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The impact of share buybacks and ESG principles on banks

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To my beloved father.

Your memory is still vivid and will always be.

My personal motto is:

Work hard in silence, let success make the noise.

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Executive Summary

In recent years, the theoretical debate surrounding responsible corporate behavior has expanded beyond financial performance to encompass environmental sustainability, social responsibility, and robust governance practices. This holistic framework, commonly referred to as Environmental, Social, and Governance (ESG), has gained significant importance among investors, regulators, and stakeholders as a means to evaluate a company's long-term sustainability and social impact. While ESG considerations have predominantly focused on industries such as energy, manufacturing, and technology, the banking sector, as a crucial pillar of the global economy considering that it allocates financial resources to the economy, is increasingly under scrutiny for its role in promoting sustainable and ethical practices.

One additional specific aspect of banking operations that has attracted considerable attention over the last years is the practice of share buybacks. Share buybacks involve a company repurchasing its own outstanding shares from the open market, thereby reducing the number of shares available for trading. This mechanism has gained popularity among banks as a tool to return surplus capital to shareholders, enhance earnings per share, and potentially improve stock prices.

This study focuses on both share buybacks in banks as well as on climate risk stress tests in the banking sector thereby covering two of the three aspects related to ESG principles, environment and corporate governance.

More specifically, the first paper whose focus is on the current banking regulatory framework governing ESG principles in the EU, seeks to provide an overview of the regulations currently in place aimed at facilitating the introduction of the ESG principles in the banking processes. Delving on the environmental aspect of the ESG principles, the second paper seeks to lay down a comprehensive framework for climate risk stress tests in the banking sector. One important aspect to notice is that the pursuit of the objective of facilitating a transition to a greener economy, that is also part of the ESG principles, could sometimes be at odds with the prudential nature of the banking regulatory framework. Banks' exposure should, in fact, be classified from a prudential perspective based on their riskiness (i.e. risk sensitive framework) that could be potentially unrelated from their "greenness" (as

there is no sufficient data to prove the lower riskiness of greener assets). This specific characteristic, risk-sensitive nature of the framework, has been underscored also in a recent EBA report "the role of environmental and social risks in the prudential framework". In this vein, by focusing on a risk-based approach and leveraging on the current data available, the second paper aims at laying down a methodologically robust comprehensive prudential framework for climate risk stress tests in banks.

Shifting the attention on the corporate governance aspect of the ESG principles, the paper on share repurchases seeks to provide a comprehensive analysis of how these repurchase programs could potentially negatively impact the long-term value creation in banks. As a matter of fact, share buybacks could potentially undermine the resilience of banks by leading to a potential depletion of their capital position in the long term. Therefore, the incorporation of the ESG principles into the banking operations as a tool to improve the transparency of the decision-making process could help avoid the adoption of detrimental decisions that could threaten the resilience of the bank in the long term. Furthermore, by focusing on share buybacks and ESG principles the study aims at further unveiling potential links between these two relevant aspects widely debated in the financial literature.

The common denominator of the three papers is the need to ensure the resilience of the banking system, by testing the robustness of the capital positions of banks to climate risks and by preventing the abuse of share buybacks programs to the detriment of the long-term value creation, while promoting the incorporation of the ESG principles into the banking processes.

Throughout this work, we will try to find an answer to several key questions: How do share buybacks impact a bank's long term value creation? To this extent, what are the implications of share buybacks on the wider audience of stakeholders? Furthermore, what role do share buybacks play in shaping a bank's governance structure, transparency, and risk management practices?

To answer these questions, we will draw on a comprehensive review of existing literature as well as empirical evidence of share buybacks in the banking sector. By analyzing the potential trade-offs and synergies between short-term financial gains

and long-term sustainable practices, we aim to contribute to the ongoing dialogue surrounding responsible banking.

We will then focus the attention on the current banking regulatory framework on ESG principles. The authors believe that the incorporation of such principles into the banking processes could be an effective tool to improve the decision-making process in banks.

This research endeavors to provide insights that can inform regulatory frameworks, guide investor strategies, and empower banking institutions to adopt a more transparent decision-making process as well as more sustainable and socially responsible practices. By recognizing the multifaceted nature of banking operations, we can pave the way for a more resilient and inclusive financial sector that aligns its activities with the broader goals of environmental stewardship, social progress, and robust governance.

Overview of the European regulations on ESG principles in the banking sector

Abstract

The concept of Environmental, Social, and Governance (ESG) criteria has gained significant attention in recent years as investors and consumers alike become increasingly concerned with the sustainability and social impact of their investments. The European Union (EU) has been at the forefront of efforts to promote sustainable finance and investment, and has introduced several regulations and guidelines aimed at integrating ESG criteria into financial decision-making. This paper provides an overview of the key EU regulations and guidelines related to ESG criteria, including the Non-Financial Reporting Directive, the Sustainable Finance Disclosure Regulation, the Taxonomy Regulation, and the Action Plan on Financing Sustainable Growth. We also offer a comparison of the national level regulations for ESG practices in banking institutions and the related disclosure requirements.

Keywords

European Union; corporate governance; sustainable finance; Environmental, Social and Governance; Corporate Social Responsibility.

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1. Introduction

Environmental, Social, and Governance (ESG) policies have gained significant attention in recent years, and the EU banking sector is no exception. ESG policies focus on the incorporation of environmental, social, and governance factors into business decisions to realize sustainable and responsible business practices. As a result, ESG policies have become an essential tool for banks to manage risks, improve their reputation, and build long-term value for stakeholders.

In December 2016, the EU Commission formed a High-Level Expert Group (HLEG) to develop an overarching and detailed EU sustainable finance strategy. On January 31, 2018, the HLEG issued its final report (European Commission, 2018). This report presented a holistic view of European sustainable finance and defined two priorities for the financial system. The primary goal is to increase finance's commitment to long-term, inclusive development. The second goal is to boost financial stability by fostering awareness of environmental, social, and governance (ESG) issues while making investment decisions. By referring to the United Nations-backed Principles for Responsible Investment, Directive 2016/234 incorporated ESG principles into the EU legislative framework.

The EU banking sector has been a key player in promoting ESG policies, given its significant role in financing economic activities that have an on the spot impact on society and also on the environment. the European Union has also been at the forefront of promoting ESG policies through various regulations, guidelines, and initiatives. The increased attention by policy-makers toward this subject has also been followed by an increased appetite of investors for ESG funds. The ECB's Financial Stability Review reported that the Asset Under Management (AUM) of those funds soared passing from 500 billion USD in 2015 to 1.3 trillion USD in 2020 with a 170% staggering increase (ECB, 2020).

As suggested by the UN Environment Programme (UNEP) Inquiry and the Principles for Responsible Investment (PRI), ESG could be referred as: (i) Environmental (E) issues related to the environment and natural systems; (ii) Social (S) issues related to the rights of individuals and communities; and (iii) Governance (G) issues linked to the corporate governance arrangements of companies.

The proposal for a disclosure law, in particular, seeks to take into account environmental, social, and governance aspects into investors' and asset managers' decision-making processes. It also aims at boosting financial intermediaries' disclosure obligations to end-investors in terms of sustainability risks and investment goals. In this context, this study aims at reviewing the present legislative framework on ESG principles in Europe in relation to banks.

We thus contribute to the literature on the three distinctive factors associated with ESG (environmental, social, and governance factors) by providing a critical assessment of the legislative framework proposed for ESG practices in Europe, comparing and contrasting the various policies proposed in several countries across Europe, exposing the pros and cons of all of them, thus focusing the attention on best practices for both policymakers and practitioners.

We proceed as follows: section 2 will provide an outline of the economic literature on the ESG principles, while section 3 summarises the rules and regulations issued in Europe in recent years with respect to these principles. Section 4 compares and contrasts the regulations implemented at a national level by each European country. The last section discusses and concludes by identifying room for improvement and offering suggestions to guide policymakers' actions.

2. Literature Review

The literature associated with social responsibility of firms is extremely rich and articulated. the primary studies focused on the need to integrate aspects associated with social responsibility issues into strategic planning processes and management systems of companies so as to properly consider the expectations of all stakeholders. The neoclassical position, whose main advocate was Friedman (1970), maintained that the sole objective that a company should pursue is to employ resources in activities that cause the maximization of profits abiding by the fundamental rules of a civil society as enshrined into the laws and ethical principles. An antithetical position as compared to the neoclassical one was expressed by Freeman (1984) that argued that a firm should consider not only the interests of its shareholders but also those of the plurality of actors involved in its activities (employees, customers, local communities, etc.). Following this theory, some

authors like Post, Preston and Sachs (2002) argued that companies should apply the principles of social, environmental and governance responsibility without caring of the costs. Other authors, specifically Porter and Kramer (2011), have argued that the first objective of firms should be the profits' maximization while trying to follow the principles of social, environmental responsibility and company governance.

At its inception, the studies within the banking sector were also specifically focused on social responsibility issues. They mainly analysed the correlation between banks' financial performance and the integration of the social responsibility principles within their management processes and systems. The results of those studies have led to divergent conclusions; Simpsons and Kohers (2002) found a material positive correlational between the introduction of socially responsible practices and the financial performance of banks. However, the results of the work of Esteban-Sánchez (2017) conducted between 2005 and 2010 on a sample of 154 banks from 22 countries that enacted social responsibility principles, presented mixed results that rejected the positive relationship between the adoption of those principles and the financial performance of banks.

Some authors employ a "reputation-building" hypothesis, that postulates that sound environmental management can help firms improve their reputations and thus their performance (Konar and Cohen, 2001); however, there's a lack of evidence regarding the link between ESG and bank performance. Dell'Atti (2017) discovered a correlation between reputation and social performance and a indirect correlation between corporate governance and environmental performance. The authors claim that this unfavourable link is the results of banks' ineffective implementation of environmental awareness practices. On the opposite hand, Forcadell and Aracil (2017) found that responsible banks gain from reputational benefits that are reflected in their financial success.

Fayad (2017), particularly, found a a significant connection between their findings and the stakeholder theory because voluntary activities to strengthen banks' social responsibilities are taken in the interest of social, economic and environmental protection. In addition, they conclude that a bank that operates sustainably and responsibly will earn above-average profits, which motivates the bank's

management to invest in ESG activities that have as objective the resolution of environmental and social problems.

Recently, the main target of research has been broadened by shifting the focus on environmental issues. Relevant studies include those by Jeucken (2010), Jo (2015), Finger (2018), and Laguir (2018) that focused on the creation of import by banks that perform activities having a positive environmental impact. Konar and Cohen (2001) show that both the ejection of toxic chemicals and therefore the number of environmental lawsuits are significantly and negatively associated with Tobin's Q. Along the identical lines, Hernández (2019) analysed the link between the adoption of ESG principles (thus considering environmental in addition as social responsibility issues) by banks and the impact on their financial performance. This analysis found empirical evidence of a direct correlation between the banks' Tobin Q and therefore the adoption of ESG principles. At the same time, it also found a negative correlation between the adoption of those principles and the creation of shareholder value. Bauer and Hann (2010) investigated the link between ESG principles and the cost of capital on a sample of 2200 bond issues within the U.S., and found that companies with better environmental management standards have lower credit spreads. Brammer, Brooks and Pavelin (2006) demonstrate that for UK companies, firms with good CSR ratings tend to underperform in comparison to their counterparts having poorer CSR rating, and that they attribute this finding to the environmental indicators driving this finding. Brogi and Lagasio (2019) focused on the impact of the implementation of ESG practices on the financial performance of a sample of banks compared to a sample of industrial companies. This study found empirical evidence of a significant positive correlation between ESG policies and banks' financial performance; the study also found that this correlation is even more material in banks than in industrial firms. Derwall et al. (2010) find that overall ESG scores have a positive association with both subsequent stock returns and return on equity (ROE) even after controlling for sector effects. Kim et al. (2012) find that socially responsible firms are less likely to manage earnings through discretionary accruals, to control real operating activities, or to be the subject of SEC investigations.

Specific contributions on the state of art of the EU regulatory framework for banks on ESG principles are provided by de Sá (2022), Kern and Fisher (2018), and Gábor (2020).

There are few contributions in the economic literature that investigate the role of ESG practices in bank regulation. Kern and Fischer (2018) focused on initiatives that regulation and prudential supervision should undertake to encourage banks to foster the adoption of business practices that have a positive environmental sustainability impact.

3. Current European Regulatory Framework for Banking Institutions with Reference to the ESG Principles

The European Union (EU) has been at the forefront of efforts to promote sustainable finance and investment, and has introduced several regulations and sectoral guidelines aimed at integrating ESG criteria into financial decision-making processes. These regulations and guidelines provide a framework for companies to disclose information on their ESG practices, as well as for financial market participants to integrate ESG criteria into their investment decision-making practices. The main aim of these regulatory efforts is to provide adequate support to the so-called European Green Deal[1].

Key EU Regulations and Guidelines on ESG:

1) The EU Non-Financial Reporting Directive (2014/95/EU);
2) The EU Sustainable Finance Disclosure Regulation (SFDR) (2019/2088);
3) The EU Taxonomy Regulation (2020/852);
4) The EU Action Plan on Financing Sustainable Growth (2018);

1. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

Figure 1: Relevant disclosure rules in the EU

Source: European Banking Authority

As shown in the figure above, the Taxonomy Regulation, entered into force in 2020, introduces some criteria for the classification of the activities performed by industrial companies based on their environmental sustainability (in line with the provisions laid down in the Paris Climate Agreement). The definition of specific criteria for the classification of the activities performed by industrial companies provides more clarity regarding the environmental sustainability of the firms' businesses.

The Non-Financial Reporting Directive (NFRD) imposes additional disclosure requirements on listed industrial companies with more than 500 employees. The aim of this directive is to improve the quality of data available to banks and investors to direct financial resources toward sustainable investments.

Furthermore, following the introduction of the so-called CRR2 (i.e., Capital Requirements Regulation), the European significant banks are expected to disclose in the information provided to investors the risks related to ESG factors to which they are exposed and the related mitigating actions they are undertaking to reduce their severity.

In 2021 also the Financial Services Sustainability Disclosure Regulation (SFDR) came into force. This regulation introduces a new set of rules that is aimed at making the sustainability profile of funds, financial instruments and products more comparable and easier for investors to understand. The new rules will lead to the classification of financial products into specific categories based on predefined metrics aimed at assessing their environmental, social and governance (ESG) impacts.

It is worth noting that the EBA has been given three specific mandates to further enforce the introduction of the ESG principles in the European banking regulation. Under the taxonomy regulation, the EBA has been requested to propose to the European Commission some Key Performance Indicators (KPIs), together with the related methodology for the disclosure by credit institutions and by investment firms, on how and to what extent their activities qualify as environmentally sustainable. In its opinion issued in March 2021,[2] the EBA underlined the importance of the green asset ratio (so-called GAR) as a key metric to understand how institutions are financing sustainable activities and meeting the Paris Agreement targets.

