adoption bank level index consists of five categories including Mobile Banking, Online Banking, Express Banking, ePayments and eSecure. The index measures banks' adoption of Fintech to assess its effect on their performance, risk and sustainability. Our results show Islamic Banks' performance and sustainability increase with increased Fintech Adoption with mixed results for risks.

Second, the study explores a strand of ethical banking which is Islamic banking by adding into its growing literature. Previous research highlighted different effects on Islamic banks' performance including comparative studies with conventional banks (Abedifar et al., 2013; Hassan & Aliyu, 2018; Sorwar et al., 2016; Trad et al., 2017). However, this study focuses the analysis on the effects of innovation on Islamic banks' main performance and risks indicators as well as sustainability.

Finally, the study contributes to the general Sustainable Development Goals (SDG) discussion by improving the understanding of the role of digitalisation in improving banks' financial and sustainable performance, which subsequently creates affordable, sustainable and healthier societies.

## 3.2 Literature Review and Hypothesis Development

Although Fintech is said to disrupt financial services and force change at an accelerated speed, the level of disruption, however, is still debatable amongst researchers and analysis. Ruehl & Morris (2019) argue that "traditional banks across Asia and the west have warned for several years that deep-pocketed technology companies were eyeing their turf – particularly in personal finance and payments – attracted by the prospect of valuable spending data".

There appears to be two camps that have divergent views on fintech approaches and contextualisation for banks. The first strand of thinking is led by technologists such as Bill Gate who famously said in 1994 that 'banks are dinosaurs … they can be bypassed*'*(Streeter, 2017). The argument is that banks have gone off track and deviated from their clients' needs. They are not keeping up with customers' changing behaviours and appetite for efficiency and low costs that can be brought about through technology. (Gurdgiev, 2017) reinforces this view through the study he presented as "62 percent of industry C-level leaders think they deliver excellent customer service. Only 35 percent of the industry's customers agree with such an assessment". This statement shows a clear mismatch between what banks believe they offer and what clients want or receive.

Banks themselves are fearing the technology invasion and are calling for a stronger response to the fintech revolution. Commenting on this point, James Staley, former Barclays Chief Executive said "banks need to defend themselves against encroachment from tech companies such as Amazon, Google and Apple" (Ruehl & Morris, 2019). In his support, JPMorgan Chase Chief Executive, Jamie Dimon warned that Sillicon Valley wants to "eat our lunch".

On the other hand, the second camp argues that banks will survive the fintech invasion. They have the history, client base, reputation and customer protection to put them in a more advantageous position than Fintech start-ups. Navaretti et al (2017), in their study of banks and fintech relationship, concluded that Fintech start-ups will not replace banks, stating that "Fintech provide a more efficient way to do the same old things. Yet banks are well placed to adopt technical

innovations and do the things in the new way themselves" (Navaretti et al., 2017).

Sorkin (2016), adds that fintech start-ups will soon be acquired by powerful traditional banks. The argument that banks are too big to fail and remain crucial to the economy was strengthened by the publication of a proposal by the Bank of England and Prudential Regulation Authority (PRA) in December 2018 (BOE, 2018). The document presents a resolution regime for banks to protect the economy and prevent another government bailout scenario similar to the 2007 financial crisis. The aim will be to intervene in managing a failed bank to protect depositors and taxpayers' money, as well as reduce risk and financial system failure.

Lerner & Tufano (2011) argue that whilst trial and error are part of the innovation process, failure could be considerably expensive. A view emphasised by Frame et al (2018) as they highlight the importance of caution when debating Fintech as no financial innovation is immune of failure and guaranteed to succeed. This research will join the second camp in support of banks surviving the fintech invasion. The condition will be for banks to embrace change as a survival mechanism to succeed and remain central to a strong economy.

A review of literature as illustrated below, suggests that this angle of research hasn't been attempted before. Frame et al (2018) book chapter entitled 'Technological Change and Financial Innovation in Banking: Some Implications for Fintech' presents a review of papers and academic research conducted on banking and fintech over the past 30 years. They highlight focus areas of research and academics over the years which could be summarised in two main groups. Group one is Fintech Process Innovations including Blockchain / Distribution ledgers and Machine Learning (ML) / Artificial Intelligence (AI). Group two is Fintech Product Innovations including payment services (such as debit cards and online banking). Frame et al (2018) review of literature shows a real gap in recent studies examining the impact of fintech adoption on banks' performance, risk and sustainability, particularly Islamic banks. This study will aim to fill this gap.

Hernández-Murillo et al (2010) explored Commercial banks in the US for the period of 2003 – 2006 to determine banks influencers in adopting advanced payment websites for their clients. They concluded that even though bank characteristics are crucial to their decision whether to adopt advanced websites, other factors such as competition have also an impact on banks' decision. However, they did not consider Islamic Banks in their sample.

More recently, papers such as Vives (2017), looked at the impact of fintech on efficiency, banking market structure, strategies of incumbents and financial stability. Although there wasn't a specific set of banks sampled or countries or regions analysed, the paper presents an overview on global fintech effects on banking sector and emphasises the importance of regulations to achieve efficiency. There was no specific examination of Islamic Banks by Vives (2017).

Li et al (2017), however, address a more specific issue as they examined the impact of fintech start-ups on incumbent retail banks' share price. The authors studied 47 US retail banks between 2010 and 2016. They concluded that banks' share price is more likely to be positively influenced by funding of fintech start-ups through standard loan financing. Their results support the debate that fintech complements traditional banking.

Whilst fintech theories are nascent reflecting its recent emergence and speedy developments, to our knowledge, no paper has explored the impact of fintech adoption on banks' sustainability. Hence it was challenging to find previous research or studies to build a theoretical model around it. This study's structure comprises of three main pillars; Fintech adoption and bank performance, risk and sustainability. An attempt to analyse each element separately is performed first. Then both arguments are joined together to address this paper's research question.

### 3.2.1 Fintech Adoption Studies

Due to rapid expansion of Fintech services in recent years, Fintech adoption literature is dominated by consumer focussed research and business reports. The latter are usually produced by consultancy firms, the likes of EY, to target businesses owners by disentangling consumer behaviour changes in respect of

new emerging technologies. As far as firm level studies are concerned, little attention has been paid to this relatively new phenomenon. More precisely, no empirical studies could be found that have been conducted on the impact of fintech adoption on Islamic Banks' performance, risk and sustainability.

Ample research, however, has been conducted on firms' adoption of Information technology and more specifically Internet Banking Adoption. In view of this, our fintech adoption literature review will analyse these two approaches with the aim being to lay foundations for this paper's theoretical model. There are two reasons for addressing technology adoption without focusing on Islamic banks. Firstly, is that technology adoption is related to banks' information systems and advanced technology no ethics or core values are involved. Secondly, literature on technology adoption centres around conventional banks and there is no evidence to show that Islamic banks are any different in this respect.

#### *3.2.1.1 Information Technology Adoption theories*

Oliveira & Martins (2011) are in the Information Technology Adoption group as evidenced through their paper entitled "Literature Review of Information Technology Adoption Models at Firm Level" which is prominent in this field. They summarise the theories of IT adoption at firm level and present tables of studies that used either one or more theories. Oliveira and Martins (2011) concluded that the majority of empirical studies are linked to the DOI theory and the TOE framework[14]. The authors conclude with the TOE framework as their theory of choice as it "has a solid theoretical basis, consistent empirical support, and the potential of application to IS [Information Systems] adoption" (Oliveira & Martins, 2011, p119).

The Diffusion on Innovation (DOI) is "a theory of how, why and at what rate new ideas and technology spread through cultures, operating at the individual and firm level". On the other hand, the Technology, Organisation and Environment (TOE) framework "identifies three aspects of an enterprise's context that influence the process by which it adopts and implements a technological innovation" (Oliveira & Martins, 2011, p112). Another example

[14] The Diffusion on Innovation (DOI) theory is by (Rogers, 1995), and the Technology, Organization, and Environment (TOE) Framework by (Tornatzky & Fleischer, 1990).

of TOE use is in Gibbs & Kraemer (2004, p125) work as they analyse the factors of e-commerce scope of use. They concluded that "Adopting a technology does not guarantee that it will be used extensively". Even though the paper is older, it is another illustration of the positive use of the TOE framework.

Another prominent paper in this field is "Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors" by Zhu et al (2003). The study developed a model to assess the adoption of e-business at the firm level in eight European countries. They had a sample of 3100 businesses and 7500 consumers. They divided their sample into high and low intensity countries and using control variables and logit models, they concluded that 'the more informed firms are, the less aggressive in adopting e-business'(Zhu et al., 2003, p251).

In their research, Zhu et al (2003) explored the Technology, Organisation and Environment framework (TOE) and its relevance in assessing e-business adoption in EU. They present an extensive literature review of all studies that used TOE framework. They concluded that *"*TOE framework is appropriate for studying e-business adoption, because e-business is enabled by technological development of the internet, driven by organisational factors such as firm scope and size, and influenced by environmental factors related to consumers, business partners, as well as competitors" (Zhu et al, 2002, p253).

On the other hand, EY (2017) in their Fintech adoption Index 2017 report, employ the DOI theory to contextualise and benchmark Fintech adoption at consumer level. The report analyses the consumer adoption level of fintech in 20 markets. One of their conclusions is that the adoption of fintech increases as the awareness of its existence grows.

Examining further these two theories (DOI and TOE), it becomes evident that their foundation is to identify the determinants of Information Technology Adoption at firm level rather than analyse the firm's performance or response to technology adoption once it is implemented. As a result, for the purpose of this study, Information Technology Adoption theories will not be included as they are not deemed fit for this research's objectives.

#### *3.2.1.2 Internet Banking Adoption*

Internet banking and Fintech services share a lot of characteristics together. There is a strong correlation since fintech services require the internet for many applications. DeYoung et al., (2007, p1038) view the Internet as a product innovation as "it makes valuable new services and new combinations of services available". This holds for Fintech services as their core values centre around innovation and easy access to different products. DeYoung et al (2007) using Probit regressions, analysed 424 US community banks between 1999 and 2001 with their findings showed a positive impact of internet banking adoption on profitability as revenues from service charges increased. The study's main limitation is its sample period (only two years).

Dandapani et al (2008) also examined the impact of internet adoption on US credit unions between 1999 and 2006 using regression equations. Their findings highlighted an increase in total assets of credit unions with websites, although this significant result only applied to three years out of the eight studied. Ciciretti et al (2009), however, not only studied the impact of internet on bank performance, but they included risk as well using different estimations. Their dataset includes 105 Italian commercial banks analysed between 1993 and 2002. Their findings show a significant positive link between internet adoption and bank performance. On the other hand, internet activities had a significant negative link with bank risk.

Tunay et al (2015) used the Demitrescu – Hurlin panel causality test to study banks from 30 European countries for the period of 2005 to 2013. Their results matched previous studies and confirming a significant positive link between bank performance and internet banking adoption. Stoica et al (2015), in a different study, looked at Romanian banks in 2010 using the DEA and PCA approach. They concluded that only a few of their sampled banks adopted internet banking with view of increasing their efficiency.

Regardless of data sample sizes, countries or periods of study, all the papers reviewed above agree that internet adoption made a positive impact on bank performance with one highlighting a negative impact on risk. Therefore, based on our assertion of a link between internet banking adoption and fintech

adoption, it is safe to assume that fintech adoption would also have a significant impact on banks performance, risk and sustainability. No single theory was adopted in these studies as each author employed different estimation models to analyse their datasets. This validates the case for this research as no specific theory will be addressed given the fact that there isn't a known one at present on fintech adoption. However, due to the similarities between Internet Banking and Fintech, studies on Internet Banking adoption are more relevant to this study and will be used as the point of reference in this research.

### 3.2.2 Bank Performance and Risk

Trad et al (2017) presented a study with a sample of 78 Islamic Banks in 12 countries over a period of 2004 to 2013. They used Return of Assets (ROA) and Return on Equity (ROE) as measures of profitability and EQL and Z Score as measures of risk. Using the GMM System, they concluded that there are no differences between Islamic Banks and their conventional counterparts based on profitability and risk features. However, since this study's research question is on Islamic Banks, the following reviewed literature will focus on Islamic banks only.

Using a sample of 65 Islamic and 65 conventional banks, Sorwar et al (2016) analyse the market risk profiles between these banks and concluded that there is no difference in risk between the two. A surprising result given that Islamic Banks are supposedly have unique differentiating characteristics. On the other hand, Abedifar et al (2013), studied a sample of 553 banks from 24 countries between 1999 and 2009. They concluded that lower credit risk is noted amongst small Islamic banks based in Muslim countries.

Hassan & Aliyu (2018, p8) posit that a "bank's performance assessment provides a clear understanding on their institutional self-sufficiency. The self-sufficiency of an institution determines the operational and financial viability of the banks without intervention, merger, or acquisition". They conclude that "Islamic banks performed relatively well in capitalization, profitability and liquidity, especially during crisis, with lower inefficiency compared to conventional banks" (Hassan & Aliyu, 2017, p10). Shaban et al (2016) also highlight a structural difference

between Islamic and conventional banks as they investigate SME lending by both types of institutions using a differentiated duopoly model[15]. They conclude that lending to SMEs is more cost effective for Islamic Banks due to their special contract (Murabaha)[16] compared to conventional banks lending contracts.

### 3.2.3 Banks' Environmental Sustainability

Since Islamic banks amongst global financial institutions committed to achieving United Nations Sustainable Development Goals, discussions about financing sustainable growth started emerging. Becoming a climate neutral economy, reducing emissions and decarbonising the economy is most countries including the European Union (Macchiavello & Siri, 2020). It is crucial that capital is geared towards green investments and risks coming from climate change and environmental degradation are managed, while nurturing transparency and continuous financial activity are maintained.

New concepts such as corporate carbon accounting and auditing started emerging. As a result, corporations became more and more able to quantify their impact on the environment by measuring and reporting on their carbon emissions. Known as corporate carbon footprint, it represents a company's total carbon and/or greenhouse gas emissions generated as a result of its activities or products (Harangozo & Szigeti, 2017)[17]. In the banking sector, some studies investigated banks' carbon emissions and shown mixed results. Boutabba (2014) studies the Indian financial market and concluded it has a long-term effect on its carbon emissions which causes damage to the environment. Mahmood & Masih (2018), on the other hand, examined OIC countries and highlighted the correlation between Islamic banks' performance and carbon emissions at country level. One challenge facing these studies was scarcity of carbon emissions data for the banking sector given it emits less compared to other

[15] The model was developed by y Singh and Vives (1984) and extended by (Zanchettin, 2006)

[16] A Murabaha contract implies the buyer is informed in advance of the cost of the asset and the banks' profit margin. For instance, if a client desires to acquire an asset for $100,000, the Islamic bank buys the asset for that price then sells it to the client for an increased price of $120,000 (Shaban et al., 2016)

[17] The most widely used framework for carbon emissions is the GreenHouse Gas (GHG) protocol outlined by World Business Council for Sustainable Development and World Resources Institute (WRI & WBCSD, 2004).

industries such as energy and agriculture (Ritchie, 2020). Other measures of environmental sustainability such as Environmental, Social and Governance scores have also been emerging lately with banks increasing their reporting on these activities.

