GREEN BANKING AND GREENWASHING: SYSTEMATIC LITERATURE REVIEW

Jyväskylä University
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Master's Thesis

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ABSTRACT

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Abstract	

Climate change is the most significant crisis of our time, and solving it requires a joint contribution of all sectors. The Paris Agreement, signed in 2015, aiming to stop warming to the 1.5-degree limit, was a turning point in mitigation. The agreement defined the banks' responsibility for channelling funding to low-carbon projects. Banks have both an external motive (achieving a common agenda) and an internal motive (climate-related financial risk management) in considering climate change in their operations. In this master's thesis, I examine how banks can contribute to preventing global warming and whether possible greenwashing affect the green transition of the economy.

The study uses a systematic literature review as a research method, and the research material is collected from several different databases, such as Scopus. The final research sample is 22 articles over the years 2010-2022. The key observations are themed and analysed using the narrative synthesis method.

The results yield that banking has the potential to prevent climate change through financial intermediation. However, the literature is currently debating whether banks' mandates should be expanded to cover climate-related policies. Several climate-related policies are proposed to work simultaneously or together with fiscal policies to reduce climate change. "Greening" of current policy measures is presented to work as a short-term solution.

The literature on greenwashing in banking is still scarce. Due to the lack of taxonomy and disclosure requirements, greenwashing occurs in banking both directly and indirectly. Banks have challenges in evaluating the environmental performance of the objects they finance because of asymmetry in data. However, current high-carbon financing and ambiguous climate commitments have a negative impact on the green transition of the economy.

Key words	
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Tiivistelmä

Ilmastonmuutos on aikamme merkittävin kriisi, ja sen ratkaiseminen edellyttää kaikkien alojen yhteistä muutosta. Vuonna 2015 allekirjoitettu Pariisin ilmastosopimus oli käännekohta ilmastonmuutoksen hillitsemisessä. Sen tavoitteena on pysäyttää lämpeneminen 1,5 asteeseen. Ilmastosopimus määrittää pankkien vastuun rahoituksen ohjaamisesta vähähiilisiin hankkeisiin. Pankeilla on sekä ulkoisena motiivina yhteisten tavoitteiden saavuttaminen, että sisäisenä motiivina ilmastoon liittyvien rahoitusriskien hallinta. Tässä pro gradu -tutkielmassa tarkastelen, miten pankit voivat osaltaan ehkäistä ilmaston lämpenemistä ja vaikuttaako mahdollinen viherpesu negatiivisesti talouden vihreään siirtymään.

Tutkimuksessa hyödynnetään systemaattista kirjallisuuskatsausta. Tutkimusaineisto on kerätty useista eri tietokannoista, kuten Scopuksesta, ja lopulliseen tutkimusotokseen on sisällytetty 22 artikkelia vuosilta 2010–2022. Keskeiset havainnot ovat teemoitettu ja analysoitu narratiivista synteesimenetelmää hyödyntäen.

Tulosten valossa pankkitoiminta voi ehkäistä ilmastonmuutosta säätelemällä rahoitusta. Tutkimuskentällä ei kuitenkaan ole konsensusta siitä, pitäisikö pankkien mandaatteja laajentaa kattamaan ilmastopolitiikkaa. Ratkaisuna ilmastokriisiin esitetään ilmastopolitiikan ja rahoitussääntelyn välineiden käyttämistä yhdessä finanssipolitiikan työkalujen kanssa. Lyhyen aikavälin ratkaisuksi esitetään nykyisten keskuspankkien työkalujen vihertämistä.

Pankkitoiminnan viherpesua käsittelevää tutkimusta on tehty vähän. Pankkitoiminnassa esiintyy viherpesua niin suoraan kuin epäsuorasti puuttuvien taksonomian ja tiedonantovaatimusten takia. Pankeilla on haasteita arvioida rahoittamiensa kohteiden vaikutusta ilmastonmuutokseen, sillä päätöksentekoon liittyvä informaatio on asymmetrista. Nykyiset rahoitustoimet ilmastonmuutosta kiihdyttäviin kohteisiin ja epäselvät ilmastositoumukset vaikuttavat kielteisesti talouden vihreään siirtymään.

Asiasanat
vihreä pankkitoiminta, viherpesu, systemaattinen kirjallisuuskatsaus, ilmastonmuutos, keskuspankki

Säilytyspaikka
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1   INTRODUCTION

The climate has been warming at an alarming rate in recent decades, making the phenomenon a fundamental part of the international and political debate. There is a clear consensus in the scientific community that global warming should be kept at 1.5 degrees or well below 2 degrees compared to pre-industrial times to avoid severe consequences of climate change (IPCC, 2018). However, the IPCC's Sixth Assessment (2021) shows that annual greenhouse gas emissions from 2010 to 2019 were the highest in recorded history, although growth has slowed. They estimate that without an immediate reduction in emissions in all sectors, the goal will not be reached. The world's situation is critical, but fortunately, actions toward the green transition have already been considered by policymakers. Nonetheless, new policies and regulations should be expanded and introduced more widely to reduce emissions and prevent global warming.

Indeed, global warming is a relevant topic to discuss. To start with, 2020 was the hottest year ever recorded (Brown, 2021). Extreme climate events, like floods and heat waves, are increasing globally. To give an example, three billion animals were killed or displaced during the Black Summer of Australia in 2019-2020. People are not safe, either. More than 200 lives were lost during the floods in Germany in 2021. These issues must be addressed, and money is a strong tool to implement the required changes. It is studied that the energy sector would need 2.4 trillion dollars on average annually to stay in the 1.5-degree pathway (IPCC, 2018). From a perspective, the Covid-19 pandemic showed that the world's leading economies were able to use stimulus packages of more than 15 trillion dollars to revive the economy (Wilkes & Carvalho, 2020). It has been observed over the years that the operations of banks can have globally significant (negative) effects, but this time, proactive work is required to obtain a positive outcome.

The role of the financial sector in mitigating climate change has been under discussion in recent years. Paris Agreement, signed in 2015, may be considered a turning point in a collective concern of climate change mitigation. For the financial sector, it was pivotal since it was agreed to make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (*Paris Agreement*, 2015). Financial institutions act as

financial intermediaries and control a large part of the assets in the market. Their investment decisions, therefore, play a crucial role in how funding may be allocated from high-carbon sectors towards a more sustainable alternative.

However, participating in climate change mitigation due to regulation is not the only reason the financial sector should be concerned about climate change. It has been observed that global warming causes climate risks, which are also reflected in the financial sector and financial stability. Climate risks refer to environmental changes, such as rising sea levels and droughts, caused by climate change. Studies have found that through economic transmission channels, climate risks affect financial risks and thus affect financial stability. (Alogoskoufis et al., 2021; Feyen et al., 2020; *Overview of Environmental Risk Analysis*, 2020.) Therefore, banks also have an intrinsic inducement to take climate issues into account in their operations.

Many international and national organisations have contributed to the development of green finance through research and various regulatory proposals. Especially after the announcement of the Paris Agreement, climate-related policies and financial regulations have increased. The actors greening the financial industry include (among others) the Network for Greening the Financial System (NGFS) and the G20 Sustainable Finance Working Group (SFWG). Despite efforts, a common taxonomy and disclosure requirements have not yet been drawn up (NGFS, 2019). This enables greenwashing activities in green finance, which may partly retard the economy's green transition. Greenwashing refers to activities where a company misleads consumers or investors about its environmental actions or the level of environmental protection (*Sins of Greenwashing*, n.d.)[1].