In March 2021, the EBA also published a consultation paper on draft implementing technical standard (ITS)[3] on Pillar 3 disclosures on Environmental, Social and Governance risks as a response to the second mandate shown at the bottom of figure 1. In line with the requirements laid down in the Capital Requirements Regulation

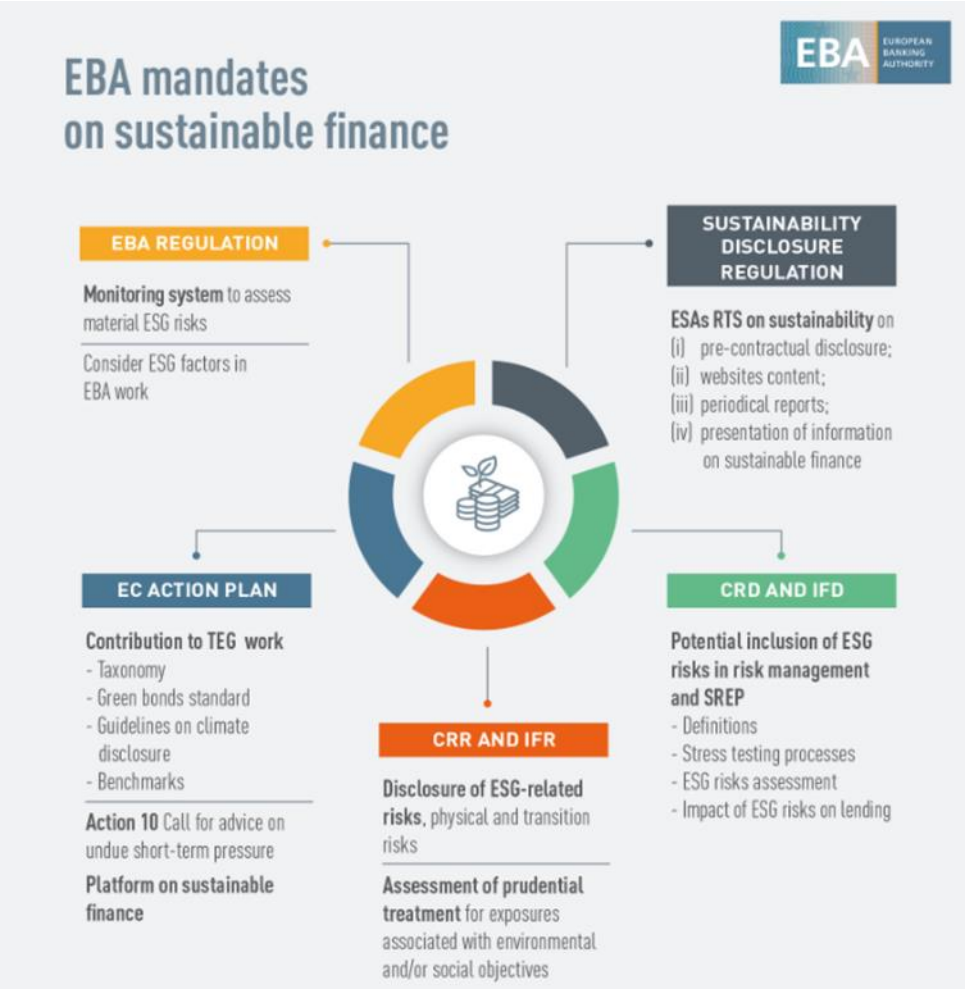
2. https://www.eba.europa.eu/sites/default/documents/files/document_library/About%20Us/Missions%20and%20tasks/Call%20for%20Advice/2021/CfA%20on%20KPIs%20and%20methodology%20for%20disclosures%20under%20Article%208%20of%20the%20Taxonomy%20Regulation/963620/Letter%20to%20EC%20-%20CfA%20Article%208%20Taxonomy%20Regulation.pdf

3. https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Consultations/2021/Consultation%20on%20draft%20ITS%20on%20Pillar%20disclosures%20on%20ESG%20risk/963621/Consultation%20paper%20on%20draft%20ITS%20on%20Pillar%203%20disclosures%20on%20ESG%20risks.pdf
https://www.eba.europa.eu/financial-innovation-and-fintech/sustainable-finance.

(CRR), the draft ITS proposes comparable quantitative disclosures on climate-change related transition and physical risks, including information on exposures towards carbon related assets and assets subject to chronic and acute climate change events. They also include quantitative disclosures on institutions' mitigating actions supporting their counterparties in the transition to a carbon-neutral economy. In addition, the standards require significant banks to disclose their GAR. The GAR identifies the institutions' assets financing activities that are environmentally sustainable according to the EU taxonomy. These activities must be consistent with those identified by the European Green Deal and the Paris Agreement. Finally, the draft ITS provide qualitative information on how institutions are embedding ESG considerations in their governance, business model and strategy and risk management framework.

Figure 2 summarises the main mandates that have been given to the EBA through the new banking regulatory package.

Figure 2: EBA mandates concerning sustainable finance legislation.



Source: European Banking Authority

The first mandate (also mentioned in the chart shown in figure 1), stemming from the introduction of the SFDR, that was given to the European Banking Authority (EBA) and the other two authorities that are part of the European Supervisory Authorities (ESMA and EIOPA) led to the introduction of a binding technical standard that provides detailed indications on how financial investors must communicate the potential negative impacts of their investment choices (through the disclosure of specific indicators) on sustainability factors[4]. Furthermore, the technical standards also provide detailed indications on the precontractual

4 https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Draft%20Technical%20Standards/2021/962778/JC%202021%2003%20-%20Joint%20ESAs%20Final%20Report%20on%20RTS%20under%20SFDR.pdf

information on sustainability issues to be provided when placing financial products on the market.

The second mandate entrusts the EBA with the task of exploring the possibility of introducing ESG risk factors within the Supervisory Review and Evaluation Process (SREP) and the regulatory stress tests.

Finally, another mandate entrusts the EBA with the role of supporting the work of the group of experts (set up by the European Commission) on sustainable finance. EBA is expected to provide its technical support on issues such as the update of the taxonomy of sustainable assets, the definition of binding technical standards for the identification of so-called "Green Bonds" and the issuance of specific guidelines on the disclosure of information related to climate risk.

In addition to the mandates that have been received by the European Commission, the EBA has recently updated its guidelines on loan origination and monitoring process targeted to European banks[5]. In these guidelines, it is explicitly requested that banks incorporate ESG risk factors in the definition of their credit risk appetite and in their credit risk management practices.

Moreover, the Single Supervisory Mechanism, the Supervisory Authority tasked with the oversight of the significant banks of the 19 Eurozone countries, has issued its own guide on climate and environmental risks in which it sets out specific supervisory expectations pertaining to the management of such risks and the related disclosure to investors[6]. Table 1 shows the main impacts on the various risk categories highlighted in the guide issued by the European Central Bank.

[5] https://www.eba.europa.eu/regulation-and-policy/credit-risk/guidelines-on-loan-origination-and-monitoring
[6] https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr201127~5642b6e68d.en.html.

Table 1: Examples of climatic and environmental risk factors

Risks affected	Physical		Transition	
	Climate-related	Environmental	Climate-related	Environmental
	• Extreme weather events • Chronic weather patterns	• Water stress • Resource scarcity • Biodiversity loss • Pollution • Other	• Policy and regulation • Technology • Market sentiment	• Policy and regulation • Technology • Market sentiment
Credit	The probabilities of default (PD) and loss given default (LGD) of exposures within sectors or geographies vulnerable to physical risk may be impacted, for example, through lower collateral valuations in real estate portfolios as a result of increased flood risk.		Energy efficiency standards may trigger substantial adaptation costs and lower corporate profitability, which may lead to a higher PD as well as lower collateral values.	
Market	Severe physical events may lead to shifts in market expectations and could result in sudden repricing, higher volatility and losses in asset values on some markets.		Transition risk drivers may generate an abrupt repricing of securities and derivatives, for example for products associated with industries affected by asset stranding.	
Operational	The bank's operations may be disrupted due to physical damage to its property, branches and data centres as a result of extreme weather events.		Changing consumer sentiment regarding climate issues can lead to reputation and liability risks for the bank as a result of scandals caused by the financing of environmentally controversial activities.	
Other risk types (liquidity, business model)	Liquidity risk may be affected in the event of clients withdrawing money from their accounts in order to finance damage repairs.		Transition risk drivers may affect the viability of some business lines and lead to strategic risk for specific business models if the necessary adaptation or diversification is not implemented. An abrupt repricing of securities, for instance due to asset stranding, may reduce the value of banks' high quality liquid assets, thereby affecting liquidity buffers.	

Source: European Central Bank

As reported shown above, the credit risk area might be negatively impacted by the physical risk through the lower collateral valuations in real estate portfolios in areas that are highly exposed to flooding risk. This, in turn, may negatively affect the PDs and LGDs of these portfolios. Similarly, severe climate events might lead to shifts in the market sentiment that could trigger a market crash. Extreme climate events might also have a negative impact on operational risk as they could entail physical damages to the credit institutions' premises and properties, causing disruptions in the provision of services.

In October 2023, the EBA released a report that focuses on the role of environmental risks in the prudential framework[7]. The Report explores whether and how environmental risks are to be incorporated into the Pillar 1 prudential

7 https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Reports/2023/1062711/Report%20on%20the%20role%20of%20environmental%20and%20social%20risks%20in%20the%20prudential%20framework.pdf

framework. It also assesses the opportunity of introducing of a forward-looking perspective in the prudential framework to better capture these risks related to environmental and social factors.

4. Comparing and contrasting national level regulations for banking institutions

The introduction of the above-mentioned regulations should help ensure consistency for the disclosure practices of banks and financial intermediaries across the EU. As a matter of fact, the European national legal obligations on environmental, social, and governance disclosures are generally incoherent (Lagasio and Cucari, 2019).

All European countries do not have specific prudential regulatory requirements constraining financial intermediaries to consider ESG factors in their business practices. The absence of such requirements is mainly attributable to the lack of a common definition of ESG factors. In this respect, it is worth noting that the academic literature has observed that the ESG scores assigned to the major listed companies in the euro area by three of the main providers vary significantly for the same firm, while the correlation between the more traditional credit ratings is over 90 percent (Dimson, Marsh, and Staunton, 2020). With reference to the disclosure requirements, the practices across the EU vary widely, with some jurisdictions having more stringent disclosures requirements than others.

Table 2: National European regulations on ESG factors.

Countries	Disclosure requirements	ESG related requirements	Prudential requirement related to ESG
Italy, France, Denmark	All classes of investors (banks, mutual funds, insurance companies and asset managers) have to disclose their holdings.	No specific requirement	No specific requirement
Germany, Netherlands, Spain, UK	Pension Funds (but not other investors) have to disclose their holdings.	No specific requirement	No specific requirement
Belgium	No specific requirements	Asset managers required to explain how ESG considerations are factored into their investment strategy	No specific requirement
Austria, Luxembourg Portugal, Sweden	No specific requirements	No specific requirements	No specific requirements

Countries like France, Denmark, and Italy require all classes of investors, including banks, mutual funds, insurance firms and asset managers, to disclose their holdings. Even if this first group of countries requires the disclosure of the holdings from all investors, they still have different requirements and practices for communicating this information to the market. This, in turn, determines different disclosures conventions followed by the investors that operate in these countries. Furthermore, it has to be noticed that investors do not have legal requirements compelling them to disclose any specific information on ESG.

A second group of countries has specific requirements in place only for certain classes of investors. On the one hand, Germany, the Netherlands, Spain, and the United Kingdom have legal requirements demanding pension funds (which typically have long-term investment horizons) to disclose their holdings to the market. Moreover, this group of countries does not have additional legal obligations with regard to the disclosures of ESG factors required from the investors. On the other hand, even in the absence of a specific obligation entailing the disclosure of the holdings, Belgium requires only asset managers (but notother investors) to explain how ESG considerations are factored into their investment strategy.

A third group of countries like Austria, Luxembourg, Portugal, and Sweden impose no legal obligations on disclosure on institutional investors or fund managers nor specific requirements related to ESG factors

Against this background, it is worth noting that, notwithstanding the absence of specific national requirements, the IORP II Directive allows Member States to ensure that entities subject to the directive report on the relevance and materiality of ESG factors. The deadline for the transposition of this Directive into national regulations was January 2019, and not all Member States fully transposed the provisions included in it. As a consequence, the practices followed by the EU countries are still divergent. After the Brexit, the UK does not have to adhere to the European regulatory framework any longer. However, in 2019, it published its "Green Finance Strategy" in which it pledged, among the other things, to follow the ambitions of the EU's action plan. Despite the claims made by the UK government, it still lacks a sustainable finance regulatory taxonomy (already available in the EU)[8] and most probably will not endorse similar regulations as those endorsed by the EU Commission.

The initiatives launched at a European level (see chapter 3) will therefore ensure a consistent treatment of the ESG factors by the European financial intermediaries, will provide more clarity on what should be understood as ESG-compliant, leading the way to the collection of reliable data on this matter.

[8] https://www.clearygottlieb.com/-/media/files/alert-memos-2020/sustainable-finance-a-global-overview-of-esg-regulatory developments.pdf

5. Summary

During the recent years, the European policy-makers stepped up their efforts to create a regulatory framework for banks that embraces ESG principles. The main energies have been devoted to enhancing the disclosure requirements for banks, financial intermediaries and industrial companies. The main initiatives implemented are: i) the taxonomy regulation, that introduces specific criteria for the classification of the activities performed by industrial companies; ii) the Non-Financial Reporting Directive (NFRD) that imposes additional reporting requirements for listed companies having more than 500 employees to facilitate the comparability of the information provided to financial investors; iii) the CRR2 that requires European banks to disclose the ESG risks to which they are exposed to as well as the remedial actions undertaken to reduce the severity of these risks and iv) the Financial Services Sustainability Disclosure Regulation (SFDR) aimed at making the sustainability profile of funds more comparable and easy to understand for financial investors.

All these initiatives have been beneficial given that the disclosure requirements at a national level were quite diverging (Brogi, Engle, Cucari, Lagasio, 2021). In addition, through the introduction of clearer criteria for the classification of the activities performed by industrial companies, policymakers shall set the stage for the introduction of more specific guidelines and regulations. The mandates given to the EBA by the new banking regulatory package (CRR2 and CRDV) are explicitly aimed at introducing the ESG principles in the regulatory framework for banks. Other relevant initiatives in this respect are the introduction of these principles in the EBA guidelines on loan origination and monitoring for banks, the SSM guide on climate risk targeted at the significant banks of the Eurozone countries and the EBA report on the role of environmental and social risks in the prudential framework.

Guidelines for the implementation of a robust climate risk stress testing framework for banks

Abstract

Climate change poses significant risks to the stability and resilience of the global financial system, and banks are increasingly recognizing the need to assess and manage climate-related risks. Climate risk stress testing has emerged as a vital tool for banks to evaluate the potential impact of climate change on their portfolios and to enhance their overall risk management practices. This paper aims to provide a set of key principles for the structuring of a robust climate risk stress testing framework for banks. In the paper, the climate risk stress tests that have been carried out in recent years by many supervisory authorities (among the others ECB, FED, EBA, BoE, ACPR) are examined, and some valuable lessons are drawn from them. This paper distinguishes the potential impacts of climate risk on banks' portfolio into short and medium-long term. The potential negative effects of the climate change on banks in the short-term period could be properly captured by using a traditional stress-testing model, as the hypothesis underpinning the model are still verified. In the medium-long term, given that the key assumptions of a traditional stress test model are not verified (namely the static balance sheet assumption), other relevant tools could be properly deployed to factor in the climate risks to which the bank is exposed. The portfolio benchmarking tool could be effective, and its result could be properly factored by supervisors in their Supervisory Review and Evaluation Process ('SREP') decisions.

Keywords

Climate risk stress test; banks' capital position; banks' resilience; prudential supervision; traditional stress test; stress testing framework.

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1. Introduction

During the recent years, several climate stress test exercises have been conducted by prudential and regulatory authorities around the world. The main assumptions underpinning these climate stress tests will be analysed in the following paragraphs. The analysis will be split into two sections, one addressing the exercises carried out by the EU authorities and the other one focused on the exercises carried out by the other non-EU authorities.

The main features characterising the stress test exercises carried out by EU authorities[9] were the following:

- risks considered: almost all the authorities devised the stress test in a way to mostly consider both physical and transition risks. However, DNB[10] excluded the physical risk from its exercise.
- Data (type of stress test, top-down vs bottom up): from the analysis emerges that the authorities did not follow a no unique approach in relation to the type of stress considered. Some authorities used a top-down approach (ECB[11]), whereas others a bottom-up only (ACPR[12]); in other cases, however, a mixed approach (partly top down, partly bottom up) has been used (EBA[13], DNB).
- Time-horizon: DNB carried out the exercise envisaging a time horizon of 5 years; for the stress tests of the other authorities, the horizon considered was 30 years.

[9] The European supervisory and regulatory authorities that carried out a climate stress test in recent years and that are considered in the analysis are: ACPR (France), DNB (The Netherlands), the European Banking Authority (EBA), and the European Central Bank (ECB).