The growth in sustainability and digitalisation in the financial industry appear to evolve simultaneously as countries started realising the potential of using newly developed technologies to support financing sustainable projects (Macchiavello & Siri, 2020). Therefore, in the context of climate change, digital transformation has been increasingly investigated to establish its impact on sustainable development. Dorfleitner and Braun (2019) highlighted how fintech and blockchain helped create access to new sources of finance for green investments. Nassiry (2019) also shows how fintech in the form of blockchain technologies could advance sustainable financing and renewable energy. However, to our knowledge, no research has investigated the impact of fintech on banks' environmental activities, especially in the context of Islamic banks, which is the gap this paper aims to fill.

### 3.2.4 Hypothesis Development

As seen in pervious sections, several studies such as DeYoung et al (2007), Dandapani et al (2008) and Tunay et al (2015), have concluded that Internet banking adoption has impacted positively on Banks' performance. As with Internet Banking adoption, fintech adoption is showing signs of growth and expansion, particularly with services such as payments and transfers. According to EY's Fintech adoption Index 2017 report (EY, 2017, p14), "Money transfer and payments services were, and continue to be, the most popular Fintech service, growing from 18% in 2015 to 50% in 2017". On this basis, we expect the relationship between Fintech adoption and Return on Assets to be significant and positive and we build our first hypothesis as follows:

$\boldsymbol{H_1}$*:* Fintech adoption has a positive impact on Islamic Banks' performance.

As far as bank risk is concerned, FSB (2017, p14) report presents a list of what is categorised as Micro-financial risks. Its Micro-financial risks list consists of "maturity mismatch, liquidity mismatch, leverage, governance/process control,

cyber risks, third-party reliance, legal/regulatory risk, business risk of critical financial market infrastructures (FMIs)". Banks strive for better assessment, monitoring and management of credit risk to improve lending decisions, reduce losses and improve profitability. Although, Fintech aims to help with better credit risk management, it also represents challenges rendering the impact of Fintech adoption on banks' credit risk intricate and multifaceted.

Studies have shown mixed results with regards to the effect of Fintech adoption on banks' credit risk. Tunay et al (2015, p364) concluded in their Internet Banking Adoption study of banks in 30 EU countries that internet banking "has three basic factors such as cost advantages, high profitability and low risk". This is a view shared by Ciciretti et al (2009) when they studied the impact of internet on bank performance using 105 Italian banks. Banks' operating efficiency and risk management capability are known to be improved due to Fintech (Liang et al., 2023) which also reduces banks' risk taking (Cheng & Qu, 2020; Deng et al., 2021).

However, other studies highlighted a positive relationship between Fintech adoption and banks' risk taking (Wang et al., 2021). Industry reports seem to suggest that fintech adoption could also increase banks' risks. In a call to financial institutions to review their risk strategies, the European Banking Authority published a report EBA (2018, p4) in which they argue that the emergence of fintech and its interaction with financial institutions "may fundamentally change the risk profiles of institutions by creating new risks and/or amplifying some existing risks". With technological advancements, new sources of credit information emerge. While the inclusion of innovative data sources such as social media activity and mobile phone usage into the creditworthiness might provide more accurate assessment; the data might lack consistency or standardisation leading to mispricing of risk. This in turn could exacerbate credit risk as new technologies might fail to assess client creditworthiness. While increased lending to high-risk customers might expand banks' client base, it could lead to higher default risks.

Therefore, we contend that FinTech adoption impacts banks' credit risk in two keyways. On one hand, FinTech could reduce credit risk as emerging

technologies enhance the efficiency of risk management and internal governance, thereby lowering credit risk. On the other hand, FinTech introduces technical and regulatory risks, which could potentially increase credit risk. Therefore, our second research hypothesis is formulated as follows:

$\boldsymbol{H_2}$: The relationship between Fintech Adoption and banks' credit risk is dual-faceted, with Fintech Adoption having both positive and negative effects on credit risk'

As for environmental sustainability, most studies investigate the effect of digital transformation on non-financial firms with focus on their carbon emissions. Globally, studies such as Belkhir and Elmeligi (2018), investigated the Information and Communication Industry (ICT) industry and how much it contributes to the global GHG. They found that digital transformation benefited high carbon emitting companies and those with strong financial resources as it helped them reduce their carbon emissions. Other studies such as Deng et al. (2019) focused on banks in specific countries like China. They studied the effects of fintech on peer-to-peer lending platforms' sustainability and concluded that the relationship is significant depending on the regional economic development. Other research highlighted the significance of digital transformation and how it improved the environment via optimising production processes and better management (Cecere et al., 2014; Feuerriegel et al., 2016). Therefore, our third research hypothesis is formulated as follows:

$\boldsymbol{H_3}$: Fintech Adoption has a positive relationship with Banks' environmentally sustainable activities.

## 3.3 Methodology and Data

### 3.3.1 Sample Selection

The dataset under examination was compiled by the researcher using different data sources which makes it unique for this study. The sample used in this research contains 63 banks from eight OIC countries (Bahrain, Indonesia, Malaysia, Jordan, Kuwait, Oman, Saudi Arabia and United Arab Emirates) over

a period of 2012 to 2018. Below are detailed steps as to how the final sample was selected.

The original sample included 169 banks in ten countries classed as the top ten according to Islamic Finance Development Indicator 2018 ranking report (Thomson Reuters, 2018). The original sample was the Thomson Reuters purchased database as they claim it 'is part of the Islamic Finance Development Indicator (IFDI), which is the true barometer of the state of the industry across its fundamentals'. The Thomson Reuters' list of Islamic banks was the foundation upon which the rest of the data selection and examination was completed. The first selection stage involved verifying bank type to ensure consistency in business model and this resulted in investment banks being excluded. The second phase involved the use of Bloomberg as the second data source to fill the gaps in the Thomson Reuters' database. This meant that banks with missing data from both data sources were excluded. The last phase in the sample selection involved the use of other data sources such as banks' websites and annual reports to construct the fintech index.

### 3.3.2 Fintech Adoption Index Creation

The Fintech Adoption Index was created using the Islamic finance development indicator (IFDI) database purchased from Refinitiv (LSEG), as well as the selected 63 banks' websites, annual reports and press releases. Each bank's website and annual report was studied to establish whether they adopt fintech in their strategy and implement it in reality and when. A list of offered fintech services was created and similar services grouped. A total of 47 services were identified across all 63 banks. The services were split into the following five categories: Mobile Banking, Online Banking, Express Banking, ePayment and eSecure (see Table 35 and Appendix 5 for definitions and sub-categories).

Categorisation was used as a measure to understand which of the identified fintech services impacts these banks' performance and risk the most. It was also influenced by the Islamic Finance Development Index which measures the overall development of Islamic Finance in the following categories: Quantitative Development, Knowledge, Governance, Corporate Social responsibility and Awareness. According to DeYoung (2005), the first bank websites were

launched in 1995. On this basis, we assume that all banks who offer Online Banking have had it available at least since 2012 when the study sample starts. The same assumption applies to ATM use as according to Frame et al (2018, p17), ATMs have been made available since 1990s. The same applies to Mobile Banking.

Therefore, the index starts with 4 points to all banks which were in operation before 2012. Once the services launch date was allocated to the relevant year, the index points were added. As a result, the points increased over the sample period (2012-2018) every time a bank introduced a new innovative service or upgraded an existing one; such as mobile banking and online banking. DeYoung et al (2007, p1038) view the Internet as a product innovation as "it makes valuable new services and new combinations of services available". The same view applies to Fintech services as they fulfil the product innovations classification above. Appendix 6 shows full list of Fintech Adoption Index points from 2012 until 2018.

The Fintech Adoption Index was then compiled incorporating all five categories (Mobile Banking, Online Banking, Express Banking, ePayment and eSecure) using the Principal Component Analysis (PCA). PCA is commonly employed in empirical studies involving indices and large datasets. It is used to concise observed variables into components which explain the majority variance in those variables (Brauner & Shacham, 2000). PCA is first calculated so that each variables' data is centred on the mean. The first principal component is derived from the linear combination of all variables accounting for the highest variance in the set. Although the calculation of the second component is the same, it is conditioned to account for the second highest variance and should not be correlated to first principal component. The same process continues until all five variables have a principal component each. All principal components should have the same sum of variance as the original variables. Known as eigenvalue, principal components' variance covariance matrix shows each principal component's variance starting with the first principal component then descending to the fifth one.

**Table 32: Principal Components Analysis - correlation**

| Component | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Comp1 | 1.648 | 0.545 | 0.330 | 0.330 |
| Comp2 | 1.103 | 0.220 | 0.221 | 0.550 |
| Comp3 | 0.883 | 0.071 | 0.177 | 0.727 |
| Comp4 | 0.812 | 0.259 | 0.162 | 0.889 |
| Comp5 | 0.553 | . | 0.111 | 1.000 |

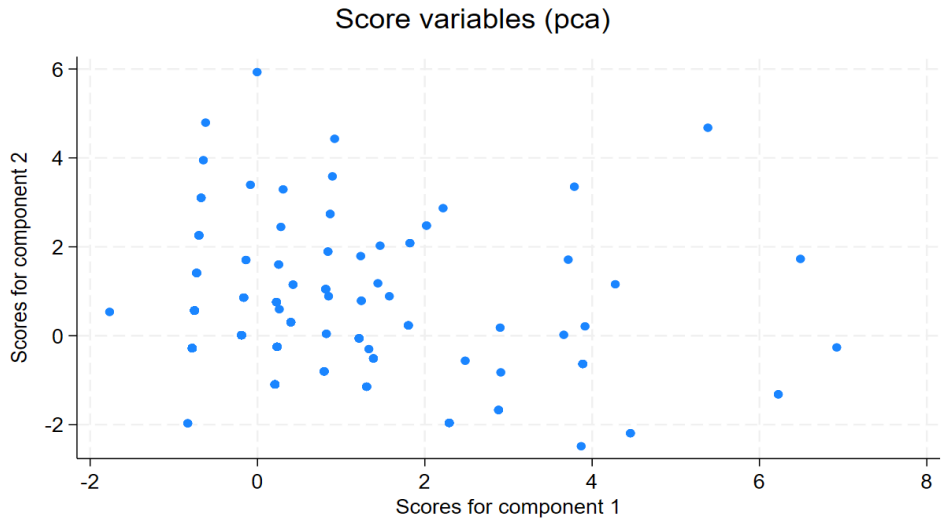
***Principal components (eigenvectors)***

| Variable | Comp1 | Comp2 | Comp3 | Comp4 | Comp5 | Unexplained |
|---|---|---|---|---|---|---|
| Online Banking | 0.590 | -0.245 | 0.186 | -0.282 | 0.691 | 0 |
| Mobile Banking | 0.454 | -0.375 | 0.367 | 0.619 | -0.367 | 0 |
| Expres Banking | 0.024 | 0.757 | 0.612 | 0.168 | 0.153 | 0 |
| ePayments | 0.548 | 0.272 | -0.066 | -0.539 | -0.575 | 0 |
| eSecure | 0.380 | 0.390 | -0.672 | 0.467 | 0.185 | 0 |

*Number of observations = 438 ; Number of Components = 5 ; Trace = 5*

Eigenvalue or else known as Truncation-to-noise (TNR) indicator, measures the level of collinearity between variables. If it is greater than 1, then the information included in the variable is valuable and should be kept. If it is less than 1, then this indicates that the variable's information contain mostly noise and could be left out of the composed set (Brauner & Shacham, 2000). With the condition that components are selected when their eigenvalue is equal to or greater than 1, it is noted that in Table 32, Component 1 and Component 2 meet this criterion. To further check how the data plots around these components, Figure 6 shows the scores plot of how the original data observations load on the two components selected.

**Figure 6: PCA scores plot**



To measure the sampling adequacy, Kaiser-Meyer-Olkin (KMO) test was used with a recommended grade of 0.5 or above is required to use PCA (Bro, Smilde 2014).

Table 33 below, shows that the overall KMO score is 0.563 which allows us to proceed to use PCA.

**Table 33: Kaiser-Meyer-Olkin (KMO) test results**

| Variable | KMO |
|---|---|
| Online Banking | 0.547 |
| Mobile Banking | 0.587 |
| Express Banking | 0.432 |
| ePayments | 0.557 |
| eSecure | 0.633 |
| **Overall** | **0.563** |

Therefore, based on Table 32 data, our Fintech Adoption index is constructed using component 1 and 2 as follows:

*Index = [pc1*(Comp1 proportion/Comp2 cumulative)]+ [pc2*(Comp2 proportion/Comp2 cumulative)]*

The final sample for this study became 63 banks from eight OIC countries (Bahrain, Indonesia, Malaysia, Jordan, Kuwait, Oman, Saudi Arabia and United Arab Emirates) over a period of 2012 to 2018. The dataset is then classified by region (East Asia Pacific: Malaysia and Indonesia) and Middle East and North Africa (Jordan, Bahrain, Kuwait, Saudi Arabi, UAE, Oman). The banks were also sorted by country level income: Lower Middle Income Economies ($996 to $3,895) (Indonesia). Upper Middle Income Economies ($3,896 to $12,055) (Jordan, Malaysia). High Income Economies ($12,056 or more) (Oman, Bahrain, Kuwait, UAE, Saudi Arabia) (WorldBank.org). Initially, the aim was to also group banks into adopters of fintech and non-adopters. However, after constructing the index it became apparent that the number of adopters which is 50 banks outweigh the non-adopters which are 13 banks only. This meant the

analysis would be unbalanced should we implement the adopter and non-adopters grouping.