The purpose of this study is to find out how green banking may contribute to curbing climate change. It also examines whether greenwashing exists in banking operations and whether it negatively impacts the economy's green transition. The research utilises a systematic literature review that compiles existing information. The study examines the effects of banking on climate change mitigation, often referred to as "green banking", which is a subtheme of the sustainability research topic. Many academic publications and studies have been conducted on green finance, green bonds, and sustainable banking, but only a few utilises systematic literature review research method (see e.g. Akomea-Frimpong et al., 2021; Aracil et al., 2021; Şimandan & Păun, 2021; Singh & Jayaram, 2021). However, greenwashing in banking, and its possible harmful effects on climate change mitigation, have not been comprehensively studied. A research gap exists in the literature examining the relationship between green banking and greenwashing.

For my research material, I use studies regarding "green banking" and greenwashing related to banking. Green banking includes, for instance, green financing and green investments. The research is limited to include studies only from the financial sector, as greenwashing, in particular, has also been extensively studied in other sectors. Furthermore, to get a holistic picture, only

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[1] Sins of Greenwashing. (n.d.). UL Solutions. Retrieved September 5, 2022, from https://www.ul.com/insights/sins-greenwashing

studies that address the topic from the perspective of economic zones rather than economies of single countries are accepted as research material.

This master's thesis is structured as follows. In the second chapter, I go through the essential theory, which includes, for example, the role of central banks, greenwashing, and current climate-related regulations. In the third chapter, I present the research problem and the research questions in more detail. Then, in the fourth chapter, I present and justify the research method and material chosen for the study and describe the research process. In the fifth chapter, I analyse the themes found in the material using the narrative synthesis method. I examine how the mandates of central banks enable green activities and what kind of climate-related policies have been proposed in the studies. In addition, I examine how banks' climate sentiment and incentives affect their adaptation to climate-related objects. I scrutinise what kinds of greenwashing activities have been found to be either indirectly or directly in the operations of banks. Finally, I compile the most critical findings in the sixth chapter and discuss them. Reflections on the theoretical framework are given in this chapter as well. Then I critically evaluate the reliability of my research and consider possible topics for further study.

2 GREEN FINANCE AND BANKING

2.1 The role of central banks

The role of central banks has changed in recent decades. Especially since the financial crisis forced them to develop solutions beyond price stability and inflation targeting. The change has continued as central banks have increased their cooperation with other policymakers, particularly with fiscal policy, after the Covid-19 pandemic. Post-crisis, central banks have been crucial in maintaining economic and financial stability through monetary policy. As stated earlier, climate change has a substantial impact on financial stability, and therefore, the role of central banks in mitigating climate change is considered necessary. (Abdelli et al., 2021.)

According to Abdelli et al. (2021), it is the responsibility of central banks and financial institutions to take care of the economy's resilience and its ability to withstand unexpected risks. In addition, it is pertinent that they identify, evaluate, and account for the risks to themselves and the risks to financial intermediaries. Furthermore, Abdelli et al. (2021) point out that central banks need to ensure that the financial risks on their balance sheets remain moderate. Hence, they say climate-related financial risks are now crucial to a central bank and other financial authorities' decision-making.

Bolton et al. (2020) present two key dilemmas related to the role of central banks in limiting climate change. First, in addition to assessing climate risks, central banks should be able to influence their management, as they cause financial instability, which they have a pivotal role in managing. But on the other hand, in addition to maintaining price stability, financial stability has increasingly become another critical role for central banks. The next problem is that central banks would also play a key role in supporting fiscal policy if managing climate risks. With these changes, the functions of central banks would further expand.

Bolton et al. (2020) argue that the second critical problem in expanding the activities of central banks is, in particular, that they are not elected political actors. This would weaken the credibility of the operations. In addition, they point out that mitigating climate change also requires expertise in areas central banks do not have. D'Orazio and Popoyan (2022) come to similar considerations. They estimate that central banks have an independent authority to achieve monetary policy objectives. Nonetheless, targeting funding to low-carbon companies without a specific mandate could undermine their credibility.

Bolton et al. (2020) suggest that central banks should focus on their current core tasks but increase proactive action and demand change. They also note that even if some of the action required is not directly within the central bank's mandate, they can intervene if it affects financial stability. Additionally, D'Orazio and Popoyan (2022) observe that central banks play a major role in pricing climate risks through financial intermediaries in terms of green finance. Therefore, their role in combating climate change cannot be ignored. Bolton et al. (2020) also point out that in the European Union, central bank mandates include securing economic growth. The EU has defined that economic growth must also consider sustainable development. Therefore, it is equivocal whether curbing climate change with the current guidelines is already part of central bank operations in the EU. On the contrary, D'Orazio and Popoyan (2022) remark that central bank mandates are more flexible in developing countries, such as China and Brazil, allowing for more effective climate action.

Mitigating climate change should be a common goal of all economic actors. National governments can steer the economy through fiscal policy, while central banks use monetary policies as their independent policy tool. Both policies play an essential role in climate action. Bolton et al. (2020) assess that fiscal policies are a prominent factor in accelerating the green transition, while monetary policies can support the goals set. However, Campiglio et al. (2018) remark that governments have difficulty pushing through decisions that put companies and other actors in a predicament because of their political background. Therefore, the authority of central banks should be exploited in the green transition.

2.2   Climate change and financial stability

Risk management is an essential part of financial institutions' role in maintaining financial stability. Risk management refers to how risks related to all the business activities of the institution are identified and analysed, and, if necessary, a plan is made to accept or mitigate them. This study refers to the financial sector's and supervisors' actions in financial risk management. The conventional financial risks are categorised as credit, market, underwriting, operational, and liquidity risks and are managed by guidelines based on regulated prudential requirements (*Overview of Environmental Risk Analysis*, 2020). In recent years, it has been recognised that climate change is also affecting financial stability via the newly emerging climate-related financial risks (CRFRs). Even though the financial sector and supervisors have admitted that the CRFRs occur, understanding their effects is

tricky since climate-related shocks differ from conventional financial shocks. (Alogoskoufis et al., 2021.)

Alogoskoufis et al. (2021) note that the climate stress test has been proposed to assess CRFRs. However, studies do not agree on its suitability. According to Brunetti et al. (2021), the difficulty in assessing climate-related risks is due to a lack of appropriate metrics and resources. They specify that countries collect climate data differently, making it difficult to compare them. In addition, Brunetti et al. (2021) noted that countries face diverse climate impacts and react to them differently. Besides, the actions of independent nations and territories also indirectly affect other countries, which complicates risk management. Other studies have also found that developing an appropriate method is challenging as the climate-related risks are unclear and cannot be predicted in the same way from past events as is usually done in stress tests (Alogoskoufis et al., 2021; Battiston, Dafermos & Monasterolo, 2021; Bolton et al., 2020).