[10] https://www.dnb.nl/media/pdnpdalc/201810_nr-_7_-2018-_an_energy_transition_risk_stress_test_for_the_financial_system_of_the_netherlands.pdf;

[11] https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.climate_stress_test_report.20220708~2e3cc0999f.en.pdf;

[12] https://acpr.banque-france.fr/sites/default/files/medias/documents/20210602_as_exercice_pilote_english.pdf;

[13] https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Reports/2021/1001589/Mapping%20Climate%20Risk%20-%20Main%20findings%20from%20the%20EU-wide%20pilot%20exercise%20on%20climate%20risk.pdf;

- Scenarios and transition from shocks to financial variables: the scenarios applied in the exercises by the authorities were mostly based on the assumptions used by the Network for Greening the Financial System (NGFS); the translation of the climate shocks to financial variables mostly happens through the probability of default (for credit risk); however, for some exercises (EBA, ECB) such shocks have also been considered through a top-down approach to sectors thereby including the impact on LGDs and on market risks (for bonds).
- Balance-sheet assumptions: almost all authorities applied a static balance sheet assumption; nevertheless, ACPR chose a static balance sheet assumption for the first 5 years and a dynamic one afterward. The EBA also kept static the greenness level of customers.
- Ultimate goal: the stress test exercises of the DNB, ACPR and ECB have mostly been aimed at quantifying the losses for banks under pre-defined scenarios and transmission channels (e.g., credit risk and market risk channels). On the contrary, the EBA exercise was mainly aimed at exploring data and methodological challenges to categorise exposures on the basis of selected climate risk factors rather than quantifying the impact on banks' risk profile; this exercise was complemented with a scenario analysis that was carried out by applying shocks stemming from different NGFS climate risk scenarios to risk parameters to measure the impact in terms of expected loss.

The main distinguishing features of the climate stress test exercises carried out by the non-EU authorities[14] are the following:

- Risk considered: both physical and transition risks have been considered in the case of the exercises carried out by the BoE[15] and the FED,[16] while only

[14] The non-European supervisory/regulatory authorities that carried out a climate stress test in recent years and that are considered in the analysis are: BoC (Canada), BoE (England), FED (United States), APRA (Australia).

[15] https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario;

[16] https://www.federalreserve.gov/publications/climate-scenario-analysis-exercise-instructions.htm;

transition risk was considered in the exercises carried out by the Bank of Canada[17] and the Australian Prudential Regulatory Authority (APRA)[18].

- Data (type of stress test, top-down vs bottom up): as for the case of the EU authorities, no unique approach can be identified. More specifically, the Bank of Canada and BoE used a mixed approach (both top down and bottom up), the FED used a top-down approach and the APRA used a bottom up approach.
- Time horizon: almost all the exercises (BoE, Bank of Canada and APRA) considered a time horizon of 30 years; however, the FED exercise does not identify a specific time horizon for the analysis.
- Scenarios and transition from shocks to financial variables: the number of scenarios considered ranged from two (APRA) to four (Bank of Canada), with the BoE considering three scenarios and the stress methodology of the FED exercise that estimates a climate risk factor and then applies it when determining the beta of financial institutions through the Capital Asset Pricing Model (CAPM). The transition to financial variables was considered in the case of the Bank of Canada by calibrating the credit model (i.e., the Merton model) to link the financial impacts to credit outcomes; in the BoE's exercise, the impact was modelled by financial institutions (with some reference curves provided by the BoE) whereas in the FED exercise, the impact on the financial institutions' equity was derived by computing a Beta that properly captured climate risk and by using it in the CAPM.
- Balance sheet assumptions: as for the European authorities, the static balance sheet assumption was used in almost all the cases (Bank of Canada, BoE and APRA) even though the BoE envisaged an impact assessment every five years. On the contrary, the FED exercise considered a dynamic balance sheet assumption.
- Ultimate goal: as in the case of the majority of the EU authorities, the goal was to quantify the losses for banks under predefined scenarios and transition channels.

[17] https://www.bankofcanada.ca/2022/01/assessing-climate-change-risks-to-our-financial-system/;
[18] https://www.apra.gov.au/climate-vulnerability-assessment-november-2022.

Therefore, as the analysis shows, the exercises carried out by the different authorities around the world shared a common goal, fully aligned with one of a traditional financial stress test, i.e., testing the resilience of banks and financial intermediaries against some sort of shocks (in this case, climate-driven shocks). Different approaches and assumptions have been used by authorities around the world to estimate the impact of climate-driven shocks on banks. These approaches and assumptions are mostly drawn from traditional stress testing exercises.

However, notwithstanding the commonalities of the climate risk stress test with the traditional stress testing exercises, it is worth noticing that a climate risk stress test has several unique features (long-term horizon, non-reliability of past data for future projections, dynamics of the balance sheet of banks and dynamics of the level of greenness of financed firms, reputational or fiscal incentives which can increase the financial support to favour the green transition of financed firms) which could eventually yield unreliable results. . In addition, differently from the standard stress test, in the case of the climate risk, long-term environmental goals have been already set. The current climate stress test has been focused *on the impact (in ter*ms of loss) of different NGFS scenarios, which can give a good macro-prudential view of the transition with possible view of the bank-by-bank impact.

In the short-run, the impact is already included in the standard stress test framework (a possible climate shock in the scenario could be added to separate the environmental impact on risk from the impact of traditional macro-financial shock).

In the long-run, the exercises already conducted do not help to measure how far the system (and every single bank) is from the regulatory goal (e.g., goals set in the Paris Agreement document). The distance from the expected goal, and the consequent guidance, is a supervisory tool already used by supervisors for traditional risks. The main goal of this paper is to focus on the long-run effects.

The purpose of this policy paper is therefore to present a different approach to the incorporation of the climate stress test in the prudential framework of the credit institutions. The paper is structured as follows: section 2 features the literature review on the topic, the following section will discuss in detail the specificities of the traditional stress test exercises; section 4 will discuss what should be the objective of a climate stress test; section 5 will present a list of key principles for

the incorporation of the climate risk in the supervisory assessment of credit institutions and section 5 will draw the conclusions.

2. Literature review

The economic literature on climate risk has been focused on the macroeconomic impact of climate change, and it generally focuses on two main channels (Batten et al. 2020). The first, supply side shocks that could negatively affect the productive capacity of the economy. The second, is the uncertainty and financial losses triggered by climate change related events such as natural disasters (especially in cases in which the insurance coverage is not perfect) that could discourage investments (Batten et al. 2020).

The most important finding on which researchers tend to agree is that climate change has a negative effect on potential growth. Some studies have proven that productivity can decline by about 1.7 percent for each 1 °C increase in daily average temperature above 15 °C (Deryugina and Hsiang, 2014). Climate change can also have an adverse impact on the rate of productive capital accumulation, as it can induce permanent or long-term damage to capital and land (Stern 2013), or by increasing its depreciation rate (Fankhauser and Tol 2005; Keen and Pakko, 2011). Moreover, labor markets are affected by the deviation of weather behavior from the seasonal norms, which can affect both payrolls and the labour supply (Boldwin and Wright, 2015).

The economic literature seems to agree also on the fact that the climate risks could negatively affect the financial sector. The creation of the Network of Central Banks and Supervisors for Greening the Financial System ('NGFS') at the Paris "One Planet Summit" in 2017 underlines this widespread belief. In its Call for Action of 2019, the NGFS details how climate change can be a source of financial risk (NGFS, 2019). In particular, the Task Force on Climate-Related Financial Disclosures ('TCFD', 2017) two new types of risk for the financial sector stemming from climate change are identified: physical risk and transition risk. Physical risks relate to the physical consequences of climate change, such as physical assets'

destruction by extreme weather events, whose frequency is increased by climate change. Transition risks refer to the economical and societal changes which are related to climate change mitigation efforts implemented through climate policies, development of green technologies or a reorientation of financial flows and consumer preferences from high to low-carbon activities. More in general, according to the Basel Committee on Banking Supervision (2021) the climate-related risks may have an impact on financial institutions through the standard financial risk categories as reported in the tables below.

Table 1. Transmission channels of physical risks to financial institutions

	Microeconomic channels and direct impacts	**Macroeconomic channels and indirect impacts**
Credit risk	Reduction in debtors' wealth, revenue or loan collateral (households, corporates, public institutions)	Decline in labour productivity, output reduction; increase in sovereign spreads or defaults; downgrade of (local) public institutions in vulnerable areas
Market risk	Uncertainty about physical risk materialisation: mispricing, increased volatility, increased difficulty of hedging	Same as microeconomic channels, which can spread through value chains and macroeconomic variables
Liquidity risk	Increase in funding cost due to exposure to physical risk; increased demand for liquidity following a natural disaster	Rush on liquidity following important natural disasters
Operational risk	Disruption of transportation facilities, telecommunications or market infrastructures; damages to tangible fixed assets	Same as microeconomic channels, which can spread through value chains and macroeconomic variables
Underwriting risk (for insurers)	Higher than expected increase in claims on damaged insured assets (for non-life insurers), higher than expected mortality or morbidity rates	No specific macroeconomic channel identified
Underwriting risk (for financial institutions)	Decrease in insurance coverage which would increase financial institutions' exposure to physical risks	No specific macroeconomic channel identified

Source: Basel Committee (2021)

Table 2. Transmission channels of transition risks to financial institutions

	Microeconomic channels	Macroeconomic channels
Credit risk	Decrease in creditworthiness of corporates vulnerable to transition risk; higher litigation costs for corporates and governments	Changes in production value chains structure can lead to output reduction (decrease in creditworthiness of households, corporates and governments)
Market risk	Uncertainty about corporates exposure to transition risk: mispricing, risk of abrupt repricing events (ex: stranded assets), increased volatility	The spread of microeconomic market risk channels through value chains and macroeconomic variables
Liquidity risk (asset liquidity)	Assets becoming illiquid (ex: stranded assets)	Spillover effects between companies of same sectors or through value chains
Liquidity risk (funding cost)	Increase in funding cost due to exposure to transition risk or uncertainty related to this exposure	Cascading increases in funding costs due to dependence on carbon intensive activities upstream value chains

Source: Basel Committee (2021)

Most of the scholars studying climate change and its impact on the financial sector realised that modelling these sources of risk is a challenge as they are extremely complex phenomena, and subject to radical uncertainty (Bolton et al. 2020). They are the result of complex interactions between economic, climate, and societal dynamics. As a matter of fact, the current scientific knowledge on climate and weather dynamics does not allow predicting physical risk with a high level of confidence (Fiedler et al., 2021). Against this background, a climate risk stress test could be a possible answer to this challenge. As mentioned in the introduction, many banking supervisory authorities around the world conducted some pilot climate stress test exercises. However, given that they are in a trial phase, it is not yet clear what objective they should achieve. Those that have been conducted so far answer a wide range of objectives: they allow raising awareness and knowledge of climate-related risks among participating banks and insurance companies, hence fostering climate risk management among them. It is important to notice, however,

that they are not prudential in the sense that they do not entail any capital requirement or other regulatory constraints for financial institutions.

It is not a case that the development of climate stress testing methodologies has been the main object of the academic research in this field over the last few years. Several studies (Battiston et al., 2017; Roncoroni et al., 2021; Battiston et al., 2019; Bressan et al., 2022) focused on finding stress testing methodologies that had a financial contagion module to stress the importance of financial institutions' interconnectedness when assessing financial risks stemming from climate-related risks. Mandel et al. (2021) worked on a model for assessing the impact of flood risk on the aggregate financial sectors of many countries, emphasizing the impact of international exposures when assessing the impact of flood risk on the mortgage exposure of banks. Reinders et al. (2020) adapted Merton's model of contingent claims pricing to evaluate the potential impact of a carbon tax on asset pricing, particularly on mortgage debt. Nguyen et al. (2020) worked on data of debtors' carbon emissions using a U.S. bank loan portfolio to extract relevant information on bank exposure to transition risks. Gourdel and Sydow (2021) used a complex model of contagion in a network of European investment funds to evaluate the impact of various climate-related shocks on these financial institutions. Grippa et al. (2020) showed how a climate stress testing methodology can be fruitfully adapted to the economy of a specific country; in particular, in their research paper, they worked on the example of Norway, whose fiscal revenues strongly rely on oil activities. Bikakis (2020) assesses the impact of flood risk on mortgage default risk and derives potential losses in terms of CET Tier 1 of several UK banks. Cartellier (2022) provides a comprehensive overview of all the climate risk stress test methodologies developed in recent years by scholars and supervisory authorities.

3. Objective of the traditional stress test model and how it works

Stress tests have become a widespread instrument to gauge and monitor the risks of financial institutions and of the banking sector. This instrument has been added to the ordinary toolbox of supervisors, to complement the usual backward-looking measures of risks. Indeed, stress tests are forward-looking exercises run to assess

the resilience of financial institutions under hypothetical severe but plausible scenarios by measuring the impact of shocks on capital adequacy. Stress tests are usually run over a pre-determined time-horizon, which should be long enough to assess the effects of the scenario (e.g., 2 to 5 years for a standard solvency stress test; the time horizon is usually shorter for a liquidity stress test). From a technical point of view, solvency stress testing requires:

- to use all the scenario inputs (e.g., market, macroeconomic, and funding shocks).
- a risk modelling framework, usually based on different blocks of risks (e.g., credit, market, and operational risks),
- in order to compute the impact on capital via the estimation of economic and balance sheet projections (e.g., losses on loans or on securities, NII and other revenues or costs; RWA and capital).

In economic literature, stress tests are usually classified based on the policy objective, the agent who applies the scenario, the assumptions on banks' reaction (see FSI insight 12, BIS).

For policy objectives, a stress test can be "macroprudential", if it aims at assessing the resilience of the whole system to shocks, or "microprudential", when the exercise is designed to measure the impact of the adverse scenario on individual banks. Macroprudential stress tests help to have a homogeneous view of the impact of the scenario on the whole system; in this case, even possible second-round effects, from each bank to the system, could be estimated, going beyond the simple sum of microprudential estimates. "Microprudential" exercises are more focused on measuring the impact of the shocks on each bank, assessing the resilience of the financial institution, and defining possible remedial actions.

With regard to the type of agent performing the exercise, the stress test can be performed directly by the supervisory authority or by banks. If the authorities run the stress test (top-down approach), they use their own data and methodologies, often without the involvement of the banks themselves. Otherwise, banks are called to use their own stress test framework to measure the impact of the shock on their own capital condition (bottom-up approach). In this case, a quality assurance (QA) process is usually established to ensure a consistent application of the methodology.

At last, in cases where reactions implemented by banks during the stress test horizon are also considered (e.g., if the bank's balance sheet is allowed to vary), the stress is run under a dynamic balance sheet assumption; otherwise, it is performed under a "constant balance sheet" constraint. It is worth noting that, though the inclusion of possible changes in the balance sheet ("dynamic balance sheet"), both in terms of size and composition, increases the realisms of the exercise, the definition of the path for the changes has some levels of discretion, possibly hampering the comparability of results across different banks.

Additional relevant features of ordinary stress tests are related to the outcome of the exercises. Indeed, how the results of the exercise are used in supervisory activities and how they are communicated are relevant steps in the stress test process.

In practice, micro-prudential stress tests are often used in the SREP process, for supervisory objectives (e.g., by setting a pillar 2 buffer requirement), while macro-prudential ones are fit for system-wide risk analysis purposes. With reference to communication, authorities may decide to publish bank-specific results or aggregate results, to share information about the level of risk of each bank or of the whole system. The communication of bank-by-bank results helps in levelling the playing field and is beneficial for banks to understand and assess the major risks embedded in their portfolio. As underlined in the literature (Schuerman et al. 2016), a richer disclosure may be especially beneficial in times of crisis.

With reference to the features described above, the EBA EU-wide stress test is a microprudential exercise, with bottom-up calculation performed under a constant balance sheet constraint for a three-year time horizon. The results of the exercise, published at bank level, are used in the SREP process to set a Pillar 2 requirement. With these characteristics, the EBA EU-wide stress test aims to assess the resilience of EU banks to a common set of adverse economic developments, under a common methodology, in order to identify potential risks, inform supervisory decisions and increase market discipline. The analysis is limited to a three-year horizon.

As we will see in the next sections, the climate risk stress test has some crucial differences with respect to the standard stress tests, due to the lack of sufficiently granular data, the different time horizon, and the currently unclear impact on capital requirements for the climate stress test. In addition, possible overlapping, in terms

of impact on Pillar 1 risks, between the standard stress test and the environmental stress test should also be considered.