### 3.3.3 Descriptive Statistics

Following the literature and to address this paper's research question, a number or variables were employed as illustrated in Table 34 below:

**Table 34: Descriptive Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ***Fintech Index*** | | | | | |
| Fintech Adoption Index | 441 | 0.00 | 0.88 | -1.30 | 5.10 |
| Online Banking | 441 | 1.08 | 0.28 | 1.00 | 3.00 |
| Mobile Banking | 441 | 1.24 | 0.46 | 0.00 | 3.00 |
| Express Banking | 441 | 2.36 | 0.89 | 0.00 | 9.00 |
| ePayments | 441 | 0.40 | 0.93 | 0.00 | 7.00 |
| eSecure | 441 | 0.13 | 0.38 | 0.00 | 3.00 |
| ***Bank Level Variables*** | | | | | |
| Total Assets (m US$) | 441 | 0.11 | 0.4 | 0.002 | 2.69 |
| Return on Assets | 441 | 1.24 | 0.95 | -4.23 | 5.42 |
| Non Interest Income % | 441 | 1.19 | 0.97 | -4.60 | 5.15 |
| Efficiency % | 441 | 5.61 | 3.64 | -11.28 | 27.83 |
| Leverage % | 441 | 1.26 | 1.35 | 0.00 | 13.47 |
| Non-Performing Loan % | 441 | 0.77 | 2.82 | 0.00 | 40.25 |
| Risk Weighted Assets % | 441 | 7.24 | 1.89 | 0.04 | 15.63 |
| Environmental Disclosure | 441 | 2.05 | 6.56 | 0.00 | 43.43 |
| ***Country Level Variables*** | | | | | |
| GDP growth Rate | 441 | 3.80 | 2.02 | -3.50 | 9.10 |
| Inflation | 441 | 2.63 | 1.68 | -0.90 | 6.40 |
| Ease of Doing Business | 441 | 68.44 | 6.85 | 56.68 | 81.65 |

#### *3.3.3.1 Performance Variables*

Two performance indicators were selected: Return on Assets and Non-Interest Income. Return on Assets (ROA) was designated as it indicates bank's profitability relative to its assets(Bloomberg, 2020). According to Chokri & El Ammari (2018), "The banking performance is essentially represented by the quantitative indicators such as the financial indicators (ROA, ROE etc)". A higher ROA is usually interpreted as good management of a company's assets to generate profit. Other studies such Ciciretti et al (2009), Dandapani et al (2008), Tunay et al (2015) also used ROA as a measure of bank performance. Ramlan and Adnan (2016) also confirm that ROA is a significant factor to influence Islamic Banks' profitability and performance. As for the Non-Interest

Income indicator, Al-Tarawneh et al (2016) argue that it "increases equity capital adequacy and this in turn affects the profitability positively". Non-interest income being the sum of trading account profits (losses), commissions and fees and other operating income, would reflect banks' performance from the innovative income point of view.

#### *3.3.3.2 Risk Variables*

The two dependent variables selected are Risk-Weighted Assets (RWA) and Non-Performing Loans (NPL). RWA are calculated by weighing each type of asset relative to its risk (Bloomberg, 2020). According to Das & Sy (2012, p3), "Risk weighted assets are an important element of risk-based capital ratios". In the Bloomberg database, Non-Performing Loans are defined as the "loans in default or close to default, and do not accrue interest". Kingu (2018) argues that an "increase in the level of gross non-performing loans pause a great risk to banks, the financial sector and the economy at large". Ciciretti et al (2009). Therefore, using RWA as an indicator of risk is valid. It is considered that the risk of loan losses increases the higher NPL is.

#### *3.3.3.3 Environmental Disclosure score variable*

The main proxy for banks' environmental sustainability is their Environmental Disclosure scores which are part of the Environmental, Social and Governance scores. Bloomberg is one of the leading data providers of Environmental disclosure scores. The scores range from 0.1 for minimum company disclosure to 100 for companies that disclose all data point collected by Bloomberg. Data points carry different weights depending on their importance. For instance, Greenhouse Gas emissions carry more weight than other disclosures (Bloomberg, 2020). Bloomberg's GHG estimates cover direct emissions under scope 1 and indirect emissions under scopes 2 and 3 for all companies with reported data. Bloomberg provides estimates for over 130,000 companies globally (Bloomberg, 2020).

Previous studies have used Bloomberg Environmental disclosure scores and categorised GHG data of companies depending on their level of emissions (Caragnano et al., 2020; Maaloul, 2018). Therefore, our measure of Islamic

banks' environmental activities will be their Bloomberg Environmental disclosure scores.

#### *3.3.3.4 Independent Variables*

The prime independent variable in this study will be the Fintech Adoption Index developed using PCA. The index five categories Online Banking, Mobile Banking, Express Banking, ePayment, and eSecure will also be used independently to assess their effects. The following control ratio variables in their lagged values will also be included: Total Assets, Efficiency ratio, Leverage ratio, Non-Interest Income ratio, Non-Performing Loans ratio, Risk Weighted Assets ratio, Equity to Total Assets ratio. At a macroeconomic level, GDP growth rate, inflation and Ease of Doing Business will be used to represent the rate of economic growth. All variables' definitions are in Table 35 and Correlation Matrix is presented in Table 36.

## Table 35: Variables Definitions

| Variables | Definition | Source |
|---|---|---|
| ***Fintech Adoption Index*** | | |
| Fintech Adoption Index | Hand collected data from 63 banks then categorised into five of Fintech Adoption broad technologies. Used Principal Component Analysis to construct the index as detailed in section | FCA.org.uk & Author |
| Online Banking | Online Banking, also known as internet banking and Net Banking, means accessing one's bank account and carrying out financial transactions through the internet on smartphones, tablets or computers. | FCA.org.uk & Author |
| Mobile Banking | Mobile Banking in this study will focus on payments processed through mobile applications only. FCA defines it as follows: Mobile payment services enable consumers to make payments to an individual or firm using a mobile phone, tablet computer or other handheld device. There are different methods of making mobile payments, for example by storing credit or debit cards in a mobile wallet or making payments to businesses or individuals from within a mobile banking application (app).Consumers can also use contactless technology built into the mobile device (hardware), SIM card or mobile software to 'tap and pay' at merchant terminals. | FCA.org.uk & Author |
| Express Banking | Due to new technologies emerging and banks adopting different services, Express Banking in this paper represents any service to facilitate customers' finance management experience. Any apps or platforms are also included. If a bank advertises a digital centre/service without details on what's on offer, then the express banking option is selected. If more details are offered, then the service / product is added to the e-Payments category. | FCA.org.uk & Author |
| ePayments | e-Payments category in this paper includes any payments, transactions or facilities that involve sending or receiving money nationally or internationally. A standard definition of e-Payments is not used or referred to as it would be too restrictive for this research. | FCA.org.uk & Author |
| eSecure | For the purpose of this study, e-Secure represents any security software, applications or facilities the banks in question offer. | FCA.org.uk & Author |
| ***Bank level variables*** | | |
| Environmental disclosure scores | The scores range from 0.1 for minimum company disclosure to 100 for companies that disclose all data point collected by Bloomberg. Data points carry different weights depending on their importance. For instance, Greenhouse Gas emissions carry more weight than other disclosures | Bloomberg |
| Total Assets | This is the sum of Cash & bank balances, Fed funds sold & resale agreements, Investments for Trade and Sale, Net loans, Investments held to maturity, Net fixed assets, Other assets, Customers' Acceptances and Liabilities. | Bloomberg |
| Non-Interest Income | Sum of trading account profits (losses), commissions and fees, and other operating income (losses). Calculated as: Trading Account Profits + Commissions & Fees + Other Operating Income. NIC to Total Assets Ratio is used. | Bloomberg |
| Risk Weighted Assets | Risk-Weighted Assets is calculated by weighing each type of asset relative to its risk. RWA to Total Assets Ratio is used. | Bloomberg |

| | | |
|---|---|---|
| Non-Performing Loans | Gross Nonperforming Loans, which are loans in default or close to default, and do not accrue interest. All loans that have an impairment provision are classified as non-accrual. NPL to Total Assets Ratio is used. | Bloomberg |
| Return On Assets | Indicator of how profitable a company is relative to its total assets, in percentage. Return on assets gives an idea as to how efficient management is at using its assets to generate earnings. Calculated as: (Trailing 12M Net Income / Average Total Assets) * 100 | Bloomberg |
| Efficiency Ratio | Also known as Cost to Income Ratio. Leverage ratio in percentage that defines the total amount of debt relative to assets. This enables comparisons of leverage to be made across different companies. Calculated as: Total Debt *100 / Total Assets | Bloomberg |
| Leverage Ratio | Also known as Total Debt to Total Assets ratio. Leverage ratio in percentage that defines the total amount of debt relative to assets. This enables comparisons of leverage to be made across different companies. Calculated as: Total Debt *100 / Total Assets | Bloomberg |
| Common Equity to Total Assets Ratio | One of many financial ratios (in Percentage) used to determine the financial health and long-term profitability of a corporation. Calculated as: Common Equity * 100 / Total Assets | Bloomberg |
| ***Country level variables*** | | |
| Gross Domestic Product | GDP measures the monetary value of final goods and services – that is, those that are bought by the final user – produced in a country in a given period of time. | IMF |
| Inflation | Inflation measures how much more expensive a set of goods and services has become over a certain period, usually a year. | IMF |
| Ease of Doing Business | A score indicating an economy's position to the best regulatory practice. | World Bank |

## Table 36: Correlation Matrix

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Fintech Index | 1.000 | | | | | | | | | | | | | | | | |
| (2) Online Banking | 0.524 | 1.000 | | | | | | | | | | | | | | | |
| (3) Mobile Banking | 0.318 | 0.299 | 1.000 | | | | | | | | | | | | | | |
| (4) Express Banking | 0.429 | -0.083 | -0.026 | 1.000 | | | | | | | | | | | | | |
| (5) ePayment | 0.656 | 0.270 | 0.066 | 0.088 | 1.000 | | | | | | | | | | | | |
| (6) eSecure | 0.658 | 0.138 | 0.096 | 0.058 | 0.179 | 1.000 | | | | | | | | | | | |
| (7) Total Assets | 0.065 | -0.058 | -0.122 | -0.052 | 0.222 | 0.054 | 1.000 | | | | | | | | | | |
| (8) ROA | 0.109 | -0.023 | 0.032 | 0.211 | -0.002 | 0.059 | -0.156 | 1.000 | | | | | | | | | |
| (9) Non-Interest Income | 0.124 | -0.003 | 0.055 | 0.203 | 0.017 | 0.059 | -0.141 | 0.941 | 1.000 | | | | | | | | |
| (10) Efficiency Ratio | 0.044 | 0.101 | 0.017 | -0.001 | 0.060 | -0.034 | 0.108 | -0.279 | -0.311 | 1.000 | | | | | | | |
| (11) Leverage Ratio | 0.036 | 0.028 | 0.023 | -0.104 | 0.008 | 0.122 | 0.166 | -0.218 | -0.200 | -0.031 | 1.000 | | | | | | |
| (12) NonPerforming Loans | -0.086 | -0.052 | 0.033 | -0.064 | -0.075 | -0.034 | -0.062 | -0.345 | -0.519 | 0.263 | -0.027 | 1.000 | | | | | |
| (13) Risk Weighted Assets | 0.038 | -0.066 | 0.064 | 0.133 | -0.062 | 0.048 | -0.276 | 0.228 | 0.209 | -0.183 | -0.120 | 0.090 | 1.000 | | | | |
| (14) Environmental Score | 0.006 | -0.061 | 0.110 | 0.030 | 0.007 | -0.012 | -0.046 | 0.089 | 0.090 | -0.014 | -0.018 | -0.058 | -0.084 | 1.000 | | | |
| (15) GDP | -0.208 | -0.112 | -0.176 | -0.058 | -0.116 | -0.142 | 0.167 | -0.056 | -0.033 | -0.016 | 0.054 | -0.082 | -0.065 | -0.032 | 1.000 | | |
| (16) Inflation | -0.217 | -0.029 | -0.167 | -0.119 | -0.140 | -0.149 | -0.040 | -0.104 | -0.084 | 0.070 | 0.078 | -0.111 | -0.189 | -0.082 | 0.419 | 1.000 | |
| (17) Ease ofDoingBusiness | 0.032 | -0.088 | -0.048 | 0.094 | 0.063 | 0.007 | 0.379 | 0.058 | 0.049 | -0.049 | 0.024 | -0.034 | -0.020 | 0.147 | 0.251 | -0.232 | 1.000 |

## 3.4 Empirical Model

To establish the impact of fintech adoption on Islamic Banks' performance, risk and sustainability, the analyses were conducted on multiple stages as detailed below. For performance, ROA and Non-Interest Income (NII) are the dependent variables. For risk, the dependent variables are RWA and NPL. For sustainability, the dependent variable is Environmental disclosure score. To analyse the relationship between different variables, we use Fixed effects panel estimations.

Fixed Effects (FE) estimation is applied controlling time effects while time demeaning the data. The demeaning process addresses the unobservable factors by removing any element that is invariant over the sample period. FE estimation also permits the unobserved individual effects to be correlated with variables included (Greene, 2002). Time effects, on the other hand, help capture what might affect cross sectional units equally (Pedace, 2013). The baseline model is as follows:

$$Y_{it} = \alpha + \beta \cdot Fintech\_Index_{it-1} + \lambda \cdot X_{it-1} + \sigma \cdot Z_{it-1} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{it} \quad (3)$$

Where, $Y_{it}$ is the dependent variable, $Fintech\_Index_{it-1}$ is the main independent variable, $X_{it-1}$ is vector for bank level control variables and $Z_{it-1}$ is vector for country level control variables. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity. $\beta$, $\lambda$, $\sigma$ are the coefficients to be estimated and $\varepsilon_{it}$ is the error term. We lag all right hand-side variables by one year to mitigate the problem of endogeneity. $i$ is the subscript for the number of banks and $t$ is the subscript for the number of years. All control variables are lagged by one year. Year-country fixed effects to account for any differences in the data that could be constant over time within each country. $\alpha$ is the constant and $\varepsilon_{it}$ is the error term. The following section will detail how this baseline model was adapted for Performance, Risk and sustainability analysis.

### 3.4.1 Performance Estimation Models

As performance in this study is measured by Return on Assets (ROA) and Non-Interest Income (NIC), the estimation model for each measure will be presented separately bellow:

$$Perf_{it} = \alpha + \beta \cdot Fintech\_Index_{it-1} + \lambda \cdot X_{it-1} + \sigma \cdot Z_{it-1} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{it} \quad (3.1)$$

Where, Perf is the dependent variable for Islamic banks' performance being either Return on Assets or Non-Interest Income ratio; Fintech Index is the study's developed Fintech Adoption Index and main independent variable. Banks level variables are Total Assets, Efficiency Ratio, Leverage Ratio, Equity to Total Assets Ratio, Non-Performing Loans ratio and Risk Weighted Assets. Country level variables include GDP growth rate, inflation and Ease of Doing Business. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity. $\beta$, $\lambda$, $\sigma$ are the coefficients to be estimated and $\varepsilon_{it}$ is the error term. We lag all right hand-side variables by one year to mitigate the problem of endogeneity. $i$ is the subscript for the number of banks and $t$ is the subscript for the number of years. All control variables are lagged by one year. Year-country fixed effects to account for any differences in the data that could be constant over time within each country. $\alpha$ is the constant and $\varepsilon_{it}$ is the error term.

As we study the effects of each FinTech category on both dependent variables. We replace Fintech Index in Eq (3.1) with the five categories: Online (Online Banking), Mobile (Mobile Banking), Express (Express Banking), ePayments and eSecure to also assess the effect of the categories separately. This is reflected in the results tables where column (1) reports the Fintech Adoption Index results and columns (2) to (6) report the results for each of the five categories.