According to Abdelli et al. (2021) central banks should act on the principle that environmental degradation and biodiversity loss caused by climate change will also be reflected in financial risks. However, climate-related risks can be categorised to facilitate their identification and management. In NGFS report (2020), climate and environmental-related risks are categorised into physical and transition risks. The physical risks originate from extreme weather conditions, rising sea levels, and changes in the ecosystem, such as the decline of rainforests and corals. The transition risks arise when people try to adapt to the previously mentioned events, such as implementing new policies, inventing new technologies, and changing consumption habits. Alogoskoufis et al. (2021) estimate that the physical and transition risks are twisted. For example, Feyen et al. (2020) note that the transition to a climate-friendly economy means that high-carbon companies face adverse economic consequences, e.g. decrease in their asset values.

In addition to the aforementioned risks, the PwC and WWF (2020) research group introduce litigation and systemic risks. Climate-related litigation risks refer to a situation where a company or organisation could face litigation over the loss of biodiversity caused by its activities. In contrast, systemic risk describes the overall risk caused by the destruction of natural capital and biodiversity, with broad economic implications. (Koumbarakis et al. 2020.) The NGFS (2021b) has also detected a climate-related litigation risk but classifies it under transition risks.

It is considered partly unclear how climate risks may affect traditional financial risks, and as a result, their management has been limited, especially in developed countries. The NGFS (2020) has assembled a framework of the transmission channel from climate-related risks to financial risks, simplified in Figure 1. The transition risks are affecting in microlevel by weakening companies' current operations and affecting household wealth, thus creating, e.g., financial risks for banks. The effects of transition risks are also reflected in the macroeconomy, as changes in regulations can lead to the generation of stranded assets. As shown in Figure 1, the physical risks are divided into chronic and acute impacts. The chronic effects are reflected in regional global warming and sea-level rise, leading to changes in agriculture, for example, which insists on adaptation from companies and governments. On the other hand, the acute impacts originate from extreme weather events, which suddenly destroy the property of businesses and

households, thus leading to a decrease in asset values causing underwriting risks. Multiple scenarios cause climate risks to be reflected in financial risks. (*Overview of Environmental Risk Analysis*, 2020.)

Transmission channels:

Climate-related risks to financial risks

Environment and climate-related risks	Economic transmission channels	Financial risks	
Transition risks: Policy & regulation Consumer preferences Tech development	**Microlevel**: Affecting individual businesses and households	**Credit risk** **Market risk** **Underwriting risk** **Operational risk** **Liquidity risk**	Financial system contagion
Physical risks: Chronic Acute	**Macrolevel**: Aggregate impacts on macroeconomy		

Environment and economy feedback Economy and financial system feedback
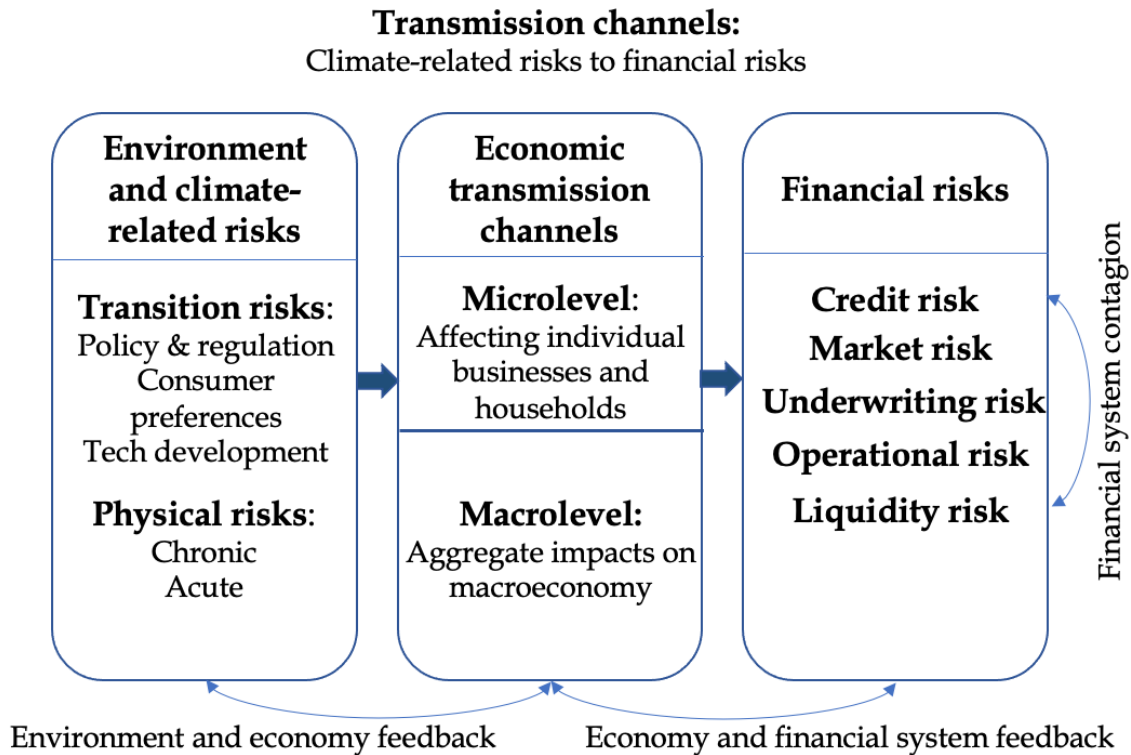
Figure 1 Climate risks transmission channel to financial risks (Adapted from NGFS (2020))

Previously presented studies have found that managing and predicting climate risks is challenging. Feyen et al. (2020) study concentrated on assessing how climate change affects macro-financial risks and development. They emphasised that climate-related risks are increasing the prevalence of macro-financial risks. But at the same time, macro-financial vulnerabilities do not allow for introducing sufficiently effective climate action. However, Feyen et al. (2020) point out that environmental and economic feedback also allows for the emergence of a positive cycle. As a result, it can be estimated that macro-financial operations have the potential to contribute to climate change mitigation. Therefore, it would be necessary for climate risk management to make the data collection and information consistent to allow the policymakers to benefit from the effects of the financial economy and climate.

Research has shown that transition risks may be reduced if climate policy decisions are taken promptly. This is explained by the fact that global warming is accelerating yearly, making the measures taken at a later stage much tighter. (NGFS, 2019.) According to Belloni, Kuik and Mingarelli (2022), banks should reallocate their funding from high-emission companies to lower emissions, reducing banks' credit risk. However, they found that preparing for the risks

posed by climate change does not fully protect banks from losses. Though, uncontrolled climate change would have complicated and powerful consequences, of which economic and political instability would be only one part.

2.3 Green finance and reporting

The essential tool for banks in the green transition is allocating funding to low-carbon companies and projects. When commercial banks finance green activities through conventional loans, central banks can buy, for example, green bonds. The financing decision is essentially related to the information obtained from the object to be financed. Thus, banks use reports from companies and supervisors to support decision-making, which is why reporting requirements are essentially related to green finance. Green finance is often referred to as sustainable finance, but it is important to note that the term sustainable usually includes social and governance related topics. However, this study focuses on the environment and climate, which is why financing is prefixed with green. There is no general definition for green finance yet, but various guidelines and taxonomies have been compiled in recent years to determine it. Section 2.4 will present the current regulations and guidelines in more detail, while this chapter outlines what green finance means, what aspects it covers, and the sustainability reporting frameworks.