4. Objective of a climate risk stress test

4a. Challenges in applying traditional stress test for climate risk shocks

Financial crises can occur at any time and are often unpredictable in their timing. Therefore, the application of plausible, stressed scenario can help to complement the traditional assessment of risk exposures, based on actual or past data. The possible impact of financial crises can be, at least in part, assessed on the basis of the estimation of the relation between macro-financial variables and banks' risks, based on the available dataset of past data. Climate risk has a new, more complex way of manifestation. Part of the risk has both a continuous, day-bay-day manifestation (transition risk), sometimes with a barely perceivable annual change of risk, but with a material, multi-year cumulated impact and a more unpredictable, and possibly immediately material, risk (physical risk) which may impact both banks' clients (and credit, market risks) and the bank itself.

Several exercises have been performed to examine the possible impact of climate risk; these exercises have often leveraged on principles and experience acquired with financial stress tests. However, it is worthwhile to highlight at least three key features to be considered when using financial stress-test modelling for climate stress tests: the different time horizon, data availability, measurability of the impact of the variables on risk measures.

In terms of time horizon, the ordinary, financial stress tests are based on scenarios of short-term economic downturn; the impact is then directly estimated based on the evolution of macro-financial variables and is often material. Differently, a climate risk stress test should leverage on longer-term scenarios, with the impact in the short-term period possibly modest (for transition risk, which in principles has a lower but recurrent annual impact) or scarcely predictable (for physical risk).

For data, the climate risk stress test needs more granular information (e.g., breakdown at activity level, counterparty, and sector), and there are significant

issues in measuring key variables (e.g., emissions scope 3). These gaps will require time to be filled for present and future data, and can hardly be filled for past data.

At last, in terms of the measurability of the effects of the scenarios, while the estimation of the impact of the evolution of macro-financial variables is based on long experience and the availability of past data, the estimation of the impact of climate-related variables is less straightforward, since large datasets of adequate past data are not available. This lack of data makes it more difficult to build estimation models leveraging upon large datasets of past data, as is usually done for financial stress tests, hampering the usual backward-looking approach used to model the effects on risks of macro variables[19].

All the above draws the attention to some of the structural differences to be considered when structuring the framework for a climate stress test. In addition, a further layer of complexity is related to the overlapping areas between the effects related to the impact of environmental variables and those of macro-financial variables. Indeed, the current risk-based approach used by banks should already encompass most of the environmental risks, as expressed in a recent EBA Discussion Paper[20]. For instance, most of the effects related to transition and physical risks should already be included in credit, market, and operational risks. In principle, the inclusion of these effects in Pillar I risk can favor the use of the usual stress-test toolbox also for environmental risks, though it could make it harder to disentangle the climate-risk effects from the macro-financial effects. In this framework, where environmental risks are measured as a portion of Pillar 1 risks, Pillar 2 could be dedicated to institution-specific analysis performed by competent authorities (for instance, to allow appropriate recognition of different business models and specific risks) or to considering the effects of the stress tests. However, as mentioned above, this framework (Pillar 1 and possible Pillar 2) is applicable for a short-term period (e.g., stress tests have a three-year horizon), so it does not consider the less measurable and potentially most material part of the climate-related risks, which is the one with a long-term impact. In addition, for climate risk, there is no clarity at this stage on whether capital is a target (see EBA discussion

[19] See "Capturing risk differentials from climate-related risks", Technical document of the NGFS (Network for greening the financial system), May 2022;
[20] EBA Discussion Paper 2022/02, "The role of environmental risks in the prudential framework".

paper 2022/02). The forward-looking and non-linear nature of environmental risks needs to be considered further, given the current role of the Pillar 1 framework, the lack of environment-related attributes in existing historical data for measuring risk, and the relevance of forward-looking information with respect to environmental risk. Against this background, in this paper, we will focus on this dichotomy of short-term vs long-term impact, often neglected in the empirical climate-related stress tests, leaving aside the possible impact of climate risk on Pillar 1 in ordinary times, on which the EBA discussion paper 2022/02 aims to shed some light, and dealing very concisely with the impact of stress test on a short-term horizon, already examined by several stress test exercises and possibly included in the standard stress test framework, given that Pillar 1 risks already includes environmental effects of stressed scenarios.

In detail, we will discuss the possible scenario design to consider the impact of environmental risk, taking a look at a possible top-down, macro-prudential approach. Lacking adequate granular data for longer-term estimations of the impact of climate change on the banks' risks, the analysis presented in this paper could pave the way for studying similar approaches that might be used for micro-prudential reasons. Interestingly enough, the approach here presented is not strictly embodied in the "constant or dynamic balance sheet" dichotomy, since it assumes that past dynamics of the balance sheet will be replicated in the future.

4b. Incorporation of the climate risk in the prudential framework

Climate-related risks pose different kinds of threats to credit institutions. The key components of the climate-related risks identified by the Task Force on Climate-Related Financial Disclosures (TCFD) are[21] the physical risk and the transition risk. Depending on their nature, these risks could materialise in the short, medium, and long-time horizons. Prudential authorities should therefore address these sources of risk with the most appropriate tools. As noted by the Bank of England[22] and the

[21] https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf;

[22] https://www.bankofengland.co.uk/stress-testing/2022/results-of-the-2021-climate-biennial-exploratory-scenario;

BIS[23], the climate-related risks are not yet fully captured under the current micro-prudential framework for credit institutions in all the main jurisdictions. In this section, we therefore call for the application of a different micro-prudential treatment depending on the source of risk to be addressed (i.e., whether the risk materialises in the short term rather than in the medium to long term).

According to the definition provided by the TCDF, physical risk arises due to the occurrence of extreme weather events that can have financial implications for industrial companies and banks alike, as they entail direct damage to assets and indirect impacts due to supply chain disruptions. Physical risk also materialises due to the longer-term shifts in the climate patterns (e.g., sustained higher temperatures) that may cause sea level rise or chronic heat waves.

Given the potential for short-term impacts on the banks' balance sheets, physical risk could be properly considered from a prudential perspective by supervisors by using a traditional stress-testing methodology (for more information, please refer to the EBA discussion on 2023 EU-wide stress test methodology) that determines the potential impacts on the capital of a bank by applying defined stress scenarios over a three-year time horizon. Using this methodology, in fact, it would be possible to estimate the financial losses stemming from the occurrence of severe climate events on the banks' holdings (i.e., both on the credit and market portfolios). Similarly, the short-term effects of the transitional risk (i.e., the potential introduction of new legislation having disruptive effects, such as, for instance, the carbon tax) could be considered in this framework. New legislation entailing disruptive changes might, in fact, have an impact on market risk for banks (as their market portfolios might be exposed to substantial losses) but also, as a second-round effect, on credit risk (as the impact on the market value of the assets could then also have an impact on the PDs and LGDs of the credit portfolios). It should be noted that notwithstanding the specificities of physical risk and transition risk, notably the difficulties in estimating the impact due to the unpredictability of extreme weather events as well as the unpredictability of the likelihood of governments enacting new policies, the assumptions underpinning the traditional stress test methodology, i.e., the static balance sheet assumption as well as the short time horizon taken into account in

[23] https://www.bis.org/fsi/fsibriefs16.pdf.

order to estimate the impact of potential losses on the banks' balance sheets, still hold true. Along the same lines as the traditional stress tests, prudential supervisors may then use the outcome of the exercise to inform the setting of the Pillar 2 Guidance (P2G). Furthermore, by using the traditional stress testing methodology, prudential supervisors would also have the opportunity to consider the potential mitigants (such as, for instance, the insurances) that the banks have put in place with the aim of reducing the impact of such unexpected extreme weather events on their balance sheets.

On the contrary, the impacts of transition risk will mostly unravel over the medium to long term. The TCFD defines transition risk as the negative impact on organisations that could stem from a transition to a low-carbon economy. Such a process might entail extensive policy, legal, technology and market changes to address mitigation and adaptation requirements related to climate change. Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organizations.

The incorporation of transition risk into the micro-prudential framework for credit institutions poses some challenges. More specifically, capturing the potential negative impacts in the medium to long term stemming from this source of risk by considering them into a stress stressing framework is rather challenging for a number of reasons: i) lack of data on the phenomenon, building such a database would be rather challenging for credit institutions and most probably would require several years in order to be fully operational; ii) the assumptions underpinning the traditional stress testing framework, i.e., static balance sheet assumption and short term time-horizon, would not hold as banks are expected to change their holdings in order to implement the transition to a lower carbon economy and this process will occur over a longer time-horizon than the one foreseen in the traditional stress testing frameworks; iii) difficulty in determining the capital implications for banks also when using a dynamic rather than a static framework.

For all the above-mentioned reasons, it does not seem practical to consider the transition risk in the stress testing framework. Prudential supervisors may nevertheless take this source of risk into account when performing the business model analysis in the context of the SREP. More specifically, multiple scenario

analysis could be used to assess the level of alignment of the banks' portfolios with respect to some specific predefined climate targets (such as, for instance, those part of the Paris Agreement). Such an approach would ensure more flexibility while also allowing supervisors to carry out benchmarking analysis between the bank and its peer group. Moreover, supervisors would also be able to actively monitor the progress made by credit institutions in achieving (and supporting companies in achieving) the climate goals that have been agreed upon at a supranational level. Another important advantage of this option would be the absence of a specific time constraint (as already said, traditional stress testing methodologies estimate the impacts on the capital of banks over a 3-year time-horizon), thus allowing supervisors to consider a long-term horizon in the analysis. The outcome of such an analysis could then be used to feed the SREP process, which could eventually lead to the application of specific supervisory measures.

The case for incorporating the physical risk together with the estimated impacts of transition risk over the short term in the traditional stress testing framework could be made, considering that the integration of these sources of risk does not pose major methodological challenges. On the contrary, integrating the medium- to long-term impacts of the transition risk into the stress testing framework would be more challenging due to its dynamic nature. It is therefore claimed that it would be more practical to consider this source of risk using a multiple scenario analysis when assessing the sustainability of the business model of the institution in the context of the SREP assessment.

5. Key policy principles on how to take into account climate risk in the supervisory assessment

5a. Short term. Key principles on how to structure a climate stress test

This paragraph presents 10 key principles aimed at structuring an effective regulatory climate stress test framework for banks. The objective of such a stress test should be to assess the resilience of banks to climate-related risks. As for traditional stress tests, the horizon that a climate stress test should cover is 3 years. The list of principles is detailed below.

Key principle 1. Define the scope: The stress test should clearly define the scope of the analysis, including the types of risks to be assessed, the institutions to be included, and the time horizon.

Key principle 2. Use a scenario-based approach: The stress test should use scenario-based modeling to assess the potential impact of adverse economic and financial market events on the bank's operations, financial position, and capital adequacy.

Key principle 3. Consider different climate scenarios. The stress test should consider a range of climate scenarios, including both physical risks (such as floods, hurricanes, and wildfires) and transition risks (such as policy changes, technological advances, and shifts in consumer behavior). The scenarios identified should be sufficiently severe to assess the resilience of the bank's balance sheets and capital position.

Key principle 4. Incorporate uncertainties. The test should incorporate uncertainties around the potential impact of climate change, such as the timing and severity of climate events and the effectiveness of policy responses.

Key principle 5. Integrate climate risk into the existing regulatory framework. The outcome of the stress test carried out by the supervisory authority should be integrated into the SREP decision to ensure that climate risks are being appropriately taken into account by the bank.

Key principle 6. Engage stakeholders. The test should involve stakeholders from across the organization, including risk management, finance, and sustainability teams, as well as external auditors.

Key principle 7. Consider both physical and financial impacts. The stress test should assess the potential physical and financial impacts of climate-related risks on the bank's balance sheet, income statement, and capital position.

Key principle 8. Consider risk mitigation strategies. The stress test should duly consider the effectiveness of risk mitigation strategies.

Key principle 9. Review and update regularly the methodology. The stress test methodology should be reviewed and updated regularly to ensure that it remains relevant and effective in light of new information and changing market conditions.

Key principle 10. Communicate results. The stress test results should be communicated to all stakeholders, including investors, and used to inform risk management decisions and actions to mitigate climate-related risks.

5b. Long term (Scenario analysis/the "portfolio benchmarking" approach)

The scenario analysis and the portfolio benchmarking are two approaches that supervisors could fruitfully use to consider the long-term impacts of climate risk on banks. The long-term analysis of the impacts of climate risk on banks should cover a 10 years' horizon.

Through the scenario analysis, supervisors may assess the potential impacts of climate risk on the bank's operations, financial position, and reputation. The scenarios typically involve considering a range of climate-related events, such as floods, hurricanes, and wildfires, as well as the impact they could have on the bank's portfolio. The results of the scenario analysis can be used to identify key vulnerabilities of the bank. This analysis should be focused on the long-term impact of climate risk on the bank and, as such, should be different in nature from those used in the climate stress test.

The portfolio benchmarking approach involves comparing a bank's portfolio to a benchmark defined by applying the targets agreed at the global level (at the Paris Climate Conference, for example) to each single bank subject to the exercise. In other words, this approach would entail monitoring over time the contribution to

carbon dioxide production of each single bank based on the composition of the bank's portfolios vis-à-vis the benchmark that takes into account the objectives that each bank should reach in order to contribute to the achievement of the targets set in the global agreement.

An alternative option for the portfolio benchmark approach may entail defining the benchmark based on industry averages. This comparison may help supervisors in identifying areas where the bank may be exposed to higher levels of climate risk than its peers.

The second option of the portfolio benchmarking approach may be easier to apply in practice, but it does not take into account the objectives set by policymakers to tackle the climate change and, as such, could be less effective in nudging banks towards the achievement of more challenging targets.

Both approaches could be used in conjunction by supervisors with the aim of providing a comprehensive assessment of a bank's exposure to climate risk as well as its contribution to the transition towards a greener economy. Supervisors can use the insights gained from these assessments and take them into account when performing the Supervisory Review and Evaluation Process (SREP).

6. Summary

The attention paid to the potential impacts of climate change on the economy has been heightened by policymakers and market players around the world. A key turning point was the 2015 United Nations Climate Conference (COP 21) that was held in Paris. The conference negotiated the so-called Paris Agreement, a global agreement on the reduction of climate change, the text of which represented a consensus of the representatives of the 196 attending parties. According to the organisers of this conference, the expected key result was an agreement to set a goal of limiting global warming to "well below 2 °C" Celsius compared to pre-industrial levels. Against this background, global financial regulators started implementing new regulations with the aim of raising the awareness of financial intermediaries about this important topic. Financial intermediaries play an important role in the transition towards a greener economy, as they allocate the resources they gather from savers.

Recent extreme weather events, such as wildfires and floods across the world, have also stressed the importance of testing the resilience of the financial intermediaries to shocks that could be potentially triggered by severe weather conditions. Thus, a number of global regulators, just to name a few of them: the ECB, the EBA, the BoE, the FED, have launched dedicated stress tests on banks to assess their resilience to climate-related sources of risk.

The NFGS identifies two sources of risks that together constitute the climate risk: transition risk and physical risk.

The aim of this paper is to provide an alternative framework to the traditional stress testing framework (that has been used by the abovementioned authorities to carry out their first climate stress tests and pilot exercises) for the incorporation of these sources of risk into the analysis to be carried out by the prudential supervisors. It is the opinion of the author that the traditional stress test frameworks are not suitable for this purpose. Instead, a two-layered approach would be warranted to better capture the potential impacts of the climate risks on banks.

The author proposes a distinction between the potential impacts of the physical risk that, given its potential short-term nature, could be properly captured through the

traditional stress testing framework (the underpinning hypotheses, such as the static balance sheet assumption, of these models are verified in this case). The potential impacts of the transition risk, given its longer-term nature, could be properly captured through the so-called portfolio benchmarking analysis, i.e., how much the bank is deviating from its climate risk targets, whose results could be factored into the SREP exercise by the prudential supervisors.

The paper has a qualitative nature, given the lack of data to successfully test hypothetical models. Thanks to the recent changes in the regulatory framework in all the main jurisdictions across the world, the banks are now starting to build databases that are suitable to assess their exposure to climate-related risks. Additional contributions, when a robust database is in place, could therefore build on the guidelines presented in this paper to create and test models that adopt the suggested framework.

Share buybacks in banks and long-term value creation for shareholders

Abstract

Share repurchases is becoming a common method used by companies to remunerate their shareholders. Opinions on how share buybacks affect profitability and shareholders' value continue to differ. This research intends to test the signalling hypothesis on banks' share repurchases, which holds that share buybacks are implemented to signal to the market the stock's undervaluation. More precisely, the study examined how share buybacks affected banks' performance as determined by the return on equity (ROE). The findings of the analysis indicate that share repurchases have a positive albeit low impact on the ROE of banks.