### 3.4.2 Risk Estimation Models

We replace the performance dependent variables in Eq (3) with our risk dependent variables resulting in the following equation:

$$Risk_{it} = \alpha + \beta \cdot Fintech\_Index_{it-1} + \lambda \cdot X_{it-1} + \sigma \cdot Z_{it-1} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{it} \quad (3.2)$$

Where, Risk is the dependent variable for Islamic banks' risk being either Risk Weighted Assets or Non-Performing Loans ratio; Fintech_Index is the study's developed Fintech Adoption Index and main independent variable. Banks level variables are Total Assets, Efficiency Ratio, Leverage Ratio, Equity to Total Assets Ratio, Non-Interest Income ratio, Return on Assets or Non-Interest Income ratio. Country level variables include GDP growth rate, inflation and Ease of Doing Business. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity. $\beta$, $\lambda$, $\sigma$ are the coefficients to be estimated and $\varepsilon_{it}$ is the error term. We lag all right hand-side variables by one year to mitigate the problem of endogeneity. $i$ is the subscript for the number of banks and $t$ is the subscript for the number of years. All control variables are lagged by one year. Year-country fixed effects to account for any differences in the data that could be constant over time within each country. $\alpha$ is the constant and $\varepsilon_{it}$ is the error term.

As we study the effects of each FinTech category on both dependent variables. We replace Fintech Index in Eq (3.2) with the five categories: Online (Online Banking), Mobile (Mobile Banking), Express (Express Banking), ePayments and eSecure to also assess the effect of the categories separately. This is reflected in the results tables where column (1) reports the Fintech Adoption Index results and columns (2) to (6) report the results for each of the five categories.

### 3.4.3 Sustainability Estimation Models

We replace the risk dependent variables in Eq (3) with our risk dependent variables resulting in the following equation:

$$EnVscore_{it} = \alpha + \beta \cdot Fintech\_Index_{it-1} + \lambda \cdot X_{it-1} + \sigma \cdot Z_{it-1} + Year\ x\ country\ FE + \gamma_i + \varepsilon_{it} \quad (3.3)$$

Where, EnVscore is the dependent variable for Islamic banks' Environmental disclosure score; Fintech_Index is the study's developed Fintech Adoption Index and main independent variable. Banks level variables are Total Assets, Efficiency Ratio, Leverage Ratio, Equity to Total Assets Ratio, Non-Interest Income ratio, Return on Assets, Non-Performing Loans ratio, Risk Weighted Assets. Country level variables include GDP growth rate, inflation and Ease of Doing Business. We use bank fixed effects ($\gamma_i$) to control for bank heterogeneity. $\beta$, $\lambda$, $\sigma$ are the coefficients to be estimated and $\varepsilon_{it}$ is the error term. We lag all right hand-side variables by one year to mitigate the problem of endogeneity. $i$ is the subscript for the number of banks and $t$ is the subscript for the number of years. All control variables are lagged by one year. Year-country fixed effects to account for any differences in the data that could be constant over time within each country. $\alpha$ is the constant and $\varepsilon_{it}$ is the error term.

As we study the effects of each FinTech category on both dependent variables. We replace Fintech Index in Eq (3.3) with the five categories: Online (Online Banking), Mobile (Mobile Banking), Express (Express Banking), ePayments and eSecure to also assess the effect of the categories separately. This is reflected in the results tables where column (1) reports the Fintech Adoption Index results and columns (2) to (6) report the results for each of the five categories.

## 3.5 Empirical Results

In this section we present and analyse the results of the performance, risk and sustainability measures to establish whether there is indeed and impact of Fintech adoption on them. Fixed Effects (FE) was adopted as the best estimation model to interpret our results as highlighted in section 3 of this paper.

### 3.5.1 Performance Regression Results

#### *3.5.1.1 Return On Assets Regression Results*

The results in Table 37 demonstrate the positive and statistically significant impact of fintech adoption on banks' Return on Assets (ROA). To illustrate, a 1% increase in the fintech adoption index leads to an 11% increase in banks ROA. The results are in line with the growth noted in the industry which explains

the positive impact. As stated by EY (2018, p10) report "Adoption of Fintech providers for money transfer and payment services rose from 18% in 2015 to 50% in 2017". According to Bakker (2016), "payments and lending are the hottest fintech areas right now".

When exploring the results in each fintech category, the results in Table 37 highlight a significant and positive results with Online Banking and Express Banking. To illustrate, a 1% increase in Online Banking increases ROA by 3%, while a 1% increase in Express Banking increases ROA by 8%. The results are in line with previous studies which showed Online banking increased banks' ROA (Islam et al., 2019). Express Banking results are also in line with industry expectations. For example, Open Banking which is a subcategory of Express Banking, is known to have helped banks offer improved financial products tailored around customers' needs. This in turn led to customers accessing more efficient banking services.

Mobile Banking, ePayments and eSecure all showed no significant relationship to ROA which is rather surprising. One argument would be similar to Dandapani et al (2008) as they reason that the "fact that internet banking services do not significantly enhance ROA does not suggest the implementation of such technology acts a drain on financial institutions profitability". Although their argument is based on Internet Banking only, we made the case for the similarities between Fintech Adoption and Internet banking Adoption in previous sections.

**Table 37: Fintech Adoption and banks' Return On Assets Regression Results**

| *Dependent Variable* | **Return on Assets (ROA)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fintech Index | 0.113*** | | | | | |
| | (0.036) | | | | | |
| Online | | 0.032** | | | | |
| | | (0.016) | | | | |
| Mobile | | | 0.042 | | | |
| | | | (0.026) | | | |
| Express | | | | 0.080* | | |
| | | | | (0.048) | | |
| ePayments | | | | | 0.055 | |
| | | | | | (0.045) | |
| eSecure | | | | | | 0.018 |
| | | | | | | (0.017) |
| Efficiency$t-1$ | 0.002 | 0.001* | -0.000 | 0.002 | 0.002 | -0.000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.002) | (0.001) | (0.001) | (0.002) | (0.002) | (0.001) |
| Leverage$t-1$ | -0.001 | -0.003** | -0.003 | -0.002 | -0.004 | 0.005*** |
| | (0.003) | (0.001) | (0.002) | (0.002) | (0.004) | (0.002) |
| ETA$t-1$ | -0.010* | -0.004 | -0.012*** | -0.002 | -0.016** | 0.005 |
| | (0.006) | (0.003) | (0.004) | (0.006) | (0.007) | (0.003) |
| TA$t-1$ | 0.024 | 0.033*** | 0.006 | 0.015 | 0.003 | -0.014 |
| | (0.033) | (0.012) | (0.021) | (0.030) | (0.038) | (0.016) |
| NII$t-1$ | 0.055 | 0.031 | 0.132*** | -0.078 | 0.006 | 0.016 |
| | (0.058) | (0.022) | (0.038) | (0.049) | (0.068) | (0.045) |
| NPL$t-1$ | -0.027 | -0.010 | 0.041* | -0.000 | -0.040 | -0.010 |
| | (0.028) | (0.012) | (0.023) | (0.026) | (0.025) | (0.013) |
| RWA$t-1$ | 0.005** | 0.005*** | 0.002 | -0.003 | 0.003 | 0.000 |
| | (0.003) | (0.001) | (0.002) | (0.003) | (0.003) | (0.001) |
| GDP$t-1$ | 0.090 | 0.000 | 0.050 | 0.164 | 0.001 | 0.018 |
| | (0.080) | (0.026) | (0.039) | (0.145) | (0.056) | (0.025) |
| Inflation$t-1$ | -0.066 | -0.003 | -0.053 | -0.144* | -0.012 | 0.008 |
| | (0.058) | (0.026) | (0.047) | (0.081) | (0.039) | (0.016) |
| EDB$t-1$ | -0.005 | 0.006* | -0.008 | -0.026 | 0.006 | -0.002 |
| | (0.018) | (0.003) | (0.007) | (0.029) | (0.010) | (0.005) |
| Constant | -0.531 | 0.001 | 1.540*** | 3.918** | -0.045 | 0.139 |
| | (1.309) | (0.297) | (0.550) | (1.985) | (0.788) | (0.377) |
| Adj R-sq | 0.3252 | 0.1925 | 0.1174 | 0.0398 | 0.2349 | 0.0862 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of fintech adoption on banks' Return on Assets. Bank level variables are Efficiency, Leverage, Equity to Total Assets ratio (ETA), Total Assets (TA), Non-Interest Income (NII), Non-Performing Loans (NPL), Risk Weighted Assets (RWA). Country level variables are GDP, Inflation, Ese of Doing Business (EDB). This table reports estimates of the fixed effects specification in equation (2). Robust Standard errors reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

#### *3.5.1.2 Non-Income Interest Regression results*

Table 38 shows that the Fintech Adoption Index is positively and significantly associated with banks' Non-Interest Income (NII). To illustrate, a 1% increase in the Fintech Adoption Index leads to an approximately 11% increase in Non-Interest Income. The result is in line with previous research. DeYoung et al (2007) argue this for the case of Internet Banking Adoption where the same concept of offering chargeable services applies. They state that banks could charge internet depositors higher service fees and cross sell fee-baring products easily through their website. They also add that some customers might be willing to pay online to receive in person specialised services (DeYoung et al., 2007).

At a category level, Table 38 shows e-Payments to have a positive and statistically significant relationship with Non-Interest Income. To illustrate, a 1% increase in e-Payments leads to an approximately 23% increase in Non-Interest Income. This is in line with industry reports as in the ASEAN region, for instance, ePayments are one of the fintech prominent sections with a share of

43% according to EY (2018, p24). Technologies such as Mobile wallets and NFC, which are also two sub-categories in ePayments, have been highlighted for being part of the adopted fintech applications. EBA (2018, p10) report states that "the launch of mobile wallets with the use of NFC technology seem to be some of the FinTech applications already implemented by institutions". Through adopting fintech services or ePayments, banks are strengthening their existing strong position to offer better quality products. This applies to ePayments created and managed by banks or banks using third party to process them (FSB, 2019). The results are also in line with other studies' findings. According to Navaretti et al (2017, p13), "banks are also well placed in offering payment services". Although these services are offered through applications which are free to access or download, extra services offered might incur charges which would come under Non- Interest Income.

In summary, both Return on Assets and Non-Interest Income, which are our Islamic banks' performance dependent variables, have shown a positive and statistically significant relationship with the Fintech Adoption Index and some of its categories. Online Banking, Express Banking and ePayments are three categories out of five within the index to have positive and significant results. If we use the Internet Banking Adoption metaphor, similar results were presented by Ciciretti et al (2009). They confirm that their "evidence shows a strong significant association between the adoption of internet banking by traditional banks and their profitability" (Ciciretti et al., 2009, p97). Other studies such as Dadoukis et al (2021), Tunay et al (2015) and Dandapani et al (2008) highlighted the positive impact of Internet Banking Adoption on banks' performance. Therefore, Return on Assets (ROA) and Non-Interest Income (NII) regression results support our hypothesis $\boldsymbol{H_1}$.

**Table 38: Fintech Adoption and Islamic banks' Non-Interest Income Regression Results**

| *Dependent Variable* | **Non-Interest Income (NII)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fintech Index | 0.108* | | | | | |
| | (0.065) | | | | | |
| Online | | -0.029 | | | | |
| | | (0.022) | | | | |
| Mobile | | | -0.051 | | | |
| | | | (0.040) | | | |
| Express | | | | 0.033 | | |
| | | | | (0.072) | | |
| ePayments | | | | | 0.229** | |
| | | | | | (0.092) | |
| eSecure | | | | | | 0.029 |
| | | | | | | (0.031) |
| Efficiency$t-1$ | 0.001 | 0.002** | 0.000 | 0.002 | 0.001 | -0.001 |
| | (0.002) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| Leverage$t-1$ | 0.000 | -0.003** | -0.003 | -0.003 | -0.003 | 0.006*** |
| | (0.003) | (0.001) | (0.003) | (0.003) | (0.004) | (0.002) |
| ETA$t-1$ | -0.011* | -0.001 | -0.012** | -0.002 | -0.014** | 0.001 |
| | (0.006) | (0.003) | (0.006) | (0.008) | (0.007) | (0.003) |
| TA$t-1$ | 0.019 | 0.032*** | -0.005 | 0.013 | 0.022 | -0.024 |
| | (0.032) | (0.012) | (0.023) | (0.032) | (0.037) | (0.017) |
| ROA$t-1$ | 0.130*** | 0.031** | 0.080** | 0.111* | 0.049 | 0.017 |
| | (0.041) | (0.015) | (0.035) | (0.057) | (0.043) | (0.019) |
| NPL$t-1$ | -0.023 | -0.000 | 0.060*** | -0.005 | -0.053** | -0.012 |
| | (0.029) | (0.012) | (0.021) | (0.027) | (0.025) | (0.013) |
| RWA$t-1$ | 0.006** | 0.005*** | 0.002 | -0.003 | 0.003 | 0.001 |
| | (0.002) | (0.001) | (0.002) | (0.003) | (0.002) | (0.001) |
| GDP$t-1$ | 0.081 | -0.020 | 0.025 | 0.122 | 0.052 | 0.025 |
| | (0.101) | (0.024) | (0.039) | (0.136) | (0.094) | (0.031) |
| Inflation$t-1$ | -0.060 | -0.006 | -0.055 | -0.150** | 0.005 | 0.011 |
| | (0.059) | (0.023) | (0.040) | (0.076) | (0.046) | (0.018) |
| EDB$t-1$ | -0.014 | 0.005 | -0.015** | -0.023 | 0.000 | -0.006 |
| | (0.020) | (0.003) | (0.007) | (0.026) | (0.013) | (0.006) |
| Constant | 0.036 | 0.146 | 2.307*** | 3.750** | -0.324 | 0.554 |
| | (1.427) | (0.284) | (0.555) | (1.829) | (1.017) | (0.403) |
| Adj R-sq | 0.3266 | 0.1705 | 0.0887 | 0.0446 | 0.2642 | 0.1179 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of fintech adoption on banks' Non-Interest Income (NII). Bank level variables are Return on Assets (ROA), Efficiency, Leverage, Equity to Total Assets ratio (ETA), Total Assets (TA), Non-Performing Loans (NPL), Risk Weighted Assets (RWA). Country level variables are GDP, Inflation, Ese of Doing Business (EDB). This table reports estimates of the fixed effects specification in equation (2). Robust Standard errors reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### 3.5.2 Risk Regression Results

#### *3.5.2.1 Non-Performing Loans Regression Results*

The Fintech Adoption Index results in Table 39 column (1), are positive but not statistically significant suggesting no effect of overall fintech adoption on

Islamic banks' non-Performing loans. At category level, however, e-Secure appears to have a positive and statistically significant relationship with non-performing loans. To illustrate, a 1% increase in e-Secure, leads to a 2% increase in non-performing loans. The results are very interesting as tightening security appears to negatively affect non-performing loans. Tightening security affects corruption as it is linked to bad loans (Park, 2012). Corruption also affects consumer behaviour depending on the national norms of the country (Zheng et al., 2013). The national culture of the countries in the set could be described as collectivist. This could in turn link to the argument that national culture influences banks' lending as Zheng et al. (2013) highlight in their study. They state that lending corruption is high in collective countries compared to individualist ones. (Gjeçi & Marinč, 2022) argue that the association between corruption and non-performing loans is stronger in countries classed as collective.