In 2016, the G20 Green Finance Study Group was established by G20 countries to identify institutional and market barriers to green finance. In addition, they draw up a definition and a framework for green finance. According to the report, green finance is the "financing of investments that provide environmental benefits in the broader context of environmentally sustainable development". (*G20 Green Finance Synthesis Report*, 2016.) Furthermore, Kahlenborn et al. (2017) note that green finance is often used in parallel with climate and sustainable finance. However, the terms can be classified separately as seen in Figure 2. According to the simplified graph adapted from the UNEP inquiry (2016), sustainable finance can be considered an upper concept considering environmental, social, and governance matters. At the same time, the term "climate finance" is narrower and regards the adaptation and mitigation of climate change. In contrast, green finance also covers other climate change matters and other environmental subjects.
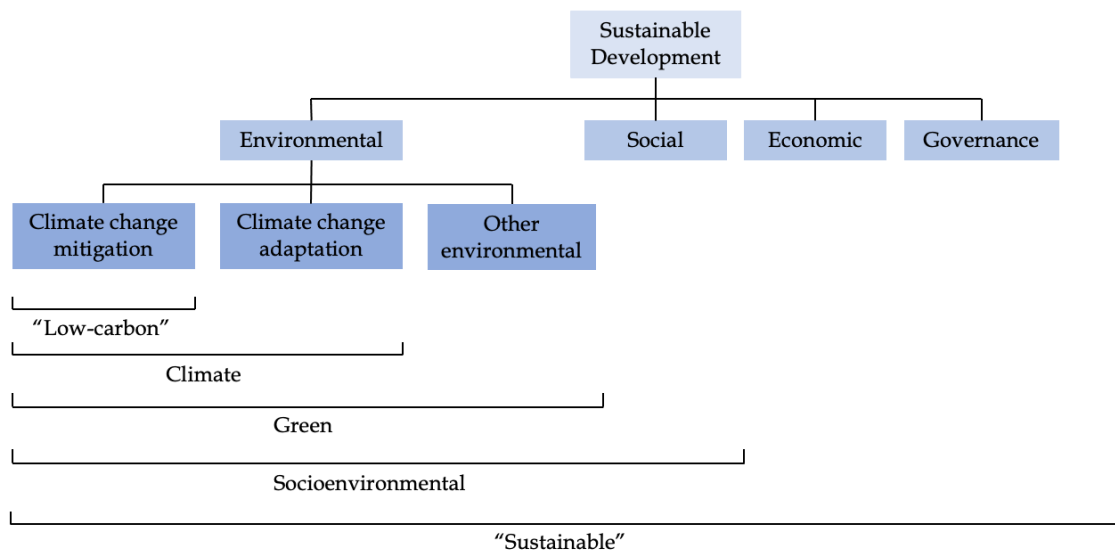
Figure 2 Simplified schema to describe the terms used (Adapted from UNEP inquiry (2016))

Kahlenborn et al. (2017) divided green finance into green bonds, green lending and green-listed equity/investment. In 2016, the Green Bond Principles (GBP) was established to provide a voluntary definition for green bonds. According to the 2021 update, green bonds are bonds that finance or refinance new or existing green projects. The GBP includes four key components, which clarify the definition. First is the "use of proceeds", which controls the projects for which funding can be used. Suitable objects include, e.g., renewable energy, the introduction of a circular economy in products/processes and clean transportation. The second component specifies that the issuer must provide information on why the project is green, how they ensure an environmentally friendly approach at different stages of the process, and how they identify and manage potential environmental risks associated with the production process. The third component is "management of proceeds," which refers to the transparent management of bond net proceeds. The final part is the reporting provided by the issuer, which aims to describe in a transparent and up-to-date way what kind of projects the funding has been used for and assess the climate impact of the projects. (*The green bond principles*, 2021.)

Green lending often refers to bank lending for green projects. As with green bonds, green loans do not yet have a common framework for banks to jointly determine which activities are considered green. However, Kahlenborn et al. (2017) estimate that banks set their climate targets to control their funding decisions. Banks' climate goals are often tied to eligibility criteria determining which technologies and products are considered environmentally friendly. For example, the European Investment Bank (EIB) has drawn up a list of 11 standards, according to which they choose the projects to be funded. The list considers, among other things, that the company to be financed uses resources efficiently and prevents pollution. (*EIB Environmental and Social Standards Overview*, 2021.)

It can be noted that the regulation of green loans is not yet harmonised. The current instructions mainly focus on corporate finance, which indicates that lending to households has not been addressed.

According to Kahlenborn (2017), green investments have no standard definition. Instead, it is possible to examine how, for example, sustainable investment is defined. For example, investments can be screened by excluding enterprises that operate in the "brown sector" or by screening with the "positive/best-in-class" method, which may distinguish businesses based on reporting. In addition, Kahlenborn (2017) suggests that the environmental performance of investments can be assessed by looking, for example, at a company's ESG reporting. However, the above definitions have only been developed by some actors, and no consensus has yet been reached on the meaning of green finance.

Green funding is mainly targeted at enterprises today, which means that the reports they produce on their operations are an integral part of assessing the effectiveness of green transition. Businesses can voluntarily follow, for example, the Green Bond Principles and European investment banks' standards in their operations. However, enterprises have external instructions to guide their sustainability reporting. One of the most well-known sustainability frameworks is the ESG (environment, social and governance) disclosure guidelines. The reporting disclosures increase the transparency and comparability of companies' responsibility actions, as it is easier for external stakeholders to review, for example, companies' emissions. In addition, the ESG guidelines require companies to be accountable for whether they are making progress in ESG matters or producing negative impacts through their operations. However, there are multiple competing ESG disclosure frameworks. The company can choose whether it follows frameworks provided by, e.g., the Global Reporting Initiative (GRI) or the Principles for Responsible Investment (PRI). (Peterdy, 2022.)

2.4 Greenwashing and current regulations

Greenwashing

The amount of sustainable finance is accelerating, and banks are setting their own climate goals. However, the problem is that financial institutions have not agreed on the definition of "green" and "sustainable", which enables banks to set their definitions or the methods by which the climate effects are evaluated. In addition, for green finance to be utilised in limiting climate change, the credibility of green claims should be ensured. The shortcomings mentioned above enable greenwashing in financial products marketed as green or sustainable.

De Freitas Netto, Sobral, Ribeiro and Soares (2020) compiled a systematic review to clarify the definition of greenwashing. The study found that researchers mainly used definitions from the Oxford English Dictionary (OED) and TerraChoice. The OED (2022) has defined greenwashing as "Misleading publicity or propaganda disseminated by an organisation, etc., so as to present

an environmentally responsible public image; a public image of environmental responsibility promulgated by or for an organisation, etc., regarded as being unfounded or intentionally misleading". In 2007, TerraChoice (later acquired by UL) compiled the "Seven Sins of Greenwashing" to make it easier for consumers to identify products with erroneous environmental claims. TerraChoice defines greenwashing as an activity in which a company misleads consumers about the level of environmental practices or environmental protection and communicates positively about the company's environmental activities (*Sins of Greenwashing*, n.d.)[1].