Keywords

Share buybacks, banks' performance, return on equity, shareholders' value, pay-out policy, banking.

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1. Introduction

Starting with Modigliani & Miller's famous pay-out irrelevance proposition in 1958, companies' pay-out policy has been an important area of study in corporate finance. In an idealized world free of taxes, frictions, and information asymmetries, the pay-out options available to firms - dividends versus share buybacks, in economic literature also known as share repurchases - are equivalent. Nonetheless, in a world with levies, frictions and information asymmetries, companies may have reasons to prefer share buybacks over dividends to distribute their profits to shareholders. More precisely, in addition to the tax advantages that could lead firms to prefer one pay-out method over the other, the economic literature has proven that share buybacks may be the preferred option for firms as they signal to the market that the company's stock is undervalued. In this context, share buybacks may therefore also serve as a deterrent to potential takeover attempts.

According to Skinner (2008), stock buybacks have emerged as the primary method of compensation in the twenty-first century. Only the firms listed in the S&P 500 Index repurchased over $800 billion worth of shares in 2018, which is nearly equivalent to their whole operating earnings. Opponents of share buybacks contend that this compensation strategy primarily helps senior executives. This claim has led to widespread criticism of the practice. Moreover, recently, there has been criticism of share buybacks also due to the belief that the surplus funds used by the companies for these operations originate from government bailouts and tax cuts, which were initially meant to encourage company investments or maintain wage increases for their employees. Because they believe that top executives and rich shareholders gain primarily from buybacks, proponents of this thesis have called for changes to tax legislation in various jurisdictions around the world to discourage share buybacks. Authorities went so far as to outlaw open market stock buybacks in certain jurisdictions, such as the US with the bill signed by Baldwin, Warren, and Schatz because "it's just wrong for big corporations to pocket massive, permanent tax breaks and reward the wealth of top executives with more stock buybacks, while closing facilities and laying off workers".[24] Because stock buybacks allow

[24] See press release at www.baldwin.senate.gov/press-releases/reward-work-act-2019.

corporations to return cash to shareholders, who can use it for other, more profitable ventures, this practice also garnered support. Warren Buffett, for example, said:" As the subject of repurchases has come to a boil, some people have come close to calling them un-American—characterizing them as corporate misdeeds that divert funds needed for productive endeavors. That simply isn't the case. . . I'm not aware of any enticing project that, in recent years, has died for lack of capital. (Call us if you have a candidate)".[25]

The economic literature noted that, in the case of banks, managers could suitably employ share buybacks as a leverage management tool in addition to the opportunistic use of buybacks by top executives to increase their performance pay (Aramonte, 2020). Many aspects of the share buybacks have been subject of studies in the economic literature. However, the impact of share buybacks on banks' performance is not entirely clear – most of the findings available are inconsistent or inconclusive (see section "2 literature review"). To close this gap, the purpose of this paper is to investigate the relationship between banks' stock buybacks and their financial performance. This research aims to test the signalling hypothesis, which argues that managers of the company - in this case, the bank – use this tool to signal to the market that the stock is undervalued considering its potential for future growth. To conduct the analysis, a sample of 1336 global banks will be examined in the period from 2015 to 2021.

The structure of the paper is as follows: section two will focus on the literature review on the topic; section three will present the relevant details on the dataset used for the analysis; section four will introduce the model used to test the link between stock buybacks by banks and their future performance; and section five will outline the conclusions of the analysis.

[25] See 2016 Berkshire Hathaway shareholders letter at www.berkshirehathaway.com/letters/2016ltr.pdf.

2. Literature review

The literature on the subject shows that, notwithstanding the relative tax benefits of share buybacks, before 1980, corporations globally primarily paid surplus to shareholders through dividends (Barclay and Smith, 1988). In the US, the number of share buybacks began to increase around 1980. US corporate share repurchases rose from 4.8% in 1980 to 41.8% in 2000, and during the 1990–2000 decade, corporations spent more on share buybacks than on dividends for the first time in history (Grullon and Michaely, 2000). Share buybacks gained traction in other industrialized nations like the UK, Canada, Australia, Japan, and France following the US example. Different and diverse are the hypotheses identified by the economic literature that could justify share repurchases by companies. The subparagraphs below provide an overview of these hypotheses.

2.1 The hypothesis on share buybacks

According to the **signalling hypothesis** endorsed by Ross (1977), Bhattacharya (1979), and Spence (1973), the dividend policy of a firm is used by the management as a means to communicate with the market. The studies investigating this hypothesis highlight the fact that share buybacks deliver two sorts of messages to the market: that the shares are undervalued or that the company has greater potential for growth. A corporation effectively tells the market that the stock is cheap when it declares it will repurchase shares at a steep discount. In this regard, Vermelen (1981) discovered that signalling is the most likely explanation for the anomalous returns observed in the stock market following the share repurchase. According to Bartov (1991), open-market buybacks provide information about changes in risk as well as earnings projections. Other research, like the one conducted by Stephens and Weisbach (1998), discovered a negative correlation between share buybacks and the stock's historical price performance. The signaling effect of three different types of US share buybacks - fixed price self-tender, open market buybacks, and Dutch auction self-tender offers - was studied by Comment & Jarrell (1991), Louis and White (2007), and Haw et al. (2013). They concluded that the fixed price self-tender method conveys a stronger signal of undervaluation than the other two.

The substitution hypothesis postulates that firms use share buyback programs as a way to remunerate shareholders instead of dividends. This theory is based on the

fact that dividends and capital gains are treated differently. As noted by Grullon and Michaely (2000), share repurchases are more advantageous for shareholders in terms of tax efficiency because capital gain tax is often substantially lower than dividend tax in most jurisdictions. The flexibility of share repurchase programs is another crucial feature, as they do not "promise" regular income flows like dividends do (Dittmar, 2000).

Advocates of **the optimum leverage hypothesis**, like Bagwell and Shoven (1988), Dittmar (2000), Mitchell and Dharmawan (2007), and Hovakimian et al. (2001), contend that businesses that have a debt-to-equity ratio below the target ratio are more likely to repurchase shares. These studies have demonstrated the importance of comparing the target versus actual leverage ratio when the company's management chooses to carry out a share buyback program. The studies found that the likelihood that the firm will implement a share repurchase program increases when there is a discrepancy between the actual and target leverage ratio . Therefore, by carrying out a share repurchase program, the management raises the leverage and, by taking advantage of the tax shelter that the extra debt provides, they also raise the firm's overall value (Modigliani, Miller).

The takeover deterrence hypothesis states that companies would likely start a share repurchase program when feeling threatened by a competitor. Bagwell (1991) showed that shareholders do not tender their shares for sale when they think their value exceeds the repurchase price. In a different study, Bagwell (1992) demonstrated that when a firm buys back shares as opposed to when it distributes dividends, the acquisition cost for a possible acquirer will be higher. Further research by Sinha (1991) found that this effect is amplified when the repurchase is financed by debt. Under such circumstances, the firm's worth rises and it becomes a less desirable target.

According **to the stock option hypothesis,** there is a positive link between the number of share buybacks that companies carry out and the outstanding stock options that are granted to its employees (Kahle, 2002; Bens et al., 2003). The authors specifically claim that an large quantity of outstanding stock options dilutes the earnings per share. Companies repurchase shares to offset this effect.

Jensen (1986) and Vafeas and Joy (1995) endorsed **the excess capital or cash flow hypothesis,** which concluded that the buyback of shares to distribute extra cash to owners is carried out to lower the agency cost. In fact, these studies indicate that companies that have excessive cash or capital excessively have also a greater likelihood of undertaking projects with negative net value. A larger dividend pay-out or share buyback will decrease the free cash flow available to the managers. Boudry (2013) discovered that, while investment opportunities remain constant, there is a positive correlation between cash availability and share buybacks.

According **to the corporate governance theory** supported by Lee et al. (2007), managers could utilize buybacks as a means of taking advantage of favourable market conditions. This hypothesis is based on the premise that managers can profitably use the insider knowledge to effectively purchase undervalued shares.

Barclay and Smith (1988) were the first to examine the connection between liquidity and share buybacks (so-called liquidity hytphothesis); However, Brockman et al. (2008) that discovered a positive correlation between the two. These research findings indicate that companies with more liquidity - that is, those with more liquid financial resources - are also more inclined to repurchase shares rather than pay dividends.

None of the hypotheses reported above has been identified unanimously by the literature as the sole determinant of share repurchase by companies. Dittmar (2000) discovered that, of all the theories, stock undervaluation is the main factor influencing US companies' share repurchase decisions, with surplus capital theories as the second determinant. According to Jagannathan and Stephens (2003), the rationale behind carrying out a share repurchase could differ based on how frequently the companies engage in share repurchases. In their report, they provide evidence that big businesses with stable operational income that use share buybacks primarily as a substitute of dividends to shareholders are the ones who repurchase shares on a regular basis. Conversely, stock undervaluation serves as the main driving force behind buybacks by smaller and less organised companies that repurchase shares occasionally. Backer et al. (2003) tested five hypotheses, i.e., signaling, agency cost of free cash flow, capital market allocations, tax-motivated substitutions for dividends, and capital structure adjustments, and found that

undervaluation is the most important motive behind repurchases, followed by a lack of investment opportunities. When Li and McNally (2007) examined a few Canadian companies to test their theories, they discovered that firms are more likely to buyback their shares if they have higher free cash flow, a lower market-to-book ratio, a negative return before an announcement, and insider holdings. Thus, in Canada, firms are motivated to do share buybacks mainly by the agency hypotheses, followed by undervaluation hypotheses.

Benhamouda and Watson (2010) investigated UK open market repurchase decisions' affecting factors. The analysis discovered that the driving forces for share repurchases are surplus capital and substitution assumptions. The stock option theory is not supported by this study.

In their analysis of a sample of Australian businesses, Farrugia et al. (2011) looked at the connection between the quantity of share repurchases and the location of the companies' headquarters. In comparison to poorer places, they discovered that share buyback schemes are positively and statistically significant in wealthy communities. Additionally, they stated that companies that made frequent buybacks had better returns overall throughout the business cycle than companies that made fewer buybacks.

According to Andriosopoulos and Hoque (2013), for companies with headquarters in nations like the UK, Germany, and France, the choice to repurchase shares is mostly explained by the firm's size, cash dividend, and ownership structure concentration. The study's findings indicate that announcements of share buybacks are more common among large, widely owned companies. In the UK and Germany, they also discovered a positive correlation between dividend payments and share repurchases.

Yarram (2014) investigated a number of variables affecting open market repurchases in Australia. The study's findings support the agency, leverage, and signaling theories while it contradicts the surplus cash flow and substitution hypotheses.

In order to ascertain the variables impacting buyback decisions in Taiwan, Chung et al. (2013) examined the signaling, free cash flow, management incentives, leverage, substitution, and moral hazard hypotheses. The analysis discovered that

only two of the aforementioned theories - signaling and free cash flow - have a substantial impact on share buyback decisions.

The relationship between share buybacks and the target capital structure of the companies was examined by Bonaime et al. (2014). The researchers discovered that the firms add greater value through share buybacks when they are both underleveraged and undervalued, out of the four combinations of target capital structure and mispricing (underleveraged/undervalued, underleveraged/overvalued, over-levered/undervalued, and over-levered/overvalued).

A different line of inquiry that concentrated specifically on the effects of share buybacks on liquidity was conducted by Singh et al. (1994), Wiggins B. (1994), Miller and McConnell (1995), Franz et al. (1995), Brockman & Chung (2001), Ahn et al. (2001), Cook et al. (2004), Ginglinger and Hamon (2007), Ridder and Råsbrant (2009), McNally and Smith (2011), De Cesari et al. (2011). It is outside the scope of this study to discuss the results of these research.

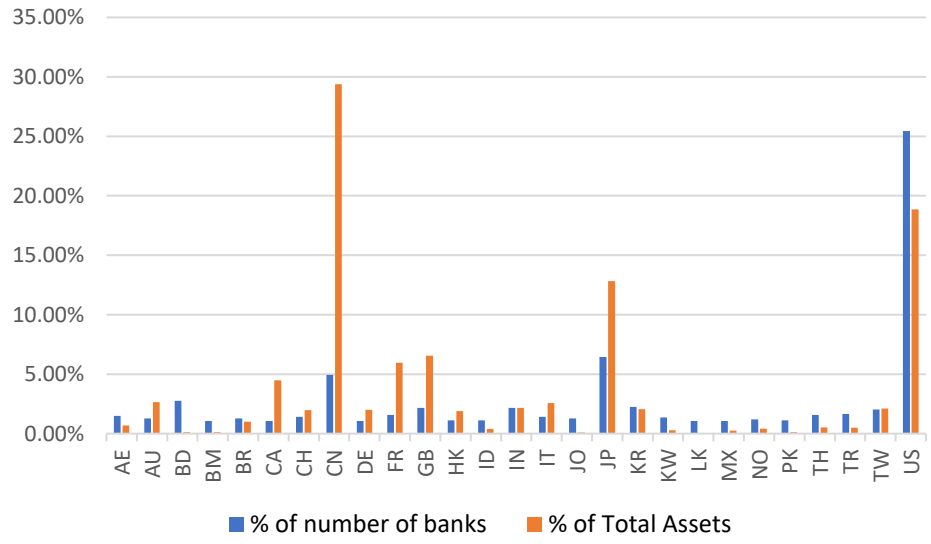
2.2 Share buybacks in banks

The limited number of studies on banks' share buybacks address a variety of topics. Share repurchases were found to be positively correlated with the financial performance of the US bank holding companies (Federal Reserve Bank of New York, 2003). A different study (Federal Reserve Bank of New York, 2014) showed that during a financial crisis, bank share repurchase programs typically decrease in comparison to dividend payments. Nevertheless, other studies found conflicting evidence with the results shown above. A study that looked at the US banking industry (Raghavan & Morris, 2005) did not find any proof that there was a signaling effect on banks. More precisely, the analysis demonstrates that share repurchases are not associated with better future results for the banks that carry out these initiatives. Similar findings were made by Howe & Jain (2006), who examined a sample of US bank holding companies between 1994 and 1998 discovered that share repurchases and capital ratios had a negative relationship (i.e., bank share repurchases programs trigger a decrease in capital ratios); however, they also found evidence of a positive relationship between share repurchases and industry-adjusted ROA in the two years that followed the announcement.

3. Dataset and statistics

The dataset, which was taken from BankScope, contains financial and economic data on 1336 global banks for the years from 2015 to 2021 (yearly data). It includes all the institutions that are available and that the provider has classified as banks during the period under observation. Using data from 2021, the chart below illustrates the geographic distribution of the banks by country of origin, taking into account both the total assets and the number of institutions in the dataset.

Figure 1: Breakdown by country of origin and total assets of the banks in the dataset



Source: internal elaboration on the data

For the sake of clarity, all the countries nations with a share of banks stake below one percent have been excluded from the dataset. None of the banks that were included by default in the dataset have been excluded from the analysis. A little over 25% of the banks in the dataset have their headquarters in the United States (25.45%). Japan and Canada are the next two most represented countries, with 6.44% and 4.94% of the total number of banks in the dataset, respectively. When looking at the total assets of the banks in their respective jurisdictions, these same countries are more represented (Canada being the first with roughly 29.38% of the total TA in the dataset, followed by the US with 18.86% and Japan with 12.82%). All the years up until the most recent one (2021), when the total number of banks

dropped to 1335, the number of institutions was constant. The table below includes information on the number of banks as well as descriptive statistics on the key indicators.