There could potentially be several other explanations to this result. First, questions are raised as to how financially responsible depositors or account holders are when they gain 24/7 access to their finances? Does this notion of 'anytime anywhere' make consumers less responsible in managing their finances? According to DeYoung et al (2007, p1039), "The Internet delivery channel also has implications for depositor behaviour. The ease of transferring funds between various deposit and investment accounts, as well as the ability to make payments closer to their due dates, may lead depositors to hold lower balances in their transaction's accounts and / or shift funds to higher yielding accounts". The concept of misuse of the easy access via online banking supports our result of statistically significant positive relationship between Fintech Adoption represented by eSecure and NPL.

The results could also be explained by the potential mis-selling activities as highlighted by the KPMG (2019) report. "The adoption of new fintech solutions could inadvertently, or intentionally, provide new or different ways for manufacturers and distributors of financial products and services to mislead consumers" (KPMG, 2019, p5). This might include targeted vulnerable age groups such as the elderly of young adults as they are pushed to commit to debt they might not afford in the long run.

**Table 39: Fintech Adoption and banks' Non-Performing Loans Regression Results**

| *Dependent Variable* | **Non-Performing Loans (NPL)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fintech Index | 0.010 | | | | | |
| | (0.024) | | | | | |
| Online | | 0.003 | | | | |
| | | (0.009) | | | | |
| Mobile | | | -0.033 | | | |
| | | | (0.025) | | | |
| Express | | | | -0.018 | | |
| | | | | (0.025) | | |
| ePayments | | | | | 0.007 | |
| | | | | | (0.038) | |
| eSecure | | | | | | 0.019** |
| | | | | | | (0.009) |
| Efficiency$t-1$ | 0.003* | 0.001* | 0.001 | 0.003 | 0.003 | -0.001 |
| | (0.002) | (0.001) | (0.001) | (0.002) | (0.002) | (0.001) |
| Leverage$t-1$ | -0.003 | -0.003 | -0.005* | -0.004 | -0.002 | 0.003 |
| | (0.003) | (0.002) | (0.003) | (0.003) | (0.005) | (0.002) |
| ETA$t-1$ | -0.012 | -0.007* | -0.004 | -0.004 | -0.013* | 0.003 |
| | (0.008) | (0.003) | (0.007) | (0.010) | (0.008) | (0.004) |
| TA$t-1$ | 0.029 | 0.013 | 0.010 | -0.000 | 0.039 | -0.003 |
| | (0.029) | (0.012) | (0.021) | (0.032) | (0.035) | (0.015) |
| ROA$t-1$ | 0.145*** | 0.054*** | 0.032 | 0.118* | 0.055 | 0.019 |
| | (0.045) | (0.019) | (0.045) | (0.065) | (0.041) | (0.021) |
| NII$t-1$ | 0.059 | 0.022 | 0.165*** | -0.010 | -0.032 | 0.014 |
| | (0.056) | (0.022) | (0.040) | (0.040) | (0.069) | (0.042) |
| RWA$t-1$ | 0.007** | 0.005*** | 0.001 | -0.001 | 0.004 | 0.000 |
| | (0.003) | (0.001) | (0.002) | (0.002) | (0.003) | (0.001) |
| GDP$t-1$ | 0.081 | 0.008 | -0.003 | 0.159 | 0.015 | 0.012 |
| | (0.077) | (0.020) | (0.027) | (0.163) | (0.040) | (0.014) |
| Inflation$t-1$ | -0.058 | 0.004 | -0.051 | -0.144* | -0.005 | 0.006 |
| | (0.062) | (0.026) | (0.063) | (0.081) | (0.049) | (0.016) |
| EDB$t-1$ | -0.009 | 0.003 | 0.008 | -0.019 | -0.005 | -0.005 |
| | (0.017) | (0.004) | (0.007) | (0.028) | (0.009) | (0.004) |
| Constant | -0.552 | 0.286 | 0.614 | 3.348* | -0.003 | 0.283 |
| | (1.263) | (0.388) | (0.631) | (2.005) | (0.837) | (0.354) |
| Adj R-sq | 0.3212 | 0.2125 | 0.0773 | 0.0502 | 0.2136 | 0.1100 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of fintech adoption on banks' Non-Performance Loans (NPL). Bank level variables are Return on Assets (ROA), Efficiency, Leverage, Equity to Total Assets ratio (ETA), Total Assets (TA), Non-Interest Income (NII), Risk Weighted Assets (RWA). Country level variables are GDP, Inflation, Ese of Doing Business (EDB). This table reports estimates of the fixed effects specification in equation (2). Robust Standard errors reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

### *3.5.2.2 Risk Weighted Assets Regression Results*

The results in Table 40 column (1) shows a negative coefficient highlighting a negative relationship between fintech adoption and risk weighted assets, although the results are not statistically significant. However, at category level,

we can see that the results of ePayments in column (5) are statistically significant with a negative coefficient. To illustrate, a 1% increase in ePayments reduces risk weighted assets by 5%. The ease of making payments and sending and receiving money via ePayments will have direct implications on banks' capital which is reflected in their risk weighted assets. This result is in line with previous studies highlighting how fintech adoption reduces banks' risk-taking behaviour (Liu et al., 2017) and improves banks' risk management capacity.

No significant result from the other categories shows that not all areas of banking operations are sensitive to all types of technologies. Although DeYoung et al (2007) raise fears that Mobile banking applications' ease of use could backfire, our results show no negative effect of Mobile banking or Online banking on banks' RWA. Indeed, Floros (2008) studied the impact of internet banking on Greek bank's performance and demonstrated that there was no impact noted.

**Table 40: Fintech Adoption and banks' Risk Weighted Assets Regression Results**

| *Dependent Variable* | **Risk Weighted Assets (RWA)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fintech Index | -0.031 | | | | | |
| | (0.028) | | | | | |
| Online | | -0.005 | | | | |
| | | (0.014) | | | | |
| Mobile | | | -0.006 | | | |
| | | | (0.018) | | | |
| Express | | | | 0.040 | | |
| | | | | (0.038) | | |
| ePayments | | | | | -0.055* | |
| | | | | | (0.033) | |
| eSecure | | | | | | -0.013 |
| | | | | | | (0.013) |
| Efficiency$t-1$ | 0.002 | 0.002** | 0.000 | 0.002 | 0.002 | -0.001 |
| | (0.002) | (0.001) | (0.001) | (0.002) | (0.002) | (0.001) |
| Leverage$t-1$ | -0.000 | -0.003** | -0.004* | -0.003 | -0.003 | 0.006*** |
| | (0.003) | (0.002) | (0.003) | (0.003) | (0.004) | (0.002) |
| ETA$t-1$ | -0.009 | -0.002 | -0.013** | -0.004 | -0.008 | 0.001 |
| | (0.007) | (0.003) | (0.006) | (0.009) | (0.006) | (0.004) |
| TA$t-1$ | 0.003 | 0.034*** | 0.005 | 0.010 | -0.004 | -0.031* |
| | (0.033) | (0.012) | (0.022) | (0.033) | (0.037) | (0.018) |
| ROA$t-1$ | 0.126*** | 0.032** | 0.072* | 0.109* | 0.042 | 0.019 |
| | (0.041) | (0.014) | (0.038) | (0.055) | (0.040) | (0.019) |
| NPL$t-1$ | -0.022 | -0.008 | 0.041* | 0.009 | -0.036 | -0.012 |
| | (0.031) | (0.014) | (0.023) | (0.026) | (0.026) | (0.013) |
| NII$t-1$ | 0.027 | 0.021 | 0.130*** | -0.073 | -0.032 | 0.014 |
| | (0.058) | (0.023) | (0.041) | (0.047) | (0.075) | (0.044) |
| GDP$t-1$ | 0.037 | -0.022 | 0.025 | 0.154 | -0.031 | 0.011 |
| | (0.074) | (0.022) | (0.042) | (0.173) | (0.055) | (0.027) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Inflation$t-1$ | -0.090** | -0.014 | -0.060 | -0.125 | -0.040 | 0.002 |
| | (0.045) | (0.015) | (0.044) | (0.088) | (0.036) | (0.018) |
| EDB$t-1$ | -0.010 | 0.004 | -0.008 | -0.026 | 0.004 | -0.005 |
| | (0.016) | (0.004) | (0.007) | (0.030) | (0.010) | (0.006) |
| Constant | 0.894 | 0.546** | 1.777*** | 3.447* | 0.859 | 0.749* |
| | (1.053) | (0.259) | (0.534) | (2.004) | (0.752) | (0.424) |
| Adj R-sq | 0.2958 | 0.0948 | 0.1206 | 0.0542 | 0.2257 | 0.1101 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of fintech adoption on banks' Risk Weighted Assets (RWA). Bank level variables are Return on Assets (ROA), Efficiency, Leverage, Equity to Total Assets ratio (ETA), Total Assets (TA), Non-Interest Income (NII), Non-Performance Loans (NPL). Country level variables are GDP, Inflation, Ese of Doing Business (EDB). This table reports estimates of the fixed effects specification in equation (2). Robust Standard errors reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In summary, our results show different effects of fintech adoption on banks' risks. Non-Performing Loans (NPL) have a positive relationship with eSecure, a category of our fintech index. However, Risk Weighted Assets have a negative relationship with ePayments, another category of our fintech index. These results are in line with the industry assessment of fintech for having the potential of bringing significant benefits while increasing existing risks or creating new ones (Mnohoghitnei et al., 2019). Therefore, our risk results support our hypothesis $H_2$.

### 3.5.3 Sustainability Regression Results

Results in Table 41 show that banks' environmental activities have a positive and statistically significant relationship with Mobile Banking. To illustrate, a 1% increase in Mobile Banking leads to an almost 1% increase in banks' environmental disclosure. Although the increase is modest, it highlights Mobile Banking's characteristics of ease and convenience. Since Mobile Banking applications are free to download sophisticated and get upgraded regularly, they give the users 24/7 access to view and manage their accounts with minimal bank interactions. Similarly, banks can process received requests faster with reduced paperwork and branches interventions. According to EY (2018), mobile subscriptions in our sampled countries range from 122.1 per 100 in Saudi Arabia to 210.9 per 100 in UAE (Kuwait, Oman and Jordan are excluded due to lack of data). As all our studied banks offer Mobile Banking services, mobile

subscriptions and smartphones, in particular, would have a significant impact on Islamic banks' environmental activities as seen in the results.

One possible explanation behind the insignificant results of the Fintech Adoption Index is the lifespan of some technologies. Some technologies which might be deemed environmentally friendly such as Face ID (facial recognition) or Touch ID (fingerprints) were rolled out only recently by some of the banks studied which does not give us enough evidence to judge their performances or measure their impact. An issue that Ciciretti et al (2009, p97) highlight in their findings as they confirm that studying the adoption of new technologies does not give "enough data points of information to draw firm conclusions". Added to this, these technologies are mainly related to smartphone users who do not represent the largest section of our Islamic banks client base as discussed above.

In fact, Mobile technology has not yet reached its full potential in developing countries. Recent figures show that "a median of 76% across 18 advanced economies have smartphones, compared with a median of only 45% in emerging economies" (Silver, 2019). These figures present a huge opportunity for Islamic Banks in emerging countries as the more common smartphones become, the higher opportunity to increase their market share. Therefore, our sustainability results support our hypothesis $H_3$.

**Table 41: Fintech Adoption and banks' Environmental disclosure score Regression Results**

| *Dependent Variable* | **Environmental Disclosure scores** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Fintech Index | 0.002 | | | | | |
| | (0.006) | | | | | |
| Online | | -0.001 | | | | |
| | | (0.001) | | | | |
| Mobile | | | 0.006* | | | |
| | | | (0.004) | | | |
| Express | | | | -0.005 | | |
| | | | | (0.006) | | |
| ePayments | | | | | 0.004 | |
| | | | | | (0.008) | |
| eSecure | | | | | | 0.001 |
| | | | | | | (0.003) |
| Efficiency$t-1$ | 0.002** | 0.000 | 0.001 | 0.003 | 0.003* | -0.000 |
| | (0.001) | (0.000) | (0.001) | (0.002) | (0.002) | (0.000) |
| TA$t-1$ | 0.043* | 0.009 | -0.010 | 0.005 | 0.025 | 0.024* |
| | (0.023) | (0.009) | (0.016) | (0.025) | (0.025) | (0.013) |
| Leverage$t-1$ | 0.002 | 0.001 | 0.002 | -0.004 | -0.000 | 0.002 |
| | (0.003) | (0.001) | (0.002) | (0.003) | (0.003) | (0.002) |

| | | | | | | |
|---|---|---|---|---|---|---|
| ETA$t-1$ | 0.002 | 0.002 | 0.009** | -0.009 | -0.009 | 0.005 |
| | (0.007) | (0.002) | (0.004) | (0.008) | (0.006) | (0.004) |
| RWA$t-1$ | -0.023 | -0.011 | 0.001 | 0.013 | -0.025 | -0.007 |
| | (0.025) | (0.009) | (0.016) | (0.037) | (0.025) | (0.014) |
| NPL$t-1$ | -0.005 | 0.001 | -0.023* | 0.004 | 0.022 | -0.012 |
| | (0.016) | (0.007) | (0.012) | (0.018) | (0.018) | (0.008) |
| NII$t-1$ | 0.087 | 0.038 | -0.053 | 0.096 | 0.101 | -0.016 |
| | (0.060) | (0.026) | (0.034) | (0.059) | (0.077) | (0.024) |
| GDP$t-1$ | -0.038* | -0.008 | 0.006 | -0.033 | -0.035 | -0.004 |
| | (0.021) | (0.009) | (0.015) | (0.024) | (0.027) | (0.011) |
| Inflation$t-1$ | -0.010 | -0.004 | -0.016 | -0.003 | -0.013 | 0.004 |
| | (0.027) | (0.012) | (0.018) | (0.043) | (0.026) | (0.015) |
| EDB$t-1$ | 0.003 | -0.001 | -0.004 | 0.007 | 0.007 | -0.002 |
| | (0.006) | (0.003) | (0.004) | (0.009) | (0.006) | (0.003) |
| Constant | -1.440* | 0.868*** | 1.694*** | 1.682 | -0.657 | -0.497 |
| | (0.842) | (0.313) | (0.586) | (1.046) | (0.842) | (0.450) |
| Adj R-sq | 0.3287 | 0.1760 | 0.0805 | 0.0434 | 0.2844 | 0.0673 |
| Observations | 441 | 441 | 441 | 441 | 441 | 441 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| CountryYearFE | Yes | Yes | Yes | Yes | Yes | Yes |

This table reports the estimation results for the impact of fintech adoption on banks' Environmental disclosure scores. Bank level variables are Return on Assets (ROA), Efficiency, Leverage, Equity to Total Assets ratio (ETA), Total Assets (TA), Non-Interest Income (NII), Non-Performance Loans (NPL), Risk Weighted Assets (RWA). Country level variables are GDP, Inflation, Ese of Doing Business (EDB). This table reports estimates of the fixed effects specification in equation (2). Robust Standard errors reported in parentheses. *, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

## 3.6 Conclusion

This Chapter focuses on analysing the impact of fintech adoption on Islamic Banks' performance, risks and sustainability using a sample of 63 Islamic Banks from eight OIC countries between 2012 and 2018. The study gains its strength from a combination of a unique set of data compiled by the researcher as well as the creation of a Fintech Adoption Index to capture and track the latest Fintech services offered. The Fintech Adoption Index's five categories are Mobile Banking, Online Banking, Express Banking, ePayments and eSecure. As Fintech is a relatively new phenomenon, theoretical and empirical studies on its impact on banks are scarce. In view of this, Internet Banking Adoption papers and studies were referenced throughout this work to lay foundations for our results. A quantitative approach was deployed, and data was analysed using Fixed effects models.