The Swiss Bankers Association (SBA) (n.d.)[2] has divided greenwashing in the banking sector into three categories. The first part is related to the definition of sustainable financing. According to the SBA, there is still no consensus on how the environmental impact of financial products should be measured, which is why standard definitions have not been drawn up either. Similarly, Marchant (2020) states that banks' climate pledges are often inconsistent, and there is no standard definition of the terms. As a result, assessing the actual effect of sustainable commitments and comparing sustainable investment products is challenging. Despite this, Brunnermeier and Landau (2022) mention that new rating agencies have emerged in the sector to fill the need to classify investments according to their environmental performance. However, due to non-comparable data, the classifications are noisy and thus increase greenwashing.

The second part of the SBA's definition deals explicitly with private investors' protection for receiving individualised investment advice and recommendations for investment products suitable for their risk tolerance. In the third category, the SBA defines greenwashing as an activity where the characteristics of the investment product differ from, e.g. market claims. (*Greenwashing*, n.d.)[2] In addition to incorrect market claims, Marchant (2020) states that banks' exaggerated climate pledges can be classified as greenwashing. For example, some banks have announced that they aim for net carbon emissions by 2050 but have not informed the concrete changes they shall implement to achieve the goal. Marchant (2020) also points out that it can be considered greenwashing if the bank continues to finance fossil fuel and other dirty sectors despite their sustainability promises.

Current regulations

Banking operations are governed by various transnational, regional and national regulations, which aim to harmonise procedures to make them more reliable, consistent, and transparent. When the Paris Agreement entered into force in 2015, bank regulations and guidelines also began to be modified to achieve the agreed climate goals. The most critical regulatory frameworks and guidelines related to green banking are listed in Table 1 and will be reviewed next. In addition, it will be examined whether the mentioned guidelines consider the possibility of greenwashing in banking operations.

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[2] Greenwashing. (n.d.). Swiss Bankers Association. Retrieved September 5, 2022, from https://www.swissbanking.ch/en/topics/sustainable-finance/greenwashing

Table 1 Current regulatory framework

Regulation	Level	Territory	Mandatory / voluntary	Accounts greenwashing	Date of application
Paris Agreement	Transnational	195 UN countries	Mandatory	No	2015
G20 SFWG	Transnational	G20	Voluntary	Yes	2021 (re-established)
NGFS	Transnational	116 independent members	Voluntary	Yes	2017
UNEP FI: Principles for Responsible Banking	Transnational	290 independent signatories	Voluntary	No	2019
ICMA GBP	Transnational	Individual organisations	Voluntary	No	2021 (updated)
European Green Deal	Regional	EU	Mandatory	Yes	2019
EU Taxonomy	Regional	EU	Both	Yes	2022-2023
EU Green Bond Standard	Regional	EU	Voluntary	Yes	2021
SFDR	Regional	EU	Mandatory	Yes	2021
China Green Finance Guidelines	National	China	-	No	2022 (updated)
China Green Bond Principle	National	China	Mandatory	Yes	2022
Green Finance Strategy	National	UK	Voluntary	No	2019
Green New Deal	National	USA	-	-	Proposal

The Paris Agreement is an international climate agreement signed by 195 United Nations countries. The agreement's primary goal is to limit global warming to 1.5 degrees from pre-industrial times, which requires, e.g., plans for reducing greenhouse gas emissions and balancing greenhouse emissions and carbon sinks. In addition, the agreement stipulates that the financial flows must be directed to decarbonisation and environmentally sustainable projects. Progress concerning the goals is reviewed every five years. (*Paris Agreement*, 2015.) Several

international actors monitor whether achieving the agreed goals with the current actions is possible. For example, the independent scientific analyst, the Climate Action Tracker, has estimated that the climate is warming to 2.7 degrees with current activities since the greenhouse emissions are still twice as high as is justified (*Despite Glasgow Climate Pact, 2030 Target Updates Have Stalled.*, 2022).

Since 2016, the G20 countries have studied and developed the possibilities of green finance. In 2021, the function was re-established as the G20 Sustainable Finance Working Group (SFWG), with the purpose of, e.g., preparing research-based and climate-focused solutions for developing green finance and harmonising the operations of the financial sector in line with the goals of the Paris Agreement. The organisation has drawn up a "Sustainable Finance Roadmap" to make it easier for members and other stakeholders to act under the operating models. The roadmap is divided into five focus areas and 19 actions which consider, for example, assessing and managing climate risks and publishing reliable and comparable information for investors. *(G20: Sustainable Finance Roadmap*, 2021.)

The G20 research group has assessed that the current procedure is fragmented, as different regulations and guidelines can be applied to estimate the sustainability of projects and investments. Furthermore, the key problem is that various tools and metrics are used to measure the greenness or sustainability of investments. This enables the investments to be evaluated as favourably as possible. According to the G20 SFWG, this increases greenwashing, weakens credibility and causes market segmentation in sustainable finance. *(G20: Sustainable Finance Roadmap*, 2021.)

In addition to intergovernmental organisations, associations consisting of individual financial market participants and central banks have fostered the greening of the financial sector. As presented in Table 1, two significant transnational associations have been established since the signing of the climate agreement. The Network for Greening the Financial System (NGFS) (2021a) was established in 2017 by eight central banks and supervisors and has 116 independent members nowadays. UNEP FI: Principles for Responsible Banking was introduced in 2019, having nearly 300 independent banks as signatories covering more than 40% of global banking assets. NGFS and UNEP FI develop recommendations and principles that enable committed financial sector operators to green their current operations or develop new operating models. For example, the UNEP FI has put together six principles, which include, e.g. the goal of managing risks arising from operations that affect the environment and people. (UNEP FI, n.d.)[3]

The NGFS research group has found flaws in the financial sector's climate actions, which enable the risk of greenwashing. According to the report "Final Report on Bridging Data Gaps" published in 2022, identifying, mitigating, and managing climate risks is challenging, as there are inadequate tools to create comparable and applicable climate data. The NGFS report states that cooperation between international regulatory authorities and stakeholders is needed to

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[3] UNEP FI. (n.d.). About the Principles – United Nations Environment – Finance Initiative. https://www.unepfi.org/banking/bankingprinciples/more-about-the-principles/

harmonise disclosure standards. The partnership could create a unified taxonomy and classification of sustainable finance. Additionally, it is stated in the report that reporting requirements of enterprises should be tightened and harmonised. *(Final Report on Bridging Data Gaps*, 2022.)

In 2019, the European Union set ambitious climate goals under the "European Green Deal" agreement. All EU member states have committed to reducing emissions by 55% by 2030 to be the first carbon-neutral continent by 2050. (*Delivering the European Green Deal*, n.d.)[4] As seen in Table 1, four different regulations have been drawn up in the EU, which take a direct stand on the operation of banks and financial institutions. The regulations are based on the climate goals agreed in the Paris Agreement and the European Green Deal.

The European Union's essential framework for sustainable finance is the EU taxonomy, which will gradually come into effect in 2022-2023. The purpose of the taxonomy is to direct funding to sustainable businesses and projects. In addition, the science-based classification aims to reduce greenwashing. Investments are evaluated according to six objectives: "climate change mitigation", "climate change adaptation", "the circular economy", "pollution", "effect on water", and "biodiversity". It is also essential that the taxonomy requires that one environmental objective cannot be pursued in such a way that it causes harm to other objectives. *(Official Journal L 442/2021*, 2021.)