Table 1: descriptive statistics of the sample

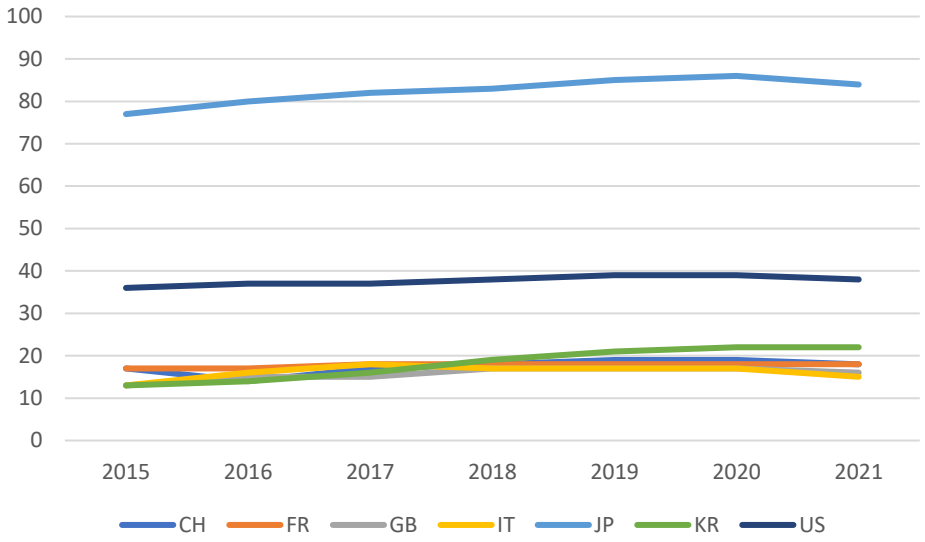
	2015			2016			2017			2018			2019			2020			2021		
	Obs.	Mean	MED	Obs.	Mean	MED	Obs.	Mean	MED	Obs.	Mean	MED	Obs.	Mean	MED	Obs.	Mean	MED	Obs.	Mean	MED
Op. Rev (USD mln)	1305	2,550	320	1329	2,511	331	1335	2,783	377	1332	2,807	380	1334	2,936	402	1335	2,996	419	1315	3,247	455
P&L before tax (USD mln)	1305	749	91	1329	743	94	1335	861	112	1332	892	105	1334	895	116	1335	711	90	1315	1,130	144
NI (USD mln)	1305	579	68	1329	554	71	1335	632	80	1332	707	83	1334	713	90	1335	572	68	1315	907	108
TA (USD mln)	1305	74,879	6,534	1329	76,578	6,892	1335	84,955	7,759	1332	86,001	7,814	1334	89,592	8,628	1335	102,364	9,751	1315	110,022	10,600
Equity (USD mln)	1305	5,950	819	1329	6,089	883	1335	6,845	989	1332	6,953	1,018	1334	7,390	1,098	1335	8,002	1,165	1315	8,698	1,241
Own shares (USD mln)	333	156	10	343	196	11	357	222	15	375	248	14	388	270	14	389	298	15	373	362	14
Number of Employess	1070	11,246	1,794	1080	11,647	1,790	1087	11,682	1,829	1075	11,670	1,963	1090	11,462	2,054	1107	11,445	2,114	1106	11,829	2,127
NPL ratio	1079	4.15%	1.40%	1110	4.46%	1.40%	1116	4.13%	1.35%	1132	4.16%	1.34%	1148	4.59%	1.45%	1142	4.70%	1.54%	1122	4.51%	1.35%
T1 Ratio (%)	824	14.27	12.89	843	14.52	13.10	875	14.64	13.44	886	14.81	13.43	892	15.28	13.86	861	15.73	14.26	835	15.97	14.37
TC lRatio (%)	978	18.84	15.03	997	18.56	15.12	1020	19.31	15.30	1019	18.64	15.35	1018	19.18	15.69	992	19.93	16.10	964	20.06	16.08
ROE (%)	1305	10.32	9.89	1329	9.08	9.58	1335	10.05	9.55	1332	8.70	9.96	1334	11.27	9.75	1335	7.84	7.83	1315	4.67	10.68
Cost/Income (%)	1293	60.59	59.45	1317	59.13	58.87	1323	58.94	58.82	1323	60.59	59.02	1324	54.43	58.56	1326	65.10	58.23	1306	58.79	56.67
RWA/TA	865	55.16%	53.49%	891	44.15%	55.06%	924	45.59%	56.09%	931	46.16%	56.47%	933	46.03%	55.87%	907	41.55%	50.07%	878	39.32%	45.25%

Source: internal elaboration on the data

The operating revenues of the banks in the sample increased gradually during the course of the analysed period, as shown in the table above. Comparable patterns might be seen with the other profitability indicators displayed. It is crucial to emphasize that the COVID-19 pandemic lead to a sharp decrease of the average net income in 2020. Similarly, between 2019 and 2020, the average NPL ratio rose substantially. The favourable increasing trends of all the key indicators (total capital ratio, T1 capital ratio, and equity in USD) underscore the banks' general improvement in capital position over the observed period. This is consistent with the BIS's results, which demonstrate the enhanced resilience of the global banking sector given by the improved levels of higher-quality capital. The dataset's ROE mean value, which gauges overall profitability, fluctuated greatly over time, bottoming out at 4.67% in 2021. However, the existence of outliers in the sample significantly skews the data. Therefore, the ROE's median value is a more appropriate metric to evaluate how the banks' profitability changed in the period between 2015 and 2021. From 2015 to 2020, median return on equity (ROE) of the banks' in the dataset remained flat at approximately 10%. The median ROE for 2020 was significantly lower and equal to 7.83%. The overall negative trend and the fall in profitability in 2020 highlight the impact of the COVID-19 pandemic on the banking industry and the economy as a whole. The average total assets of the banks in the dataset increased from roughly 74 billion to 110 billion USD during the period under observation.

The value of the shares that the bank owns and keeps in its portfolio is shown by the own shares variable. Repurchases of stocks by the bank result in an increase of this variable. Because it is measured in US dollars, the variable is rather volatile. The values for this variable are either positive or zero, if the bank did not repurchase any shares. The countries with the highest number of share repurchases throughout the observation period are shown in the chart below.

Figure 2: Number of share buybacks done per country over the period under observation



Source: internal elaboration on the data

The high number of share repurchases in some countries (as for example Japan) could be explained by different reasons such as a more favourable fiscal or regulatory treatment of this form of shareholders' remuneration over other payout methods (as for example dividends) or also by the preference of the shareholders for this specific form of payout. Furthermore, the steady trend of share buybacks seen in all countries over the observation period supports the assumption that share buybacks are a widely used payout method in some jurisdictions.

The values of the main metrics (such as for instance operating revenues and P&L before tax) of the banks in the dataset are denominated in USD.

4. Analysis

4.1 Empirical results

This paper's primary goal is to evaluate the validity of the signalling hypothesis for bank share buybacks. This theory serves as one of the primary justifications for the choice made by top executives to repurchase shares, as can be shown in section 2.

In order to test this theory, we make the assumption that there should be a connection between the bank's share repurchase program and future profitability if top executives, who possess

insider knowledge of the bank's prospects, believe the stock is undervalued. As a result, we evaluate the correlation between the higher profitability as shown by the ROE and the share buybacks (the "Own shares" variable). In the past, several authors in the economic literature have measured the effect of share repurchases on bank performance using the return on equity (ROE) (Hirtle, 2003).

4.2 Linear regression models

We first test the relationship between the share buybacks and the increased profitability as measured by the ROE by using a simple linear regression model. The variable increase in own shares was created as a dummy variable assuming a value of 1 in cases in which the difference between the own shares value increased in any of the years in the period under observation and 0 in cases in which the value remained constant (or in cases the value decreased, suggesting a reduction of the own shares held in the bank's portfolio). For banks not displaying any value for the own shares variable it was assumed that they did not implement any buybacks operation in the period under analysis. Notwithstanding the possibility that the bank not reporting information might have carried out a share repurchase in the period under observation, we assumed that this was the given the prescriptiveness of financial disclosure on share buybacks in most of the jurisdictions under analysis.

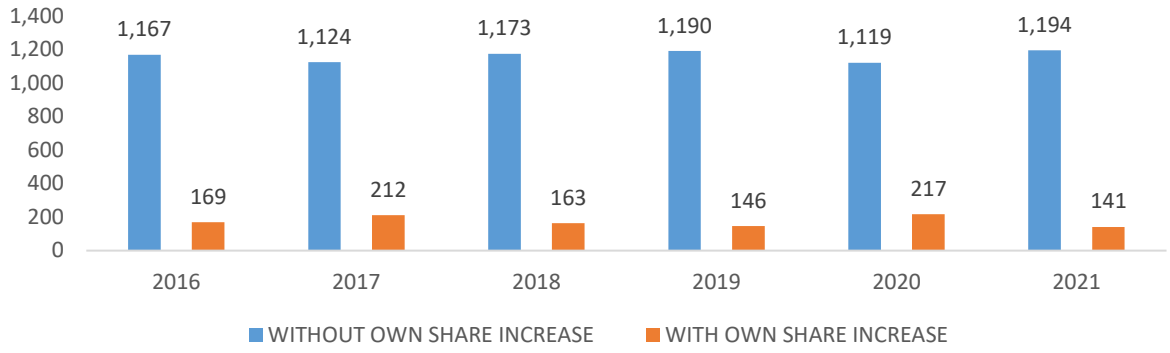
To test the hypothesis, we used the following simple linear regression model with one binary categorical independent variable:

$$(1)\ Y = a + \beta_i X_i + \varepsilon_i$$

We run a first regression using as dependent variable (Y) the ROE of year 2021 and as independent variable (X) the growth on own shares over the time period analysed (i.e. 2015 to 2021). Variable (X) has been defined as a dummy variable assuming a value of 1 in cases in which the bank realised a buyback operation in any of the years of the time period under analysis and 0 if not (as stated above, for banks not displaying any value of own shares it has been assumed that no buyback operation was implemented over the time period analysed).

The chart below shows the number of banks that reported own share increases (that is also a proxy of the buyback operations realised) and those that did not, in any of the years of the time period under analysis.

Chart 1: Number of banks that reported own share increases in any of the years (2015-2021)



Source: internal elaboration on the data

The reason for using the ROE as a relevant metric to measure the profitability performance, instead of using other metrics (such as for instance the net income or operating income) of the bank stems from two reasons: 1) the simplicity and concurrent relevance of this indicator for investors that use it as a hurdle rate when deciding on potential investment opportunities; 2) the neutrality of the indicator (i.e. potential distortions arising from the translation of the balance sheet of non-US banks in USD are neutralised by using a ratio rather than an absolute value). The use of risk adjusted metrics (that are indeed more relevant in case of banks), such as for instance RARORAC, would have entailed the use of internal data of banks not readily available in public databases. Therefore, we decided to use ROE as a proxy of the profitability of the banks conscious of the limitations of this indicator.

In order to neutralise the impact of the outliers on the sample of data the observations falling within the first and last percentile of the distribution have been excluded from the analysis.

The results of the regression model are shown below.

Table 2: results of the first simple linear regression model

The REG Procedure
Model: MODEL1
Dependent Variable: ROE_PERC

Number of Observations Read	1315
Number of Observations Used	1315

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2.10745	2.10745	0.48	0.4899
Error	1313	5801.48967	4.41850		
Corrected Total	1314	5803.59712			

Root MSE	2.10202	R-Square	0.0004
Dependent Mean	0.04665	Adj R-Sq	-0.0004
Coeff Var	4505.90612		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.02207	0.06802	0.32	0.7456
FLAG_OWN_SHARES_PER_REGRESSION	1	0.08978	0.13000	0.69	0.4899

Source: internal elaboration on the data

The low value of the Adjusted R-Square (-0.0004) underscores that the model accuracy is rather low. Furthermore, by looking at the p-value of the variable we can indeed conclude that the variable is not significant for any level of confidence chosen. Put it in other words, the independent variable (buyback operations in any of the years from 2015 to 2021) is not significant in explaining the variance of the dependent variable (ROE in 2021). Thus, the conclusion of this first simple linear regression is that there is no linear relationship between the two variables.

Given the results of the first regression model we decided to run a second simple regression model defined as follows:

$$(2)\ Y = a + \beta_i X_i + \varepsilon_i$$

As opposed to the first linear regression model the independent variable (Y) is the average ROE over the time period analysed (i.e. 2015 to 2021) while the dependent variable (X) is the same used in the previous model, growth on own shares over the time period analysed.

The results of the second linear regression model are shown below.

Table 3: results of the second simple linear regression model

The REG Procedure
Model: MODEL1
Dependent Variable: ROE_PERC_AVG

Number of Observations Read	1337
Number of Observations Used	1337

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.00209	0.00209	0.01	0.9029
Error	1335	187.69799	0.14060		
Corrected Total	1336	187.70008			

Root MSE	0.37496	R-Square	0.0000
Dependent Mean	0.08606	Adj R-Sq	-0.0007
Coeff Var	435.68381		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.08683	0.01203	7.22	<.0001
FLAG_OWN_SHARES_PER_REGRESSION	1	-0.00281	0.02302	-0.12	0.9029

Source: internal elaboration on the data

As for the first model the adjusted R-Square the model accuracy is rather low (equal to -0.0007 or -0.007%). Moreover, as for the first model, the p-value of the dependent variable leads us to the conclusion that the dependent variable included in this simple regression model is not significant for any level of confidence chosen. Also in this case, we can conclude that there is no linear relationship between the two variables of the model.

4.3 Conclusions on the linear regression models

The results of the linear regression models analysis performed provide evidence of no significant linear relationship between the profitability of banks and share buybacks.

However, the poor accuracy of the linear regression models (as measured by the R squared) estimated clearly originate from a number of limitations of this statistical methodology. More specifically, these simple linear regression models do not take into account the potential contribute of other variables to the explanation of the variability of the dependent variable (in

this case the ROE); they do not take into account time lags to properly consider changes (positive or negative) of the ROE that occurred in the periods before and after the share buybacks; the linear regression models estimated do not investigate the potential relationship between the share buybacks and other profitability indicators; finally, the use of linear regression model can lead to the biased estimators. Due to the limitations of the estimated models, we decided to run two panel regression analyses to overcome at least some of the limitations emerged and to further investigate the relationship between banks' profitability and share buybacks.

4.4 Panel regression model analysis

In model 1 we estimate a panel regression. The panel is unbalanced since not all the financial firms in each country have been trading continuously from 2015 to 2021.

We run the following panel regression model:

(3) $ROE_{i,t} = \alpha_i + \sum_{i=1}^{n} \beta_{i,t} X_{i,t} + \beta_{i,t} Own\ shares_{i,t-1} + \sum_{i=1}^{n-1} Firm_i + \sum_{j=1}^{m-1} Time_j + \varepsilon_{i,t}$

ROE is the return on equity, own shares is the annualized share buyback, and X is a (n x 1) vector of firm-specific variables chosen by constructing a model that returns the greatest Akaike information criteria. The model incorporates firm and time dummies to account for the distinct fixed firm and temporal effects, respectively.

Table 4: Panel regression results.

Dependent Variable	ROE					
Own shares	0.096*	0.0089*	0.0121	0.0095*	0.0035	0.0033*
RWA/Total Assets		-0.1253***	-0.1432***	-0.0587*	-0.0955*	-0.08112*
Market Capital		5.8136***	4.5229***	4.7628***	4.2269***	
Cost/Income			-0.2522***	-0.0373***		
Number of Employees				-0.0069	-0.0065	-0.0015
Tier 1 Ratio					0.0727**	0.0061*
Dividend Payout					0.0079	
Earnings per share						0.0274**
Dividend per share						-0.0087
Book value per share						0.0137
adj. R squared (%)	2.76	9.06	21.92	23.87	26.12	29.79

This table presents the panel regression coefficients from model 1. All the variables are taken at a annual frequency. All equations are estimated with firm and time fixed effects. Intercept results are not reported for the sake of space.

Table 2 presents the first panel regression model's estimates. The table illustrates that in three instances, the variable "own shares" has a positive, albeit low, impact on ROE. This first result stands in stark contrast to the analysis's findings from the preceding section. Upon examining the remaining outcomes displayed in the table, we can infer that, with the exception of two scenarios, the variable own share is significant at a 10% level of confidence, implying a weak statistical association.

The calculated coefficient, starting from the left of the table, shows that the ROE (measured in percentage points) rises by 0.0096 for every additional unit of "own shares." However, given that it equals 2.76%, the corrected R-squared displayed at the bottom of the table indicates that the model's explanatory ability is very constrained. The "own shares variable" has a positive effect on the ROE, as can be seen on the left side of the table when other factors are added to the model. More precisely, each unit increase in "own shares" results in an increase of the ROE equal to 0.0033 when all other variables remain constant. The addition of additional variables to the model resulted in a significant improvement in the adjusted R-squared in this instance, which equals 29.79%).