For performance measures, regression results show Fintech Adoption to have a positive and statistically significant relationship with Islamic Banks' Return on Assets and Non-Interest Income. One of banks' key day to day service is

processing payments. To couple it with advanced technologies and ease of access means banks are in an advantageous position over other channels, such as intermediaries or even fintech start-ups. Added to this, the convenience of Mobile Banking had led some Islamic Banks' customers to purchase additional chargeable products or services they, either didn't have access to before, or used to purchase them from alternative bank channels.

As for Islamic banks' risk, the results are mixed as fintech adoption appears to reduce Risk Weighted Assets through ePayments category, while Non-Performing Loan increase due to the eSecure category. The results highlight how technologies could be double edged sword. With many advantages to one being able to access, manage and even borough money anytime anywhere, the risk of account mismanagement could not be downplayed. A greater responsibility is now placed on bank account holders and their efficiency in controlling their finances is being tested. Any misuse by account holders, puts the bank at risk which could have a snowball effect on other financial institutions.

In terms of banks' sustainability proxied by their environmental disclosure scores, Mobile banking category appears to be the only one which has a positive and statistically significant relationship with banks' environmental activities. This could be explained in part by the boom in mobile technology around the world and in our eight developing countries (Bahrain, Indonesia, Jordan, Kuwait, Malaysia, Oman, Saudi Arabia and UAE). Digitalization and sustainability are identified as key factors for achieving more affordable, sustainable and healthier societies.

# Conclusions

This thesis explores global sustainable banking from different dimensions. From a regulatory perspective, Chapter 1 investigates the effects of macroprudential policies on green bonds' cost of issuance. From a macroeconomic perspective, Chapter 2 assesses the relationship between economic uncertainty and banks' Environmental, Social and Governance (ESG) activities. Finally, from an innovation perspective, Chapter 3 examines the impact of Fintech adoption upon Islamic banks' performance, risk and environmental sustainability.

As the backbone of economies, banks are better positioned to help achieve the Sustainable Development Goals (SDGs) as well as Paris Climate Agreement 2015. Therefore, this thesis chapters have been carefully selected to address contemporary issues in the banking sector and to provide relevant recommendations to banks, policy makers and other stakeholders. Since sustainable banking is a relatively nascent subject, the thesis aims to contribute to its growing literature by opening new discussions and enriching existing ones. The three chapters' research questions have all been empirically addressed using known and approved econometric methods.

Building on the work of highly regarded studies and researchers allowed for the deployment of novel approaches such as the creation of a bank level Fintech Adoption Index. The main thesis findings highlight that tighter liquidity macroprudential policies make green bonds issuance costlier for banks who also reduce their sustainability activities during high economic uncertainty. However, the adoption of technological advancement in the form of Fintech appears to increase banks' performance and sustainability. The thesis highlights several policy implications and puts forward three recommendations. Firstly, special measures in the form of Tax relieves on green bonds issuances to encourage banks and attract investors. Secondly, ring fencing ESG activities to ensure continuous relative growth during economic uncertainty. Finally, promoting Fintech Adoption with favourable policies.

In Chapter 1, we investigate the effects of macroprudential policies on banks' green bonds cost of issuance by first establishing long-term and short-term measures, classifying the policies into tightening and loosening, as well as categorising them. Second, we explore the cost of issuance of bank bonds through a comparative study between green and non-green bonds. This approach allows us to expand the literature of unintended consequences of macroprudential policies towards the sustainability route by exploring green bonds. Our findings show that macroprudential policies have different long and short-term effects on bonds' cost of issuance proxied by yield at issue. Short-term bonds' yield at issue increased following tighter macroprudential policies while no effect was noted Long-term. When categorised by policy relevance, the results were significant with liquidity related policies.

An increase in non-green bonds' yield at issue enlarges the difference with green bonds yield at issue. This difference is known as the greenium which is the additional cost of issuing green bonds absorbed by offering lower yield at issue to investors. Despite their commitments to fund environmentally friendly projects, green bonds are limited to climate change conscious investors who are willing to compromise profit for the greater good. However, the market is very competitive, and investors are known for "reaching for yield" as they buy riskier assets to achieve higher yield which is well-documented in literature.

These findings are of great relevance and importance to many stakeholders. For regulators, they highlight the need to consider promoting green bonds and incentivising long-term financing in the form of special measures in conjunction with policies introduced. For policy makers, the results revive the discussion around the green finance gap and the need for robust measures to facilitate the transition to low carbon economies to achieve the climate change targets set by the 2015 Paris agreement. It is evident that current macroprudential policies do not go far to protect green investments' growth and competitiveness. As for issuing banks, green bonds are seen as a potential driver of large-scale investments in climate change projects, therefore, crucial for their growth and image as they signal banks' commitment to sustainability. A potential negative effect of macroprudential policies on green bonds' competitiveness could be damaging and counterproductive.

In Chapter 2, we further examine banks' sustainability activities with a focus on economic uncertainty. We find that Economic Policy Uncertainty (EPU) negatively affects banks' Environmental, Social and Governance (ESG) activities. At category level, banks' governance activities are significantly affected as they reduce with increased uncertainty. The results are robust to alternative measures of sustainability and uncertainty. Further analysis shows that the effect of economic uncertainty is greater on bigger and Principles for Responsible Investments (PRI) signatory banks compared to their small and non-PRI signatory counterparts. Country level analysis show no significant effect of economic uncertainty on banks' ESG activities in countries with high Sustainable Development Goals (SDG) rating.

While the study reaffirms banks are more conservative during economic uncertainty, it highlights discrepancies in banks' ESG activities. This, in turn indicates that banks do not fully suspend investment decisions during high uncertainty but rather prioritise activities in line with the resource allocation theory. The findings expand banks' ESG activities literature by examining how they are affected by economic insecurity which is of high importance to policy makers. A reduction in governance activities is alarming due to their association with the 2008 financial crisis. Indeed, investigations into the causes of the crisis concluded that big banks' governance failures were amongst the main sources of the financial meltdown. Therefore, policy makers are required to revise the effectiveness of previously introduced governance reforms such as specialised committees.

In Chapter 3, the Thesis concludes with a novel research design as we explore the relationship between Financial Technology (Fintech) and banks' performance, risk and sustainability. With a focus on Islamic banks, the study combines the use of a unique dataset compiled by the author as well as the creation of a bank level Fintech Adoption Index to capture and track the latest Fintech services offered. The findings show that an increase in Fintech Adoption by Islamic banks' leads to an increase in their performance. Given advanced technologies facilitate ease of access and offered convenient services to customers, banks investing in these technologies enhance their performance.

As we further explore the relationship between Islamic banks' risks and their Fintech adoption, the results are mixed. Proxied by Risk Weighted Assets (RWA) and Non-Performing Loans (NLP), the findings show that RWA reduce with increased Fintech adoption while NPL increase. As customers are offered the convenience of managing their accounts 24/7 and accessing credit easier and faster, the risk of account mismanagement becomes more pronounce. Any misuse due to the "Anytime Anywhere" Fintech promise, puts banks at risk with potential snowball effects on other financial institutions.

In terms of banks' sustainability, Fintech appears to increase banks' environmental activities through increased mobile banking facilities. This could be explained in part by the boom in mobile technology around the world and in our eight developing countries (Bahrain, Indonesia, Jordan, Kuwait, Malaysia, Oman, Saudi Arabia and UAE). Digitalization and sustainability are identified as key factors for achieving more affordable, sustainable and healthier societies and our findings fully support this.

This thesis shifts Policy makers, regulators and banks focus into three separate avenues which require further improvements. To support the transition to green economies and achievement of the Sustainable Development Goals, the thesis provides recommendations to various stakeholders.

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# Appendix A – Chapter 1

## Appendix 1: Macroprudential policies definition

| *Macroprudential policies* | *Abbreviation* | *Definitions* |
|---|---|---|
| Countercyclical buffer | CCB | A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tighte dummy-type indicators. |
| Conservation buffer | Conservation | Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III. |
| Capital requirements | Capital | Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in the above measures respectively and thu included here. |
| Leverage requirements | LVR | A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., E leverage ratio). |
| Provisioning requirements | LLP | Loan-loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisi g., housing loans). |
| Credit growth limits | LCG | Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks penalties for high credit growth. |
| Loan restrictions | LoanR | Loan restrictions, that are more tailored than those captured in "LCG". They include loan limits and prohibitions, which conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), bar characteristics (e.g., mortgage banks), and other factors. |
| Limits on Foreign Currency Loans | LFC | Limits on foreign currency (FC) lending, and rules or recommendations on FC loans. |
| Loan-to-value limits | LTV | Limits to the loan-to-value ratios, including those mostly targeted at housing loans, but also includes those targeted at auto loans, and commercial real estate loans. |
| Debt-to-income limits | DSTI | Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt services or debt rel income. They include those targeted at housing loans, consumer loans, and commercial real estate loans. |
| Levy/Tax on Financial Institutions | Tax | Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gains ta |
| Liquidity measures | Liquidity | Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish curr |
| Loan to deposit limits | LTD | Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios. |
| Limits on FX operations | LFX | Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mism regulations. |
| Reserve requirements | RR | Reserve requirements (domestic or foreign currency) for macroprudential purposes. This category may currently includ for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut. |
| SIFI surcharges | SIFI | Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which ir capital and liquidity surcharges. |
| Other macroprudential measures | Other | Macroprudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, structural measures (e.g., limits on exposures between financial institutions). |

Source: (Davis et al., 2022, p7)

# Appendix B – Chapter 2

## Appendix 2: A sample of Bloomberg ESG field points

| Description | Industry | Category |
|---|---|---|
| Latest Period End Date CSR | All | Descriptive data |
| ESG Disclosure Score | All | All |
| Governance Disclosure Score | All | Governance |
| Social Disclosure Score | All | Social |
| Environmental Disclosure Score | All | Environmental |
| Nitrogen Oxide Emissions (Th Tonnes) | All | Environmental |
| GHG Intensity per Vehicle Sold | Automobiles | Environmental |
| Gas Flaring per MBOE | Oil & Gas | Environmental |
| GHG Scope 1 Intensity per Power Generated | Electric Utilities | Environmental |
| Total GHG CO2 Emissions Intensity per Vehicle Sold | Automobiles | Environmental |
| Greenhouse Gas Intensity per RPM | Airlines | Environmental |
| Carbon Offsets | All | Environmental |
| Carbon Dioxide Intensity per Square Foot | Retail - Discretionary | Environmental |
| Total Energy Consumption (MWh) | All | Environmental |
| Community Spending/Profit Before Tax | All | Social |
| Consumer Data Protection Policy | All | Social |
| Percentage of Suppliers in Non-Compliance | All | Social |
| Sustainable Development Goals Target Policy | All | Social |
| Anti-Bribery Ethics Policy | All | Social |
| UN Global Compact Signatory | All | Social |
| Employee Protection / Whistle Blower Policy | All | Social |
| Community Spending | All | Social |
| Business Ethics Policy | All | Social |
| Verification Type | All | Social |
| Employee CSR Training | All | Social |
| PRI Signatory | Financials | Social |
| Political Donations | All | Social |
| Political Donations/Profit Before Tax | All | Social |
| SRI Assets Under Management | Financials | Social |
| SRI Assets % Total AUM | Financials | Social |
| CSR/Sustainability Committee | All | Governance |
| Executive Compensation Linked to ESG | All | Governance |
| CSR/Sustainability Committee (Y/N) | All | Governance |
| ESG Linked Compensation for Board | All | Governance |
| Global Reporting Initiatives Checked | All | Governance |
| Executive Director with Responsibility for CSR | All | Governance |
| Non-Executive Director with Responsibility for CSR | All | Governance |

| | | |
|---|---|---|
| Sustainable Investment/Capital Expenditures | All | Governance |
| Pct of Independent Directors on Audit Committee | All | Governance |
| Independent Audit Committee Chairperson | All | Governance |
| Audit Committee Meeting Attendance Percentage | All | Governance |
| Years Auditor Employed | All | Governance |
| Size of Audit Committee | All | Governance |
| % Non Executive Directors on Audit Committee | All | Governance |
| % Audit Committee Members on 3+ Boards | All | Governance |
| Number of Independent Directors on Audit Committee | All | Governance |
| # of Non-Executive Directors on Audit Committee | All | Governance |
| Total Salaries and Bonuses Paid to Executives | All | Governance |
| Total Salaries & Bonuses Paid to CEO & Equivalent | All | Governance |
| Total Bonuses Paid to Executives | All | Governance |
| Total Salaries Paid to Executives | All | Governance |
| Total Bonuses Paid to CEO and Equivalent | All | Governance |
| Percentage of Female Executives | All | Governance |
| Number of Women on Board | All | Governance |
| Female Chief Executive Officer or Equivalent | All | Governance |
| Number of Female Executives | All | Governance |
| Board Average Age | All | Governance |
| Female Chairperson or Equivalent | All | Governance |
| Board Age Range | All | Governance |
| Percent of Board Members that are Women | All | Governance |
| Chairman Age | All | Governance |
| Percent of Executives that are Women | All | Governance |
| Age of the Youngest Director | All | Governance |
| Age of the Oldest Director | All | Governance |
| Board of Directors Age Range | All | Governance |
| Number of Women Directors on Board | All | Governance |
| Chief Executive Officer or Equivalent a Woman | All | Governance |
| Chairman or Equivalent a Woman | All | Governance |
| Board Age Limit | All | Governance |
| Number of Women Executives | All | Governance |
| Oldest Director Age | All | Governance |
| Youngest Director Age | All | Governance |