The EU taxonomy may be considered a pioneer of the green transition of the financial market, as it provides a clear framework for defining sustainable activities. A standard definition of green investments reduces the risk of greenwashing and makes it easier for investors to identify environmentally friendly investments (*Official Journal L 442/2021*, 2021). However, there are still some disagreements about the definition since members of the European parliament have accepted that fossil gases and nuclear power can be partially included in the scope of green finance (Haarh, 2022). For example, green political parties and environmental organisations, such as WWF, have vehemently opposed this. WWF prepared a 5-point list of why fossil gases and nuclear energy should not be included in the taxonomy. The essential reason is that the forms of energy in question are not green, especially fossil gases, and their inclusion in the taxonomy could alarmingly reduce funding for renewables and green technologies. In addition, the decision would weaken the foundations of the taxonomy, which include that the criteria are based on science and maintain technological neutrality. (*Five Reasons to Oppose the Inclusion of Gas and Nuclear Power in the EU Taxonomy*, 2021.)

In addition to the taxonomy, targeted regulations have been drawn up in the European Union, such as EU Green Bond Standard (EUGBS) and Sustainable Finance Disclosure Regulation (SFDR). Targeted regulations aim to increase the transparency of financial markets and reduce greenwashing. The EUGBS aims to harmonise the definition of green bonds following the EU taxonomy and the ICMA Green Bond Principles. The EUGBS aims to reduce the greenwashing of

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[4] Delivering the European Green Deal. (n.d.). European Commission - European Commission. Retrieved August 29, 2022, from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

green bonds by increasing reporting requirements and external review. (*European Green Bond Standard*, n.d.)[5]

The SFDR sets reporting requirements for financial market operators, both on activity and product levels. The regulation obliges financial market operators to declare how sustainability risks are considered in their operations or to justify why they are not considered. The SFDR divides the products into three categories at the product level according to their sustainability level. The higher the product's sustainability is reported, the more detailed the product information should be. (*Official Journal L 317/1*, 2019.)

In addition to the European Union, other major economic zones have also considered the financial market's potential to curb climate change. Table 1 lists regulations that are in use in China, the UK, and the US. The greenhouse emissions produced by China's manufacturing industry are relatively large, which is why climate regulation in the region is crucial. In 2012, China launched the "Green Credit Guidelines", which have been updated in 2022 as "Green Finance Guidelines for the Banking and Insurance Industry". Essential in China's Green Finance Guidelines is that banking and insurance companies must manage their ESG risks and increase ESG information disclosure and cooperation with stakeholders. (*CBIRC Releases the Green Finance Guidelines for Banking and Insurance Sectors*, 2022.) At the same time, the "China Green Bond Principles" were launched, harmonising national green bonds with international agreements such as the ICMA Green Bond Principles. The principles mention, among other things, that issuers must use an external auditor to verify bonds to increase transparency and prevent greenwashing. *(Chinese Green Bonds Required to Use 100% of Funds for Green Purposes*, 2022.)

The UK compiled a Green Finance Strategy in 2019, intending to achieve net zero emissions by 2050. Due to Brexit, the UK has its own climate goals, so the European Union's common regulations will no longer apply to it. The Green Finance Strategy is divided into three areas. The first goal is to include the climate and environmental factors in financial decision-making and stabilise the market of green financial products. The second goal is to develop and accelerate green financing to support the climate goals set by the UK. The third goal is to keep the UK a leading country in green finance by developing innovations that utilise advanced data and analytics. (*Green Finance Strategy: Transforming Finance for a Greener Future*, 2019).

Finally, Table 1 presents the "Green New Deal" proposed in the United States, which has many similarities with the EU's Green Deal. The central goal of the plan is to achieve zero net emissions and switch to renewable energy by 2030 (*Green New Deal*, 2019). Due to the two-party system in the United States, the development of climate goals and, more precisely, green finance regulation has been challenging. This is evidenced, for example, by President Trump's withdrawal from the Paris Agreement and reciprocally President Biden's re-joining the Agreement.

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[5] European green bond standard. (n.d.). Retrieved August 30, 2022, from https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard_en

3   RESEARCH PROBLEM

The purpose of my study is to examine the importance of green banking in climate change mitigation and the role of greenwashing in this. The research focuses primarily on environmental and climate issues; therefore, the topic is limited to "green" instead of the more extensive term "sustainable". As defined in the previous chapter, green banking is a variety of activities that can contribute to the green transition of the economy. The key measure is to direct funding to enterprises and organisations that provide or support environmentally friendly projects or activities. The effectiveness of climate action is hindered by the greenwashing of aforementioned. Therefore, this study also examines banks' greenwashing activities and their potential retarding effects in achieving climate goals.

The research questions can be specified as follows:

1. How can green banking contribute to mitigating climate change?
2. What kind of greenwashing actions appears in banks' operations?
3. Does greenwashing have a negative impact on the green transition of the economy?

A consensus exists in the scientific community about the harmful effects of climate change on the environment and, thus, on the economy. The effects of banking to limit climate change have not been studied excessively, and therefore examining the topic is essential and timely. To collect and analyse the data for my research, I use the systematic literature review method to form a comprehensive analysis of banks' climate actions and greenwashing activities in it. I create a synthesis of the research using the qualitative and material-driven narrative synthesis method to ensure theme-categorised comprehensiveness in the study.

4   RESEARCH METHOD

The systematic literature review is utilised as a research method for this study. This chapter will present and review the various stages of the research process, including the inclusion and exclusion criteria for articles, analysis, and description of the selected articles. It should be noted that in a systematic review, there are usually more resources and more than one author, which is why this study could also be called a semi-systematic or systematised review (Gough, Oliver & Thomas, 2012; Grant & Booth, 2009; Jesson, Matheson & M. Lacey., 2011). However, the research method is referred to as a systematic literature review for clarity.

4.1   Systematic literature review

A literature review can be considered an integral part of any study, as the empirical part is usually preceded by an applicable theoretical framework or review of previous literature. However, a literature review can also be used as a research method since it allows for a synthesis of existing studies, thereby providing oversight of current knowledge and uncovering possible research gaps (Jesson et al., 2011; Snyder, 2019; Tranfield, Denyer & Smart, 2003). According to Jesson et al. (2011), a traditional literature review provides an overview of the topic covered without a pre-defined method, which means that a reader cannot identify how literature has been selected and how the conclusion has been reached. Gough et al. (2012) suggest that systematic review or meta-analysis methods should be introduced for research to be transparent and reproducible. Snyder (2019) determines that meta-analysis is a statistical technique for processing, especially quantitative studies.

A systematic review has been widely used as a research method in health care, but over the years, its use has become more common in other disciplines (Boland, Cherry & Dickson, 2014; Jesson et al., 2011; Snyder, 2019). Defined by Boland et al. (2014), the systematic literature review seeks an "informative" and an "evidence-based" answer to a well-defined research question. The research

method includes three main steps: identifying the pertinent research, critically appraising selected data, and synthesising key findings. In addition, the steps of the research method are precisely described and predetermined (Boland et al., 2014; Gough et al., 2012).