Since a buyback performed in t − 1 could also affect the ROE, we run also model 2:

$$(4)\ ROE_{i,t} = \alpha_i + \sum_{i=1}^{n} \beta_{i,t} X_{i,t} + \beta_{i,t} Own\ shares_{i,t} + \sum_{i=1}^{n-1} Firm_i + \sum_{j=1}^{m-1} Time_j + \varepsilon_{i,t}$$

The estimates of this new panel regression model are reported in Table 5.

Table 5: Panel regression results.

Dependent Variable	ROE					
Own shares at t-1	0.0012	0.0011	0.0009	0.0010	0.0011*	0.0010*
RWA/Total Assets		-0.1067***	-0.1080***	-0.1422***	-0.1783***	-0.1496***
Market Capital		5.0168***	5.2337***	4.3261***	5.8806***	
Cost/Income			-0.1686***	-0.1602***		
Number of Employees				-0.0017	-0.0044	-0.0011
Tier 1 Ratio					0.0014***	0.0007***
Dividend Payout					0.0036	
Earnings per share						0.0348***
Dividend per share						-0.0071
Book value per share						-0.0015
adj. R squared (%)	1.23	3.92	5.83	9.02	12.07	13.45

This table presents the panel regression coefficients from model 1. All the variables are taken at a annual frequency. All equations are estimated with firm and time fixed effects. Intercept results are not reported for the sake of space.

The findings displayed in the above table demonstrate that the "own shares at t-1" variable is significant in just two cases, even when accounting for a 10% confidence level (the final two columns in the left-hand side of the table). Market capital, cost/income, and RWA/total assets are the additional variables taken into account in both models. Assuming all other variables remain constant, the computed models indicate that a unit change in "own shares at t-1" will have an impact on the ROE of 0.0011 and 0.0010, respectively. When compared to the models in table 4, the models' explanatory power appears to be somewhat limited, as seen by the low values of the R-squared adjusted displayed at the bottom of the table. Furthermore, we may determine that the model's estimates are accurate by examining the coefficients of the other variables. For example, the variable "RWA/total assets" was shown to be significant (at a 1% level of confidence) and to negatively impact the ROE in each regression model that was calculated. This is consistent with the economic literature, which suggests that an increase in RWA/total assets (i.e., the riskier assets) will increase the bank's capital requirement, probably result in a reduction in the quality of the assets it holds on its books, and worsen ROE.

4.5 Conclusion on the panel regression model analysis

Considering the poor results obtained through the estimation of the simple regression models stemming from the limitations that have been highlighted in paragraph 4.2, we decided to estimate a panel regression model. The first panel regression model estimated considered the

annualised share buyback as a variable in the model. Interestingly the results obtained, in contrast with those obtained in the simple linear regression models estimated (see paragraph 4.1), showed a positive albeit low impact of these variable on the ROE of the banks (the variable was positive in all but two cases, see table 4, considering a 10% level of confidence). Interestingly, the second panel regression model, where the own shares value at time t-1 was used in the estimation of the model, show a positive and low impact of these variable only in one case (see table 5). This finding seems to suggest that the ROE of a bank in a given year is positively influenced by the share buybacks implemented by the bank during the same year. Conversely such relationship, despite being positive, is less material if the own shares at time – 1 is considered. The estimated coefficients for both panel regression models are consistent with the reality.

5. Summary

Share repurchases, or share buybacks, have gained popularity as a capital management strategy in the banking industry.

This study aimed at providing an overview of the share repurchases practices in the banking industry, along with an empirical analysis of the effects of buybacks on profitability and shareholder value creation. Share buybacks can indeed benefit shareholders, but their improper use can also pose threats to the stability of the financial system. One reason of concern is that buybacks may be used as a tool for leverage management as the managers could use it as a tool to increase the bank's debt-to-equity ratio. This, in turn, may expose the bank to financial difficulties in the event of a downturn in the economy or other unfavourable circumstances. Buybacks may also reduce the cash available for investments or acquisitions, which may hinder a bank's capacity to adapt to shifting market conditions.

Buybacks could be used to the benefit of shareholders as they raise earnings per share (EPS) and signal confidence to the market. In particular, an increase in EPS is triggered by the reduction of the number of outstanding shares, which can improve shareholders' value. Similarly, buybacks may signal to the market that the bank's management believes that its stock is undervalued, which could eventually lead to an increase in the price of the company's stock. Other reasons that may lead to the decision of the management to buy back shares is protection from hostile takeovers or returning excess cash to shareholders.

Share buybacks in banks have been strictly regulated in most jurisdictions due to the risks they can pose to the stability of the financial system. The Federal Reserve of the United States, for instance, has established a set rules governing share buybacks, which include stress-testing requirements and restrictions on the amount of money that can be distributed to shareholders. Moreover, share buybacks are also covered by specific requirements in the Basel III regulatory framework. According to these rules, banks must maintain a certain level of capital in order to implement a share repurchase program while duly considering the impact of such a program on its capital position.

This article examined the possible effects of share buybacks on banks' financial performance as measured by the ROE. The ultimate goal was to test the validity of the signalling hypothesis that has been presented in the economic literature. Our research found inconsistent results. By applying a simple regression model, we found no evidence of significant linear relationship between share repurchases and the ROE of a bank. Considering the limitations of such a statistical methodology, and attempting to overcome them, we decided to estimate two panel regression models. In the first one we assessed the impact of the share repurchases (as measured by the variable own shares in t), performed by the bank any given year of the period under observations, on the ROE of the same banks for the same year. In the second one, we used a lagged variable, own shares in t-1, to estimate the impact of share repurchases performed the year before on the ROE of the banks. We found positive albeit low linear relationship between the ROE of the banks and their share buyback programs. Interestingly, a stronger evidence of such relationship has been found between the ROE and the share repurchases performed the same year.

We can therefore conclude that the results of our analysis only partially support the evidence of a relationship between the share repurchases and the long-term profitability of banks. Similarly, the study found no supporting evidence to confirm or challenge the signalling hypothesis that has been presented in the economic literature.

Further studies could leverage on this analysis and asses the relationship between long-term value creation and share repurchases by expanding the time period of analysis (i.e. enlarging the dataset) or using a more suitable statistical technique.

Conclusions

The integration of the ESG principles in the banking processes has increasingly been the focus of recent studies in the economic literature and attracted the attention of the regulators and the wider public. This work aimed at contributing to the existing knowledge on these aspects by: i) defining the current regulatory framework at EU level underpinning the integration of the ESG principles in banks' processes; ii) laying down a set of principles that could be helpful in determining a robust climate risk stress test model for banks, and iii) investigating the long-term impact of the share repurchases programmes performed by banks.

EU regulators have substantially improved the framework governing the integration of ESG principles in banking processes in recent years as public opinion has been focusing on these aspects. Among the most relevant initiatives that have been undertaken are: the introduction of the taxonomy regulation; the non-financial reporting directive (NFRD), the changes introduced by the review of the capital regulation requirements (so-called CRR2), and the financial services sustainability disclosure regulation (SFDR). Substantial efforts have thus been targeted at improving the transparency as well as the reporting framework for banks on these aspects as the main objective of the EU regulators is the build-up of a robust dataset that could help analysing and governing these new sources of risks.

The recent severe weather events (i.e. wildfires, droughts and floods) that have scourged European countries over the recent years, have also made clear that EU Regulators and Supervisors need to act fast to ensure the resilience of the financial system against these natural phenomena. Thus, alongside the efforts put in strengthening the Pillar 1 prudential framework (i.e. review of the CRR) that will likely take time to be successfully implemented, it is important that some targeted and dedicated initiatives will be put in place immediately by the EU Regulators and Supervisors. Among them the definition of a robust climate risk stress testing framework (the EBA and the ECB and other supervisory authorities already started some pilot exercises) to assess the preparedness of banks to manage climate risks. The second paper, thus focusing specifically on the "E" of the ESG principles, lays down a set of policy principles aimed at supporting the creation of a robust climate risk stress test framework in banks. The paper does not clearly define a specific model, albeit different theoretical models have been proposed by the Supervisor Authorities carrying out their pilot exercises, as we believe that considering the lack of reliable data it is premature to focus on the modelling side. Through the build-up of a reliable dataset, through the initiatives that have been launched at

EU level (i.e. those that have been mentioned in the previous paragraph), it will be possible to create such models. Hence, future works, leveraging on the set of high-level principles laid down in our work, could contribute to the existing knowledge by developing dedicated climate risk stress testing models.

Another widely debated topic in the economic literature is the one related to the share repurchases. It is a widely used method of shareholder retribution but the academic studies have also highlighted potential shortcomings to this practice. More specifically, it has been claimed that the share repurchases could be detrimental for banks due to the potential for increasing the leverage (BCBS). Another study by the SEC, the US market regulator, found an interesting correlation between the vesting period of the managers' stock option plans and the timing of the share repurchases in banks. In essence, according to the results of the analysis, share buybacks are realised by the managers as a way to cash out their own remuneration packages. Drawing on these studies, our paper focuses on investigating the relationship between share buybacks and long-term value creation for investors as measured by the return on equity (ROE). The potential incentive for managers to cash out their remuneration could in fact be to the detriment of long-term value creation for shareholders. This paper, by analysing the potential for misbehavior by managers is related to the "G" of the ESG principles. Interestingly, our analysis, conducted on a sample of worldwide banks, found a weak albeit positive correlation between share repurchases and the banks' financial performance. Future studies could confirm or challenge these results by enlarging the sample of banks in scope or by lengthening the timespan of analysis.

As a matter of fact, the economic literature on ESG principles is extremely diverse. This is indeed shown also by this study that relates climate risk stress tests and share buybacks in banks as both of them fall under the ESG principles umbrella. The diversity of the topics covered by ESG principles raises the question on the effectiveness of the current framework that brings together these different sources of risks. Should Prudential Regulators focus on all the three areas or should perhaps focus on those that could be properly measured (as for instance climate risk)? As a matter of fact, ESG ratings, as compared to credit ratings, attributed by the ESG rating agencies to the same issuer diverge significantly. This is indeed related to the different weights that the agencies assign to the three factors (Environment, Social and Governance). The lack of an unambiguous way of measuring the risks to which a credit institution is exposed to, compounds the efforts of the banking Prudential Regulators whose main objective is to work on the creation of an empirical-based regulatory framework. Further works, leveraging on the

dataset that are about to be built by the banks, could investigate the need for prudential regulators to focus the attention on any of the ESG principles rather than bringing these three principles together and treating them as a new “single” factor of risk.

References

- ACPR (2020). “Scenarios and main assumptions of the ACPR pilot climate exercise”. Technical report, Autorité de contrôle prudentiel et de resolution;
- ACPR (2021). “A first assessment of financial risks stemming from climate change: The main results of the 2020 climate pilot exercise”. Technical report, Autorité de contrôle prudential et de resolution;
- Ahn, H. J., Cao, C., and Choe, H. (2001). “Share repurchase tender offers and bid–ask spreads”. Journal of banking & finance, 25(3), 445-478. http://dx.doi.org/10.1016/S0378-4266(00)00084-4;
- Alogoskoufis, S., Dunz, N., Emambakhsh, T., Hennig, T., Kaijser, M., Kouratzoglou, C., Muñoz, M. A., Parisi, L., and Salleo, C. (2021). “ECB economy-wide climate stress test: methodology and results”. Number 281. ECB Occasional Paper;
- Andriosopoulos, D., and Hoque, H. (2013). “The determinants of share repurchase in Europe”. International Review of Financial Analysis, 27, 65-76. http://dx.doi.org/10.1016/j.irfa.2012.12.003;
- Aramonte, S. (2020). “Mind the buybacks, beware of the leverage”. BIS Quarterly review.
- Bagwell, L.S. (1991). “Share repurchase and takeover deterrence”. The RAND Journal of Economics, 72-88. http://dx.doi.org/10.2307/2601008;
- Bagwell, L.S. (1992). “Dutch auction repurchases, An analysis of shareholder heterogeneity”. The Journal of Finance, 47(1), 71-105. http://dx.doi.org/10.1111/j.1540-6261.1992.tb03979.x;
- Bagwell, L.S., and Shoven, J.B. (1988). “Share repurchases and acquisitions: An analysis of which firms participate. In Corporate takeovers: Causes and consequences”. University of Chicago Press, pp. 191-220;
- Baker, H.K., Powell, G.E., and Veit, E.T. (2003). “Why companies use open-market repurchases: A managerial perspective”. The Quarterly Review of Economics and Finance, 43(3), 483-504. http://dx.doi.org/10.1016/S1062-9769(02)00151-5;
- Bank for International Settlements (2017). “Supervisory and bank stress testing: range of practices”. Technical report;

- Bank for International Settlements (2021). “Stress-testing banks for climate change – a comparison of practices”. Technical report;
- Bank of England (2021). “Key elements of the 2021 biennial exploratory scenario: Financial risks from climate change”. Technical report, Bank of England;
- Bank of England (2022). “Results of the 2021 climate biennial exploratory scenario (cbes)”. Technical report, Bank of England;
- Barclay, M. J., and Smith, C.W. (1988). “Corporate payout policy: Cash dividends versus open-market repurchase”. Journal of Financial Economics, 22(1), 61-82. http://dx.doi.org/10.1016/0304-405X(88)90022-0;
- Bartov, E. (1991). “Open-market stock repurchases as signals for earnings and risk changes”. Journal of Accounting and Economics, 14(3), 275-294. http://dx.doi.org/10.1016/0165-4101(91)90015-G;
- Basel Committee (2021). “Climate-related risk drivers and their transmission channels”;
- Batten, S., Sowerbutts, R. and Tanaka, M., (2020). “Climate change: Macroeconomic impact and implications for monetary policy”, Book chapter in: Ecological, Societal, and Technological Risks and the Financial Sector, Bank of England;
- Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., and Visentin, G. (2017). “A climate stress-test of the financial system”. Nature Climate Change, 7(4):283–288;
- Battiston, S., Monasterolo, I., Riahi, K., and van Ruijven, B. J. (2021). “Accounting for finance is key for climate mitigation pathways”. Science, 372(6545): 918–920;
- Baudino, P., Goetschman, R., Henry, J., Taniguchi, K., Zhu, W. (2018). “Stress-testing banks – a comparative analysis”. FSI insights, no. 12;
- Bauer, R., and Hann, D. (2010). “Corporate Environmental Management and Credit Risk”. ECCE Working Paper. University of Maastricht, The European Centre for Corporate Engagement;
- Benhamouda, Z., and Watson, R. (2010). “A research note on the determinants of UK corporate share repurchases decisions”. Applied Financial Economics, *20*(7), 529-541. http://dx.doi.org/10.1080/09603100903459857;
- Bens, D.A., Nagar, V., Skinner, D.J., and Wong, M. F. (2003). “Employee stock options, EPS dilution, and stock repurchases”. Journal of Accounting and Economics, 36(1), 51-90. http://dx.doi.org/10.1016/j.jacceco.2003.10.006;

- Bhattacharya, S. (1979). "An exploration of no dissipative dividend-signalling structures". Journal of Financial and Quantitative Analysis, 14(04), 667-668. http://dx.doi.org/10.2307/2330441;
- Bikakis, A. (2020). "Climate change, flood risk, and mortgages in the UK: a scenario analysis". New School Economic Review, 10(1);
- Boldin, M., and Wright, J. H., (2015). "Weather adjusting economic data", Brookings Papers on Economic Activity, Fall, 227-274;
- Bolton, P., Despres, M., Da Silva, L.A.P., Samama, F., and Svartzman, R. (2020). "The green swan". BIS Books;
- Bonaimé, A.A., Öztekin, Ö. and Warr, R.S. (2014). "Capital structure, equity mispricing, and stock repurchases". Journal of Corporate Finance, 26, 182-200. http://dx.doi.org/10.1016/j.jcorpfin.2014.03.007;
- Boudry, W.I., Kallberg, J.G., and Liu, C.H. (2013). "Investment opportunities and share repurchases". Journal of Corporate Finance, 23, 23-38. http://dx.doi.org/10.1016/j.jcorpfin.2013.07.006;
- Brammer, S., Brooks, C., and Pavelin, S. (2006). "Corporate social performance and stock returns: UK evidence from disaggregate measures". Financial Management 35, 97–116;
- Brockman, P., and Chung, D. Y. (2001). "Managerial timing and corporate liquidity: evidence from actual share repurchases". Journal of Financial Economics, 61(3), 417-448. http://dx.doi.org/10.1016/S0304-405X(01)00068-X;
- Brockman, P., Howe, J.S., and Mortal, S. (2008). "Stock market liquidity and the decision to repurchase". Journal of Corporate Finance, 14(4), 446-459. http://dx.doi.org/10.1016/j.jcorpfin.2008.06.001;
- Brogi, M., and Lagasio, V. (2018). "Environmental, social and governance and company profitability: are financial intermediaries different?" in Corporate Social Responsibility and Environmental Management, pp.15-22;
- Cartellier, F. (2022). "Climate Stress Testing, an Answer to the Challenge of Assessing Climate-Related Risks to the Financial System?" SSRN: https://ssrn.com/abstract=4179311 or http://dx.doi.org/10.2139/ssrn.4179311;
- Comment, R., and Jarrell, G. A. (1991). "The relative signaling power of Dutch-auction and fixed-price self-tender offers and open-market share repurchases".