Source: (Bloomberg, 2020b)

## Appendix 3: Bloomberg's Criteria for ESG Disclosure scores

| Pillar (Weight) | Topic | Field Description | Units | Disclosure Frequency | In Old Disclosure Score? | Weight (% of Overall Score Weight) |
|---|---|---|---|---|---|---|
| Environmental 33% | Air Quality | Air Quality Disclosure Score | Percentage | | | 0.047781913 |
| Environmental | Air Quality | Nitrogen Oxide Emissions | Thousand Metric Tonnes | Annual | Y | 0.009556383 |
| Environmental | Air Quality | VOC Emissions | Thousand Metric Tonnes | Annual | Y | 0.009556383 |
| Environmental | Air Quality | Carbon Monoxide Emissions | Thousand Metric Tonnes | Annual | Y | 0.009556383 |
| Environmental | Air Quality | Particulate Emissions | Thousand Metric Tonnes | Annual | Y | 0.009556383 |
| Environmental | Air Quality | Sulphur Dioxide / Sulphur Oxide Emissions | Thousand Metric Tonnes | Annual | N | 0.009556383 |
| Environmental | Climate Change | Climate Change Disclosure Score | Percentage | | | 0.046977165 |
| Environmental | Climate Change | Emissions Reduction Initiatives | Y/N | Annual | Y | 0.001106529 |
| Environmental | Climate Change | Climate Change Policy | Y/N | Annual | Y | 0.001106529 |
| Environmental | Climate Change | Climate Change Opportunities Discussed | Y/N | Annual | Y | 0.001106529 |
| Environmental | Climate Change | Risks of Climate Change Discussed | Y/N | Annual | Y | 0.001106529 |
| Environmental | Climate Change | Direct CO2 Emissions | Thousand Metric Tonnes | Annual | Y | 0.004727895 |
| Environmental | Climate Change | Indirect CO2 Emissions | Thousand Metric Tonnes | Annual | Y | 0.004727895 |
| Environmental | Climate Change | ODS Emissions | Thousand Metric Tonnes | Annual | Y | 0.004727895 |
| Environmental | Climate Change | GHG Scope 1 | Thousand Metric Tonnes CO2e | Annual | Y | 0.004727895 |
| Environmental | Climate Change | GHG Scope 2 | Thousand Metric Tonnes CO2e | Annual | Y | 0.004727895 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Environmental | Climate Change | GHG Scope 3 | Thousand Metric Tonnes CO2e | Annual | Y | 0.004727895 |
| Environmental | Climate Change | Scope 2 Market Based GHG Emissions | Thousand Metric Tonnes CO2e | Annual | N | 0.004727895 |
| Environmental | Climate Change | Scope of Disclosure | Nominal (1-3) | Annual | N | 0.004727895 |
| Environmental | Climate Change | Carbon per Unit of Production | Metric Tonnes/Unit of Production | Annual | N | 0.004727895 |
| Environmental | Ecological & Biodiversity Impacts | Ecological & Biodiversity Impacts Disclosure Score | Percentage | | | 0.047882507 |
| Environmental | Ecological & Biodiversity Impacts | Biodiversity Policy | Y/N | Annual | Y | 0.002816618 |
| Environmental | Ecological & Biodiversity Impacts | Number of Environmental Fines | Count | Annual | Y | 0.011266472 |
| Environmental | Ecological & Biodiversity Impacts | Environmental Fines (Amount) | Million Reporting Currency | Annual | Y | 0.011266472 |
| Environmental | Ecological & Biodiversity Impacts | Number of Significant Environmental Fines | Count | Annual | N | 0.011266472 |
| Environmental | Ecological & Biodiversity Impacts | Amount of Significant Environmental Fines | Million Reporting Currency | Annual | N | 0.011266472 |
| Environmental | Energy | Energy Disclosure Score | Percentage | | | 0.047278946 |
| Environmental | Energy | Energy Efficiency Policy | Y/N | Annual | Y | 0.001408309 |
| Environmental | Energy | Total Energy Consumption | Thousand Megawatt Hours | Annual | Y | 0.00573383 |
| Environmental | Energy | Renewable Energy Use | Thousand Megawatt Hours | Annual | Y | 0.00573383 |
| Environmental | Energy | Electricity Used | Thousand Megawatt Hours | Annual | Y | 0.00573383 |
| Environmental | Energy | Fuel Used - Coal/Lignite | Thousand Metric Tonnes | Annual | Y | 0.00573383 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Environmental | Energy | Fuel Used - Natural Gas | Thousand Cubic Meters | Annual | Y | 0.00573383 |
| Environmental | Energy | Fuel Used - Crude Oil/Diesel | Thousand Cubic Meters | Annual | Y | 0.00573383 |
| Environmental | Energy | Self Generated Renewable Electricity | Thousand Megawatt Hours | Annual | N | 0.00573383 |
| Environmental | Energy | Energy Per Unit of Production | Megawatt Hours/Unit of Production | Annual | N | 0.00573383 |
| Environmental | Materials & Waste | Materials & Waste Disclosure Score | Percentage | | | 0.047379539 |
| Environmental | Materials & Waste | Waste Reduction Policy | Y/N | Annual | Y | 0.001609496 |
| Environmental | Materials & Waste | Hazardous Waste | Thousand Metric Tonnes | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | Total Waste | Thousand Metric Tonnes | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | Waste Recycled | Thousand Metric Tonnes | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | Raw Materials Used | Thousand Metric Tonnes | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | % Recycled Materials | Percentage | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | Waste Sent to Landfills | Thousand Metric Tonnes | Annual | Y | 0.006538578 |
| Environmental | Materials & Waste | Percentage Raw Material from Sustainable Sources | Percentage | Annual | N | 0.006538578 |
| Environmental | Supply Chain | Supply Chain Disclosure Score | Percentage | | | 0.047882507 |
| Environmental | Supply Chain | Environmental Supply Chain Management | Y/N | Annual | Y | 0.047882507 |
| Environmental | Water | Water Disclosure Score | Percentage | | | 0.047882507 |
| Environmental | Water | Water Policy | Y/N | Annual | N | 0.002816618 |
| Environmental | Water | Total Water Discharged | Thousand Cubic Meters | Annual | Y | 0.011266472 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Environmental | Water | Water per Unit of Production | Liters/Unit of Production | Annual | Y | 0.011266472 |
| Environmental | Water | Total Water Withdrawal | Thousand Cubic Meters | Annual | N | 0.011266472 |
| Environmental | Water | Water Consumption | Thousand Cubic Meters | Annual | N | 0.011266472 |
| Social (33%) | Community & Customers | Community & Customers Disclosure Score | Percentage | | | 0.055326426 |
| Social | Community & Customers | Human Rights Policy | Y/N | Annual | Y | 0.003420179 |
| Social | Community & Customers | Policy Against Child Labor | Y/N | Annual | N | 0.003420179 |
| Social | Community & Customers | Quality Assurance and Recall Policy | Y/N | Annual | N | 0.003420179 |
| Social | Community & Customers | Consumer Data Protection Policy | Y/N | Annual | N | 0.003420179 |
| Social | Community & Customers | Community Spending | Million Reporting Currency | Annual | Y | 0.013881903 |
| Social | Community & Customers | Number of Customer Complaints | Count | Annual | N | 0.013881903 |
| Social | Community & Customers | Total Corporate Foundation and Other Giving | Million Reporting Currency | Annual | N | 0.013881903 |
| Social | Diversity | Diversity Disclosure Score | Percentage | | | 0.054924052 |
| Social | Diversity | Equal Opportunity Policy | Y/N | Annual | Y | 0.001307716 |
| Social | Diversity | Gender Pay Gap Breakout | Y/N | Annual | N | 0.001307716 |
| Social | Diversity | % Women in Management | Percentage | Annual | Y | 0.005230862 |
| Social | Diversity | % Women in Workforce | Percentage | Annual | Y | 0.005230862 |
| Social | Diversity | % Minorities in Management | Percentage | Annual | Y | 0.005230862 |
| Social | Diversity | % Minorities in Workforce | Percentage | Annual | Y | 0.005230862 |
| Social | Diversity | % Disabled in Workforce | Percentage | Annual | Y | 0.005230862 |
| Social | Diversity | Percentage Gender Pay Gap for Senior Management | Percentage | Annual | N | 0.005230862 |
| Social | Diversity | Percentage Gender Pay Gap Mid & Other Management | Percentage | Annual | N | 0.005230862 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Social | Diversity | Percentage Gender Pay Gap Employees Ex Management | Percentage | Annual | N | 0.005230862 |
| Social | Diversity | % Gender Pay Gap Tot Empl Including Management | Percentage | Annual | N | 0.005230862 |
| Social | Diversity | % Women in Middle and or Other Management | Percentage | Annual | N | 0.005230862 |
| Social | Ethics & Compliance | Ethics & Compliance Disclosure Score | Percentage | | | 0.0557288 |
| Social | Ethics & Compliance | Business Ethics Policy | Y/N | Annual | Y | 0.009254602 |
| Social | Ethics & Compliance | Anti-Bribery Ethics Policy | Y/N | Annual | N | 0.009254602 |
| Social | Ethics & Compliance | Political Donations | Million Reporting Currency | Annual | Y | 0.037219596 |
| Social | Health & Safety | Health & Safety Disclosure Score | Percentage | | | 0.055829393 |
| Social | Health & Safety | Health and Safety Policy | Y/N | Annual | Y | 0.001508903 |
| Social | Health & Safety | Fatalities - Contractors | Count | Annual | Y | 0.00603561 |
| Social | Health & Safety | Fatalities - Employees | Count | Annual | Y | 0.00603561 |
| Social | Health & Safety | Fatalities - Total | Count | Annual | Y | 0.00603561 |
| Social | Health & Safety | Lost Time Incident Rate | Lost Time Incidents/200,000 Hours Worked or 100 Full Time Employees | Annual | Y | 0.00603561 |
| Social | Health & Safety | Total Recordable Incident Rate | Recordable Incidents/200,000 Hours Worked or 100 Full Time Employees | Annual | N | 0.00603561 |
| Social | Health & Safety | Lost Time Incident Rate - Contractors | Lost Time Incidents Contractors/200,000 Hours Worked or 100 Contractors | Annual | N | 0.00603561 |
| Social | Health & Safety | Total Recordable Incident Rate - Contractors | Recordable Incidents Contractors/200,000 Hours Worked or 100 Contractors | Annual | N | 0.00603561 |
| Social | Health & Safety | Total Recordable Incident Rate - Workforce | Recordable Incidents/200,000 Hours Worked or 100 Employees & Contractors | Annual | N | 0.00603561 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Social | Health & Safety | Lost Time Incident Rate - Workforce | Lost Time Incidents/200,000 Hours Worked or Employees & Contractors | Annual | N | 0.00603561 |
| Social | Human Capital | Human Capital Disclosure Score | Percentage | | | 0.055527613 |
| Social | Human Capital | Training Policy | Y/N | Annual | Y | 0.002112464 |
| Social | Human Capital | Fair Renumeration Policy | Y/N | Annual | Y | 0.002112464 |
| Social | Human Capital | Number of Employees - CSR | Count | Annual | Y | 0.008550448 |
| Social | Human Capital | Employee Turnover % | Percentage | Annual | Y | 0.008550448 |
| Social | Human Capital | % Employees Unionized | Percentage | Annual | Y | 0.008550448 |
| Social | Human Capital | Employee Training Cost | Million Reporting Currency | Annual | Y | 0.008550448 |
| Social | Human Capital | Total Hours Spent by Firm - Employee Training | Hours | Annual | N | 0.008550448 |
| Social | Human Capital | Number of Contractors | Count | Annual | N | 0.008550448 |
| Social | Supply Chain | Supply Chain Disclosure Score | Percentage | | | 0.055427019 |
| Social | Supply Chain | Social Supply Chain Management | Y/N | Annual | N | 0.002615431 |
| Social | Supply Chain | Number of Suppliers Audited | Count | Annual | N | 0.010562318 |
| Social | Supply Chain | Number of Supplier Audits Conducted | Count | Annual | N | 0.010562318 |
| Social | Supply Chain | Number Supplier Facilities Audited | Count | Annual | N | 0.010562318 |
| Social | Supply Chain | Percentage of Suppliers in Non-Compliance | Percentage | Annual | N | 0.010562318 |
| Social | Supply Chain | Percentage Suppliers Audited | Percentage | Annual | N | 0.010562318 |
| Governance (33%) | Audit Risk & Oversight | Audit Risk & Oversight Disclosure Score | Percentage | | | 0.041746303 |
| Governance | Audit Risk & Oversight | Audit Committee Meetings | Count | Annual | Y | 0.008349261 |
| Governance | Audit Risk & Oversight | Years Auditor Employed | Years | Annual | N | 0.008349261 |
| Governance | Audit Risk & Oversight | Size of Audit Committee | Count | Annual | N | 0.008349261 |
| Governance | Audit Risk & Oversight | Number of Independent Directors on Audit Committee | Count | Annual | N | 0.008349261 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Governance | Audit Risk & Oversight | Audit Committee Meeting Attendance Percentage | Percentage | Annual | N | 0.008349261 |
| Governance | Board Composition | Board Composition Disclosure Score | Percentage | | | 0.04164571 |
| Governance | Board Composition | Company Conducts Board Evaluations | Y/N | Annual | N | 0.001911277 |
| Governance | Board Composition | Size of the Board | Count | Annual | Y | 0.007946887 |
| Governance | Board Composition | Number of Board Meetings for the Year | Count | Annual | Y | 0.007946887 |
| Governance | Board Composition | Board Meeting Attendance % | Percentage | Annual | Y | 0.007946887 |
| Governance | Board Composition | Number of Executives / Company Managers | Count | Annual | N | 0.007946887 |
| Governance | Board Composition | Number of Non Executive Directors on Board | Count | Annual | N | 0.007946887 |
| Governance | Compensation | Compensation Disclosure Score | Percentage | | | 0.04164571 |
| Governance | Compensation | Company Has Executive Share Ownership Guidelines | Y/N | Annual | N | 0.002313651 |
| Governance | Compensation | Director Share Ownership Guidelines | Y/N | Annual | N | 0.002313651 |
| Governance | Compensation | Size of Compensation Committee | Count | Annual | N | 0.009254602 |
| Governance | Compensation | Num of Independent Directors on Compensation Cmte | Count | Annual | N | 0.009254602 |
| Governance | Compensation | Number of Compensation Committee Meetings | Count | Annual | N | 0.009254602 |
| Governance | Compensation | Compensation Committee Meeting Attendance % | Percentage | Annual | N | 0.009254602 |
| Governance | Diversity | Diversity Disclosure Score | Percentage | | | 0.041746303 |
| Governance | Diversity | Board Age Limit | Years | Annual | Y | 0.008349261 |
| Governance | Diversity | Number of Female Executives | Count | Annual | N | 0.008349261 |
| Governance | Diversity | Number of Women on Board | Count | Annual | N | 0.008349261 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Governance | Diversity | Age of the Youngest Director | Years | Annual | N | 0.008349261 |
| Governance | Diversity | Age of the Oldest Director | Years | Annual | N | 0.008349261 |
| Governance | Independence | Independence Disclosure Score | Percentage | | | 0.041846897 |
| Governance | Independence | Number of Independent Directors | Count | Annual | Y | 0.041846897 |
| Governance | Nominations & Governance Oversight | Nominations & Governance Oversight Disclosure Score | Percentage | | | 0.041846897 |
| Governance | Nominations & Governance Oversight | Size of Nomination Committee | Count | Annual | N | 0.010461724 |
| Governance | Nominations & Governance Oversight | Num of Independent Directors on Nomination Cmte | Count | Annual | N | 0.010461724 |
| Governance | Nominations & Governance Oversight | Number of Nomination Committee Meetings | Count | Annual | N | 0.010461724 |
| Governance | Nominations & Governance Oversight | Nomination Committee Meeting Attendance Percentage | Percentage | Annual | N | 0.010461724 |
| Governance | Sustainability Governance | Sustainability Governance Disclosure Score | Percentage | | | 0.041846897 |
| Governance | Sustainability Governance | Verification Type | Y/N | Annual | Y | 0.020923448 |
| Governance | Sustainability Governance | Employee CSR Training | Y/N | Annual | Y | 0.020923448 |
| Governance | Tenure | Tenure Disclosure Score | Percentage | | | 0.041846897 |
| Governance | Tenure | Board Duration (Years) | Years | Annual | Y | 0.041846897 |