A systematic literature review seeks to answer a given research question by examining previous studies and discussions on the subject. Boland et al. (2014) remark that the research question should be motivating, narrow, and researchable, especially in the master's thesis. They also claim that the research question provides the context for the entire research and is used to develop an appropriate research protocol. As clarified by Tranfield et al. (2003), the purpose of the protocol is to provide a basis for transparent and reliable research, as it includes information on the research questions, the sample literature selected for the study, the identification of suitable studies, and the inclusion and exclusion criteria for the selected studies.

The main objective of the protocol is the inclusion and exclusion criteria, which are based on the research questions and other motives, such as research resources. Boland et al. (2014) point out that the design of the research question and the criteria often run in parallel, as they can be used to delineate the research topic. This study considers the thesis requirements and particularly the limited resources in the delimitation. The inclusion and exclusion criteria for this study will be presented in section 4.2.

According to Boland et al. (2014), the next step of the process is searching, screening, and selecting the studies that comply with predetermined criteria. Tranfield et al. (2003) state that the search process involves identifying keywords, forming a combination of search strings, and choosing the proper search channels. Boland et al. (2014) remark that it is generally thought that a systematic review should reach all studies relevant to the research question. Still, when writing the thesis, limitations occur. Due to limited resources, the number of articles selected and search channels used in this study should be considered when evaluating the research results.

The last two stages of the systematic review process are a quality assessment and a synthesis. According to Jesson et al. (2011), quality assessment is carried out to evaluate the methods used in the selected studies. Boland et al. (2014) add that its purpose is to ensure that the chosen studies are valid and reliable. Finally, the main findings of the studies are compiled into a synthesis to find relationships between the results and thus fill the knowledge gap. Narrative synthesis can be utilised if the material consists of quantitative and qualitative studies. (Jesson et al., 2011.) The quality assessment of the study will be presented in section 4.3, and the synthesis method of the study will be presented in more detail in section 4.4.

4.2   Inclusion and exclusion criteria

Searching for articles yields many results, and therefore developing inclusion and exclusion criteria is integral to the research process. Snyder (2019)

emphasises that the development of the criteria is vital for ensuring the study's quality, as only relevant articles are selected for the review. Tranfield et al. (2003) highlight that due to the delimitation of the material, the researcher will focus only on examining research relevant to the research question. However, they mention that the criteria are more objective when several authors have been involved in its preparation.

In this study, the research problem is divided into three parts, which means that two criteria and two separate search strings need to be developed to answer research questions. The first search string and criteria will thereby be used to determine whether green banking can contribute to mitigating climate change. The second search string and criteria look for an answer to whether greenwashing occurs in banking operations. The results of the third research question derive from the analysis of the first two research questions. This study was conducted by an individual, which may affect the objectivity of the choices.

As stated earlier, inclusion and exclusion criteria are affected by research questions and the limitations of the thesis. Due to limited resources, only available studies free of charge through the Library of the University of Jyväskylä and databases of financial authorities were included in the material. Another critical criterion was that only peer-reviewed articles written in English were selected for the material. The English language was chosen since it is commonly used in economics research. The books were also excluded from the material, as it would take an unnecessary time to analyse them. In addition, other systematic or literature reviews were excluded since the material was desired to consist only of original empirical studies. More detailed criteria for each research question are listed under the "criteria for green banking" and "criteria for greenwashing" subheadings.

Criteria for green banking

Criteria utilised for research material collection and retrieval for the first research question:

Inclusion criteria:

- Academic research published in a peer-reviewed journal
- Original article or working paper
- Published in English
- Available free of charge through the University Library of Jyväskylä
- Published in the period 2010-2022
- Quantitative and qualitative empirical studies
- Addresses green banking from a banking perspective
- The research scope is in economic zones, e.g., European Union / EEA

Exclusion criteria

- Not peer-reviewed articles
- Systematic and literature reviews
- Books

- News, columns, and editorials
- Not available free of charge through the University Library of Jyväskylä
- Published in another language than English
- Articles that are from a non-bank perspective, e.g., corporate
- Research targeting the economics of a single country rather than economic zones

Criteria for greenwashing

Criteria utilised for data collection and retrieval for the second research question:

Inclusion criteria:

- Academic research published in a peer-reviewed journal
- Original article or working paper
- Published in English
- Available free of charge through the University Library of Jyväskylä
- Published in the period 2010-2022
- Quantitative and qualitative empirical studies
- Addresses greenwashing in finance and banking operations

Exclusion criteria:

- Not peer-reviewed articles
- Systematic and literature reviews
- Books
- News, columns, and editorials
- Not available free of charge through the University Library of Jyväskylä
- Published in another language than English
- Addresses greenwashing only from a non-financial company perspective

4.3   Research material collection and critical evaluation

A comprehensive and transparent search process distinguishes the systematic review from regular literature reviews. Therefore, the research questions and inclusion criteria are considered in the collection of material, and the process is carefully documented. (Tranfield et al., 2003.) Different software may be utilised in the documentation. Boland et al. (2014) suggest that, for example, EndNote or Ref Works could be beneficial in archiving research material. However, MS Excel and Zotero software were used in the documentation process of this study since the University of Jyväskylä does not support the usage of Ref Works. Next, the various stages of the research material collection process will be described, including selecting the database, forming the search string, reading, and critically evaluating the material.

The information retrieval process started by performing test research for different databases available via the University Library of Jyväskylä. Scopus was

chosen as the database initially, as its operating system and functions were the most familiar and clear to use. It has been found that Scopus often produces more search results than, for example, Web of Science (WoS); therefore, it takes time to go through the results (Paul & Criado, 2020). In addition, the databases administered by different financial sector authorities were utilised. The following databases were chosen:

- Scopus
- European Central Bank (ECB)
- Bank of International Settlements (BIS)
- International Monetary Fund (IMF)
- OECD iLibrary
- World Bank
- National Bureau of Economic Research (NBER).

Since the research question is threefold, the search process needs to be done in multiple parts; therefore, two different search strings were formed to answer the first two research questions. The research process will be presented under the following subheadings: "a review process of green banking" and "a review process of greenwashing". The review processes are presented using the PRISMA diagram, commonly used in systematic reviews (Boland et al., 2014; Moher, Liberati, Tetzlaff & Altman, 2009).

A review process of green banking

The collection of research material began with the use of various test search strings. The first test search yielded over 1000 results, and the results eventually diminished by testing different keyword combinations. However, meaningful information about which keywords are the most relevant to this study was gained during the first searches. In addition, it was found that some words that were thought important gave too wide results, and thereby they were excluded. For example, the words "economy" and "green" were too generic and, therefore, disproportionately increased the number of search results. Besides, it was perceived that it is more accurate to combine words in pairs, like "green finance" or "sustainable finance". An important finding was that it is impractical to use the "subject area limitation" -tool since the research topic has also been covered in non-economic journals.