The Journal of Finance, 46(4), 1243-1271. http://dx.doi.org/10.1111/j.1540-6261.1991.tb04617.x;

- Cook, D. O., Krigman, L., and Leach, J.C. (2004). "On the timing and execution of open market repurchases". Review of Financial Studies, 17(2), 463-498. http://dx.doi.org/10.1093/rfs/hhg028;
- De Cesari, A., Espenlaub, S., and Khurshed, A. (2011). "Stock repurchases and treasury share sales: Do they stabilize price and enhance liquidity?" Journal of corporate finance, 17(5), 1558-1579. http://dx.doi.org/10.1016/j.jcorpfin.2011.08.002;
- De Ridder, A., and Råsbrant, J. (2009). "The market liquidity impact of repurchase is trading". Nasdaq OMX website.
- De Sá, M. (2022). "ESG and Banks: Towards Sustainable Banking in the European Union", Springer Books, in: Paulo Câmara & Filipe Morais (ed.), The Palgrave Handbook of ESG and Corporate Governance, chapter 0, pages 375-398, Springer;
- Derwall, J., and Koedijk, K. and Ter Horst, J. (2010). "A Tale of Values-Driven and Profit-Seeking Social Investors". Journal of Banking & Finance, 35, (8), 2137-2147;
- Deryugina, T., and Hsiang, S.M. (2014). "Does the Environment Still Matter? Daily Temperature and Income in the United States." Working paper 20750, National Bureau of Economic Research;
- Dimson, E., Marsh, P., and Staunton, M. (2020). "Divergent ESG ratings". The Journal of Portfolio Management, vol. 47, No. 1, p. 75-87. https://doi.org/10.3905/jpm.2020.1.175;
- Dittmar, A.K. (2000). "Why Do Firms Repurchase Stock?" The Journal of Business, *73*(3), 331-355. http://dx.doi.org/10.1086/209646;
- Engle, R., Brogi, M., Cucari, N., and Lagasio, V. (2021). "Environmental, Social, Governance: implications for businesses and effects for stakeholders". Corporate Social Responsibility and Environmental Management;
- Esteban-Sánchez, P., de la Cuesta-González, M., and Paredes-Gazquez, J.D. (2017). "Corporate social performance and its relation with corporate financial performance: International evidence in the banking industry". Journal of Cleaner Production, volume 162, pp. 1102–1110;
- European Central Bank. Financial Stability Review, November 2020, pp. 94;

- European Commission. Financing a sustainable economy. Final report by the High-level Expert Group on Sustainable Finance, 2018, pp. 6-8;
- Fankhauser, S. and Tol, R.S.J. (2005). "On climate change and economic growth." Resource and Energy Economics, 27, 1–17;
- Farrugia, D., Graham, M., and Yawson, A. (2011). "Economic conditions and the motives for multiple open-market share buybacks". Research in International Business and Finance, 25(2), 156-168. http://dx.doi.org/10.1016/j.ribaf.2011.01.003;
- Federal Reserve Bank of New York (2003). "Stock repurchases and bank holding company performance". Journal of financial intermediation, volume 13, issue 1, pages 28 – 57. https://doi.org/10.1016/S1042-9573(03)00028-7;
- Federal Reserve Bank of New York (2014). "Bank Holding Company Dividends and Repurchases during the Financial Crisis". FRB of New York Staff Report No. 666. http://dx.doi.org/10.2139/ssrn.2423384;
- Fiedler, T., Pitman, A.J., Mackenzie, K., Wood, N., Jakob, C., and Perkins-Kirkpatrick, S.E. (2021). "Business risk and the emergence of climate analytics". Nature Climate Change, 11(2): 87–94;
- Finger, M., Gavious, I., and Manos, R. (2018). "Environmental risk management and financial performance in the banking industry: A cross-country comparison". Journal of International Financial Markets Institutions and Money, volume 52, pp. 240–261;
- Franz, D.R., Rao, R.P., & Triparty, N. (1995). "Informed trading risk and bid-ask spread changes around open market stock repurchases in the NASDAQ market". Journal of Financial Research, 18(3), 311-327. http://dx.doi.org/10.1111/j.1475-6803.1995.tb00569.
- Freeman, R.E. (1984). "Strategic Management: A Stakeholder Approach";
- Friedman, M. A. (1970). "Friedman doctrine: The social responsibility of business is to increase its profits". N. Y Times Mag, in volume 13, pp. 32-33;
- Gábor, G. (2020). "ESG and Bank Regulation: Moving with the Times". Economy and Finance, 7(4), pp. 366-385;
- Ginglinger, E., and Hamon, J. (2007). "Actual share repurchases timing and liquidity". Journal of banking and finance, 31(3), 915-938. http://dx.doi.org/10.1016/j.jbankfin.2006.07.006;
- Gourdel, R. and Sydow, M. (2021). "Bi-layer stress contagion across investment funds: a climate application";

- Grippa, P., Mann, S. (2020). “Climate-related stress testing: Transition risks in Norway”. Working Paper WP/20/232, International Monetary Fund;
- Grullon, G., and Michaely, R. (2004). “The information content of share repurchases programs”. The Journal of Finance, 59(2), 651-680. http://dx.doi.org/10.1111/j.1540-6261.2004.00645.x;
- Grullon, G., and Michaely, R. (2002). “Dividends, share repurchases, and the substitution hypothesis”. Journal of Finance 57.4: 1649–1684;
- Guth, M., Hesse, J., Königswieser, C., Krenn, G., Lipp, C., Neudorfer, B., Schneider, M., and Weiss, P. (2021). “Oenb climate risk stress test–modeling a carbon price shock for the austrian banking sector”. Financial Stability Report, (42):27–45;
- Haw, I. M., Ho, S. S., Hu, B., and Zhang, X. (2013). “Legal Institutions, Ownership Concentration, and Stock Repurchases Around the World: Signal Mimicking?” The International Journal of Accounting, 48(4), 427-458. http://dx.doi.org/10.1016/j.intacc.2013.10.002;
- Hernández, J.R., Miralles-Quirós, M.M., and Miralles-Quirós J.L. (2019). “ESG performance and value creation in the banking industry: international differences”. Sustainability, pp. 8-11;
- Hirtle, B. (2003). “Stock Repurchases and Bank Holding Company Performance”. Federal Reserve Bank of New York.
- Hovakimian, A., Opler, T., and Titman, S. (2001). “The debt-equity choice”. Journal of Financial and Quantitative analysis, 36(01), 1-24. http://dx.doi.org/10.2307/2676195;
- Howe J., and Jain R. (2006). “Share Repurchase Programs by Banks”. Banks and Bank Systems. Volume 1, Issue 2;
- Jagannathan, M., and Stephens, C. (2003). “Motives for multiple open-market repurchase programs”. Financial Management, 71-91. http://dx.doi.org/10.2307/3666337;
- Jensen, M.C. (1986). “Agency cost of free cash flow, corporate finance, and takeovers”. Corporate Finance and Takeovers. American Economic Review, 76(2);
- Jeucken, M. (2010). “Sustainable Finance and Banking: The Financial Sector and the Future of the Planet”. Earthscan Publications, pp. 45-72;

- Jo, H., Kim, H., and Park, K. (2015). “Corporate Environmental Responsibility and Firm Performance in the Financial Services Sector”. Journal of Business Ethics, volume 131, pp. 257–284;
- Jung, H., Engle, R. F., and Berner, R. (2021). “Climate stress testing”. FRB of New York Staff Report, (977);
- Kahle, K.M. (2002). “When a buyback isn’t a buyback: open market repurchases and employee options”. Journal of Financial Economics, 63(2), 235-261. http://dx.doi.org/10.1016/S0304-405X(01)00095-2;
- Keen, B.D. and Pakko, M.R. 2010. “Monetary Policy and Natural Disasters in a DSGE Model.” Federal Reserve Bank of St. Louis, Research Division Working Paper, No. 2007-025D;
- Kern, A., Fisher, P. (2018) “Banking Regulation and Sustainability” SSRN, pp.16-20;
- Konar, S., and Cohen, M. A. (2001). “Does the Market Value Environmental Performance?” Review of Economics and Statistics, 83(2), 281-289;
- Lagasio, V., and Cucari, N. (2019). “Corporate governance and environmental and social governance disclosure: a meta-analytical review”. Corporate Social Responsibility and Environmental Management, vol. 26, p. 701–711, https://doi.org/10.1002/csr.1716;
- Laguir, I.; Marais, M., El Baz, J., and Stekelorum, R. (2018). “Reversing the business rationale for environmental commitment in banking: Does financial performance lead to higher environmental performance?” Management Decision, volume 56, pp. 358–375;
- Lee, B.S., and Suh, J. (2011). “Cash holdings and share repurchases: international evidence”. Journal of Corporate Finance, 17(5), 1306-1329. http://dx.doi.org/10.1016/j.jcorpfin.2011.06.006;
- Li, K., and McNally, W. (2007). “The information content of Canadian open market repurchases announcements”. Managerial Finance, 33(1), 65 80. http://dx.doi.org/10.1108/03074350710715818;
- Louis, H., and White, H. (2007). “Do managers intentionally use repurchase tender offers to signal private information? Evidence from firm financial reporting behaviour”. Journal of Financial Economics, 85(1), 205-233. http://dx.doi.org/10.1016/j.jfineco.2006.08.003;

- Manconi, A. (2018). “Are Buybacks Good for Long-Term Shareholder Value? Evidence from Buybacks around the World”. Finance Working Paper Number 436/2014.
- Mandel, A., Tiggeloven, T., Lincke, D., Koks, E., Ward, P., and Hinkel, J. (2021). “Risks on global financial stability induced by climate change: the case of flood risks”. Climatic Change, 166(1):1–24;
- McNally, W. J., and Smith, B. F. (2011). “A microstructure analysis of the liquidity impact of open market repurchases”. Journal of Financial Research, 34(3), 481-501. http://dx.doi.org/10.1111/j.1475-6803.2011.01299.x;
- Miller, J.M., and McConnell, J.J. (1995). “Open-market share repurchase programs and bid-ask spreads on the NYSE: Implications for corporate payout policy”. Journal of Financial and Quantitative analysis, 30(03), 365-382. http://dx.doi.org/10.2307/2331346
- Mitchell, J. D., and Dharmawan, G. V. (2007). “Incentives for on-market buy-backs: Evidence from a transparent buy-back regime”. Journal of Corporate Finance, 13(1), 146-169. http://dx.doi.org/10.1016/j.jcorpfin.2006.12.002;
- Modigliani, F. and Miller, H.M. (1958). “The cost of capital, corporation finance and the theory of investment”. The American economic review, 48(3), 261-297;
- Nayar, N., Singh, A.K., and Zebedee, A.A. (2008). “Shares repurchase offers and liquidity: An examination of temporary and permanent effects”. Financial Management, 37(2), 251-270. http://dx.doi.org/10.1111/j.1755-053X.2008.00012;
- NGFS (2021). “NGFS climate scenarios for central banks and supervisors”. Technical report, Network of Central Banks and Supervisors for Greening the Financial System;
- Nguyen, Q., Diaz-Rainey, I., Kuruppuarachchi, D., McCarten, M., and Tan, E. K. (2020). “Climate transition risk in us loan portfolios: Are all banks the same?” SSRN;
- Porter, M.E., Kramer, M.R. (2011). “Creating shared value”. Harvard Business Review, volume 89, pp. 62-77;
- Post, J., Preston, L., Sachs, S. (2002). “Redefining the Corporation: Stakeholder Management and Organizational Wealth”. Published by Stanford University Press;
- Raghavan k., and Morris R. (2005). “Share Repurchases as Signals in Banking: Do They Work?” http://dx.doi.org/10.2139/ssrn.772404;

- Reddy Yarram, S. (2014). “Factors influencing on-market share repurchase decisions in Australia”. Studies in Economics and Finance, 31(3), 255-271. http://dx.doi.org/10.1108/SEF-02-2013-0021;
- Reinders, H. J., Schoenmaker, D., and Van Dijk, M. A. (2020). “A finance approach to climate stress testing”;
- Roncoroni, A., Battiston, S., Escobar-Farfán, L. O., and Martinez-Jaramillo, S. (2021). “Climate risk and financial stability in the network of banks and investment funds”. Journal of Financial Stability, 54:100870;
- Ross, S.A. (1977). “The determination of financial structure: the incentive signaling approach”. The bell journal of economics, 23-40. http://dx.doi.org/10.2307/3003485;
- Schuermann, T., Gallardo, G., Duane, M. (2016). “Stress testing convergence”. Journal of Risk Management in Financial Institutions. Volume 9, No. 1, pp. 32-45(14);
- Schuijling, B., Jansen, C., and van den Boezem F.J.B. (2019). “Sustainability and Financial Markets”. Wolters Kluwer, pp. 7-33;
- Simpson W.G., Kohers, T. (2002). “The link between corporate social and financial performance: Evidence from the banking industry”. Journal of Business Ethics, volume 35, pp. 97–109;
- Sinha, S. (1991). “Share repurchase as a takeover defense”. Journal of Financial and Quantitative Analysis, 26(02), 233-244. http://dx.doi.org/10.2307/2331267;
- Skinner, D.J. (2008). “The Evolving Relation between Earnings, Dividends, and Stock Repurchases”. Journal of Financial Economics 87 (3): 582–609. https://doi.org/10.1016/j.jfineco.2007.05.003;
- Spence, M. (1973). “Job market signaling”. The Quarterly Journal of Economics, 355–374. http://dx.doi.org/10.2307/1882010;
- Stephens, C.P., and Weisbach, M.S. (1998). “Actual share reacquisitions in open-market repurchase programs”. The Journal of Finance, 53(1), 313-333. http://dx.doi.org/10.1111/0022-1082.115194;
- Stern, N. (2013). “The structure of economic modeling of the potential impacts of climate change: Grafting gross underestimation of risk onto already narrow science models”, Journal of Economic Literature, 51(3),838–59;
- TCFD (2017). “Recommendations of the Task force on Climate-related Financial Disclosures”;

- Vafeas, N., and Joy, O.M. (1995). “Open market share repurchases and the free cash flow hypothesis”. Economics Letters, 48(3), 405–410. http://dx.doi.org/10.1016/0165-1765(94)00631-B;

- Vermelen, T. (1981). “Common Stock Repurchase and Market Signaling”. Journal of Financial Economic, 9, 139-183. http://dx.doi.org/10.1016/0304-405X(81)90011-8;
- Vermeulen, R., Schets, E., Lohuis, M., Kölbl, B., Jansen, D.J., and Heeringa, W. (2021). “The heat is on: A framework for measuring financial stress under disruptive energy transition scenarios”. Ecological Economics, 190:107205.
- Wiggins, J.B. (1994). “Open market stock repurchases programs and liquidity”. Journal of Financial Research, 17(2), 217–229. http://dx.doi.org/10.1111/j.1475-6803.1994.tb00187.
- Yeh, H.T., Huang, Y. X., and Chung, K.C. (2013). “An empirical study on influential determinants for enterprise capital reduction: evidence from cash reduction and stock repurchase”. The International Journal of Organizational Innovation, 100–114.
- Yongtae, K., Myung, S.P., and Wier, B. (2011). “Is Earnings Quality Associated with Corporate Social Responsibility?” The Accounting Review; Vol. 87, No. 3, pp. 761-796.