The score is then calculated using the following formula:

*Disclosure Score = SUMPRODUCT(Field Weight, Field with Values)/SUMPRODUCT(Field Weight, All Fields)*

Source: Bloomberg, 2021

# Appendix 4: Bloomberg's Criteria for ESG Performance scores

| Bloomberg Pillar | Bloomberg Issue | Bloomberg Sub-Issue | Field # | Field Name | Units | Polarity | Field Transformation Formula | Act Met #1 - Field Name | Scoring Model | Estimation Peer Group |
|---|---|---|---|---|---|---|---|---|---|---|
| Environmental | Sustainable Finance | Financed Emissions | SA873 | Financed Emissions Reported (Scope 1+2) (tCO2e) | Thousand Metric Tonnes CO2-e | - | | BS016 Total Commercial Loans | Intensity | Industry (Cmrcl-Bnk) |
| Environmental | Sustainable Finance | Financed Emissions | SA873 | Financed Emissions Reported (Scope 1+2) (tCO2e) | Thousand Metric Tonnes CO2-e | - | | IS010 Revenue | Intensity | Keep for DF (Dvesfd-Bnk, Instnl-Brkrg) |
| Environmental | Sustainable Finance | Financed Emissions | SA874 | Financed Emissions Reported (Scope 3) (tCO2e) | Thousand Metric Tonnes CO2-e | - | | BS016 Total Commercial Loans | Intensity | Keep for DF(Cmrcl-Bnk) |
| Environmental | Sustainable Finance | Financed Emissions | SA874 | Financed Emissions Reported (Scope 3) (tCO2e) | Thousand Metric Tonnes CO2-e | - | | IS010 Revenue | Intensity | Keep for DF |
| Environmental | Sustainable Finance | Exclusions | SA875 | Target Year to Exclude Coal Finance | Rate-Defined | - | (DS324 Equity Fundamental Year-2015)/(SA875 Target Year to Exclude Coal Finance-2015)\|(2015/SA875 Target Year to Exclude Coal Finance) | | Rate-Defined | Sector |
| Environmental | Sustainable Finance | Exclusions | SA876 | Exclusion of Oil & Gas Finance (Y/N) | Boolean | + | | | Binary | |
| Environmental | Sustainable Finance | Exclusions | SA877 | Target Year to Exclude Oil & Gas Finance | Rate-Defined | - | (DS324 Equity Fundamental Year-2015)/(SA877 Target Year to Exclude Oil & Gas Finance-2015)\|(2015/SA877 Target Year to Exclude Oil & Gas Finance) | | Rate-Defined | Sector |
| Environmental | Sustainable Finance | Exclusions | SA878 | Exclusion of Non-Certified Palm Oil Finance (Y/N) | Boolean | + | | | Binary | |
| Environmental | Sustainable Finance | Exclusions | SA879 | Exclusion of Arctic Drilling Finance (Y/N) | Boolean | + | | | Binary | |
| Environmental | Sustainable Finance | Industry Exposure | SA884 | Value of Coal Lending ($) | Currency | - | | BS016 Total Commercial Loans | Intensity | Sector(Cmrcl-Bnk, Dvesfd-Bnk), Keep for DF (Instnl-Brkrg) |

Source: (Bloomberg, 2022)

# Appendix C – Chapter 3

## Appendix 5: Fintech Adoption Index Categories and definitions

| Categories | Definition | Sub-categories | Definition Source |
|---|---|---|---|
| Online Banking | Online Banking, also known as internet banking and Net Banking, means accessing one's bank account and carrying out financial transactions through the internet on smartphones, tablets or computers. | Online Banking + Online Banking upgrades | The Money Advice Service. Org.uk |
| Mobile Banking | Mobile Banking in this study will focus on payments processed through mobile applications only. FCA defines it as follows: Mobile payment services enable consumers to make payments to an individual or firm using a mobile phone, tablet computer or other handheld device. There are different methods of making mobile payments, for example by storing credit or debit cards in a mobile wallet or making payments to businesses or individuals from within a mobile banking application (app).Consumers can also use contactless technology built into the mobile device (hardware), SIM card or mobile software to 'tap and pay' at merchant terminals. | Mobile Banking applications + Mobile Banking app upgrades. | FCA.org.uk |
| Express Banking | Due to new technologies emerging and banks adopting different services, Express Banking in this paper represents any service to facilitate customers' finance management experience. Any apps or platforms are also | Express Banking Lobbies, Digital Bank Centres, eKiosks, Open Banking / API (Application Programming Interface), Interactive teller Machine (ITM: software based (Like ATM) that allows teller (staff) to take remote control of an ATM to assist | Author |

| | | | |
|---|---|---|---|
| | included. If a bank advertises a digital centre/service without details on what's on offer, then the express banking option is selected. If more details are offered, then the service / product is added to the e-Payments category. | customers with majority of transactions typically completed by tellers inside a branch), Live Chat, e-Statement, Instant Card Issuance, e-Branch app, SMS-Banking, ATMs (Automated Teller Machines), CCDMS (Cach Cheque Deposit Machines), POS (Point Of Sale machine), e-Forms (an enquiry form or request for a call back form), e-Advice (Video calls with Bank staff), e-Application (fill in and submit applications for products and services online), STP (Straight Through Processing), Special Services (services for clients with special needs), SME apps (cashflow management app), Smart Wristband app, Smartwatches app, Feedback app, Phone Banking . | |
| e-Payment | e-Payments category in this paper includes any payments, transactions or facilities that involve sending or receiving money nationally or internationally. A standard definition of e-Payments is not used or referred to as it would be too restrictive for this research. | e-Pay, Mobile sticker (A stikcer that allows tap to pay services), e-Card (for online payments. With real-time top-ups), e-Wallets (free transfers between ewallets, transact in real time using mobile number and nickname, cardless cash withdrawals from bank ATMs), e-Commerce, e-Trade, e-Wealth, Samsung Pay, Apple Pay, Google Pay, e-Sadaqah/ e-Donation, Foreign Exchange, Bill Payments, NFC (Near Field Communication where customers tap or wave their banking card near a Point Of Sale machine or an ATM and enter their pin for their payment or withdrawal transaction to be processed), Electronic Funds Transfer System EFTS (central system that can be utilised to control and manage fund movements between banks and service providers in Bahrain) | Author |
| e-Secure | For the purpose of this study, e-Secure represents any security software, applications or facilities the banks in question offer. | Face ID, e-Signature, Touch ID (fingerprint), Token, e-Government services (Some governments offer ID verification services through banks), e-Learning (educating clients for more protection or collecting tuition fees in some cases), Sandbox | Author |

## Appendix 6:List of Fintech Adoption Index Points

| Country | Name | 2012Indx Pnts | 2013Indx Pnts | 2014Ind xPnts | 2015Ind xPnts | 2016Ind xPnts | 2017Ind xPnts | 2018Ind xPnts |
|---|---|---|---|---|---|---|---|---|
| Bahrain | Ahli United Bank - Al Hilal | 7 | 10 | 12 | 13 | 14 | 18 | 19 |
| Bahrain | Al Salam Bank | 5 | 5 | 6 | 7 | 7 | 11 | 15 |
| Bahrain | AlBaraka Banking Group | 4 | 6 | 6 | 6 | 6 | 6 | 6 |
| Bahrain | Arab Banking Corporation | 4 | 4 | 4 | 4 | 4 | 6 | 7 |
| Bahrain | Ithmaar Bank - Ithmaar Holdings | 5 | 6 | 7 | 9 | 9 | 11 | 14 |
| Bahrain | Khaleeji Commercial Bank | 4 | 4 | 4 | 4 | 8 | 9 | 11 |
| Indonesia | Bank Danamon Syariah | 4 | 5 | 6 | 6 | 6 | 9 | 10 |
| Indonesia | Bank Muamalat | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | BPD Jawa Tengah (Jatenq) | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank BCA Syariah | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| Indonesia | PT Bank BRI Syariah | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank BTN | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank Cimb Niaga TBK | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| Indonesia | PT Bank Pembangunan Daerah Sumatera Utara (Bank Sumut) | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank Permata Tbk | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank Syariah BNI | 4 | 4 | 5 | 5 | 6 | 6 | 7 |
| Indonesia | Pt Bank Syariah Mandiri | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Indonesia | PT Bank Tabungan Pensiunan Nasional (BTPN) | 4 | 5 | 5 | 5 | 6 | 6 | 6 |
| Indonesia | PT OCBC NISP | 4 | 4 | 4 | 4 | 4 | 5 | 6 |
| Jordan | Jordan Dubai Islamic Bank (Safwa Islamic Bank) | 4 | 4 | 5 | 5 | 5 | 6 | 6 |
| Jordan | Jordan Islamic Bank | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Kuwait | Ahli United Bank Kuwait | 4 | 4 | 5 | 5 | 5 | 5 | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Kuwait | Boubyan Bank | 4 | 4 | 4 | 4 | 5 | 5 | 6 |
| Kuwait | Kuwait Finance House | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Kuwait | Kuwait International Bank | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| Kuwait | Warba Bank | 4 | 4 | 4 | 4 | 4 | 6 | 7 |
| Malaysia | Affin Islamic Bank Berhard | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| Malaysia | Alliance Islamic Bank Berhad | 4 | 4 | 4 | 4 | 4 | 5 | 7 |
| Malaysia | Bank Islam Malaysia Berhad | 5 | 5 | 5 | 5 | 5 | 5 | 6 |
| Malaysia | Citibank Berhad | 5 | 7 | 7 | 7 | 8 | 9 | 9 |
| Malaysia | HSBC Amanah Malaysia Berhad | 4 | 6 | 6 | 6 | 6 | 6 | 6 |
| Malaysia | Maybank Islamic Berhad | 4 | 4 | 4 | 5 | 9 | 11 | 13 |
| Malaysia | Standard Chartered Bank Malaysia Berhad (Saadiq) | 6 | 6 | 6 | 6 | 8 | 9 | 9 |
| Malaysia | United Overseas Bank Bhd | 5 | 5 | 5 | 5 | 5 | 6 | 8 |
| Oman | Al Izz Islamic Bank | 4 | 4 | 5 | 6 | 6 | 6 | 6 |
| Oman | Bank Dhofar, Maisarah | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Oman | Bank Muscat | 4 | 5 | 5 | 5 | 7 | 8 | 8 |
| Oman | Bank Nizwa | started in 2013 | started in 2013 | 3 | 4 | 5 | 6 | 6 |
| Oman | Bank Sohar | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Oman | National Bank of Oman | 4 | 4 | 4 | 5 | 5 | 5 | 5 |
| Saudi Arabia | Al Rajhi Bank | 4 | 4 | 4 | 4 | 7 | 9 | 9 |
| Saudi Arabia | Alinma Bank | 4 | 5 | 5 | 6 | 6 | 6 | 7 |
| Saudi Arabia | Arab National Bank | 5 | 5 | 5 | 5 | 5 | 6 | 8 |
| Saudi Arabia | Bank Al Bilad | 4 | 4 | 4 | 6 | 6 | 7 | 7 |
| Saudi Arabia | Bank Aljazira | 4 | 5 | 5 | 7 | 7 | 7 | 7 |
| Saudi Arabia | Bank Saudi Fransi | 4 | 4 | 4 | 5 | 5 | 7 | 7 |
| Saudi Arabia | National Commercial Bank | 5 | 8 | 8 | 8 | 8 | 8 | 8 |
| Saudi Arabia | Riyad Bank | 4 | 4 | 4 | 4 | 6 | 6 | 8 |
| Saudi Arabia | SAMBA | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

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| Saudi Arabia | Saudi Hollandi Bank | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| United Arab Emirates | Abu Dhabi Commercial Bank-Meethaq | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| United Arab Emirates | Abu Dhabi Islamic Bank | 4 | 4 | 4 | 4 | 5 | 7 | 7 |
| United Arab Emirates | Ajman Bank | 4 | 4 | 5 | 5 | 6 | 6 | 6 |
| United Arab Emirates | Al Hilal Bank | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| United Arab Emirates | Dubai Islamic Bank | 5 | 5 | 6 | 6 | 6 | 6 | 6 |
| United Arab Emirates | Emirates Islamic Bank | 4 | 4 | 4 | 4 | 4 | 5 | 6 |
| United Arab Emirates | EMIRATES NBD PJSC | 4 | 5 | 5 | 6 | 6 | 6 | 6 |
| United Arab Emirates | First Abu Dhabi Bank | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| United Arab Emirates | National Bank of Fujairah | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| United Arab Emirates | National Bank of Ras Al Khaima | 4 | 4 | 4 | 4 | 5 | 6 | 6 |
| United Arab Emirates | National Bank of Umm Al Quaiwain | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| United Arab Emirates | Noor Bank | 4 | 4 | 4 | 5 | 5 | 5 | 5 |
| United Arab Emirates | Sharjah Islamic Bank | 4 | 4 | 5 | 5 | 5 | 6 | 6 |