The search terms to capture studies related to green finance are "green finance", "sustainable finance", "green loan", "green credit", "green security", and "green investment". Similarly, the keywords to capture the banking sector are "banking", "financial institutions", "finance industry", "banking industry", and "banking sector". The search string utilised Boolean logical operators (and, or, not), of which the most useful were "AND" and "OR". The search query was formed to search the given keywords from each article's titles, abstracts, and keywords lists. Furthermore, the period was set to involve studies from 2010 to 2022 since Paul and Criado (2020) suggested that the optimal coverage should be at least ten years but even up to 30 years. In addition, the results were limited to

only including the final articles and the language of English. The databases of financial authorities do not allow the use of search strings, so only one keyword at a time was used when searching for papers. In the end, the final search string for the Scopus database was:

> (TITLE-ABS-KEY ("green financ*" OR "sustainable financ*" OR "green loan" OR "green securit*" OR "green credit" OR "green investment" OR "sustainable invest*" OR "sustainable securit*") AND TITLE-ABS-KEY ("banking" OR "bank" OR "financial institutions" OR "finance industry" OR "banking industry" OR "banking sector")) AND PUBYEAR > 2009 AND PUBYEAR < 2023 AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))

The final search result from the Scopus database was 308 articles that were screened by reading through the titles and assessing the publication journals. Only 77 articles passed the screening process, and these were assembled into an Excel spreadsheet. After that, the abstract of each article was assessed for eligibility, and as a result, 57 articles were excluded, and thus 20 articles remained. In the delimitation process, the inclusion and exclusion criteria were used, and whether the study answered the research question was considered. Thus, articles that dealt with the topic from the perspective of only one country or, for example, from the company perspective, were excluded. Papers that met the inclusion criteria were selected directly from the databases of financial authorities.

Furthermore, based on a more detailed reading of the articles, five articles were excluded as they did not meet the criteria, and eventually, 16 articles were included in the synthesis. The sources, methods, and results of the included articles are overviewed in Appendix 1. The PRISMA flow diagram presents this review process (see Figure 3).
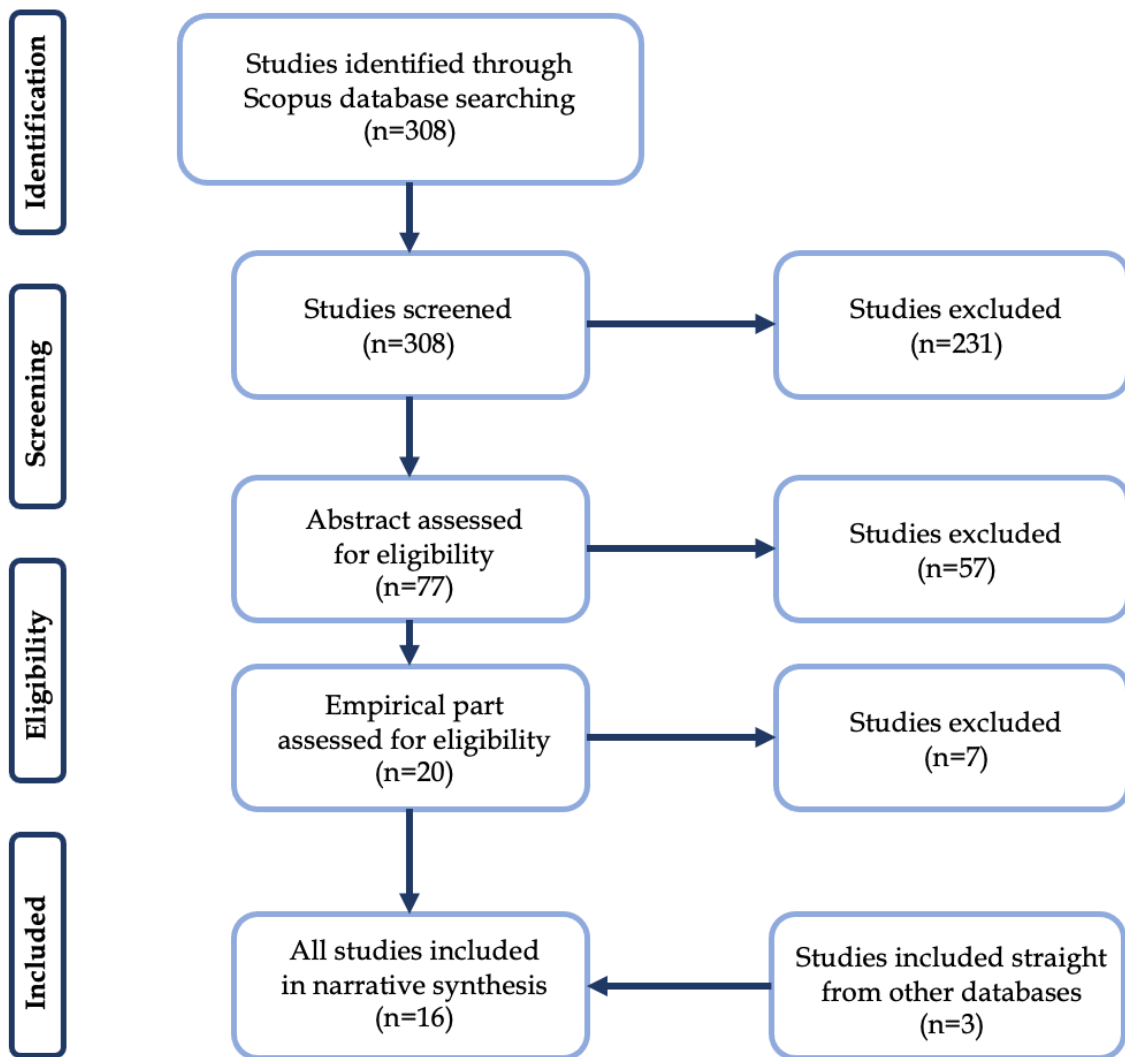
Figure 3 PRISMA diagram for the review process regarding green banking

A review process of greenwashing

The research material collection of greenwashing studies was similar to the process regarding green banking studies. The results of the first test searches ranged from 10 to more than 200 articles. It was found that a simpler search string yielded more versatile results. In addition, according to the inclusion criterion, the search results were limited to considering greenwashing in finance or banking. It was noticed in the test searches that greenwashing is mainly studied at the non-financial company level. Therefore, the search string had to be formulated to exclude company-level studies.

The search terms to capture studies regarding greenwashing are "greenwash" and "green wash" since it was noticed that the spelling varied. The keywords to capture finance are "fund", "lend", "finance", "bond", "investment", "invest", and "investing". The word "invest*" gave many results that referred to

the term "investigation"; therefore, the abbreviated form could not be used. In addition, the keyword "ESG" was included since banks commonly use the ESG framework in the loan processes to assess the environmental performance of companies. The databases of the financial authorities were also utilised when searching for studies regarding greenwashing. The period and language limitations were the same as in the search string regarding green banking. The final search string for the Scopus database was:

TITLE-ABS-KEY ("greenwash*" OR "green wash*") AND TITLE-ABS-KEY ("ESG" OR "fund*" OR "lend*" OR "financ*" OR "bond" OR "investment" OR "invest" OR "investing" OR "bank*") AND PUBYEAR > 2009 AND PUBYEAR < 2023 AND (LIMIT-TO (LANGUAGE, "English"))

The final search result from Scopus was 179 articles that were screened by reading through the titles and assessing the publication journals. 19 articles passed the screening process, and they were assembled in the Excel spreadsheet. After that, the abstracts of each article were read and assessed for eligibility, and as a result, only five articles from the Scopus database were included in the synthesis. In addition, only one article regarding greenwashing was found in databases of the financial authorities. Despite the delineation, several articles dealt with greenwashing only from the company's perspective, which resulted in limited results. The PRISMA flow diagram presents the review process (see Figure 4).
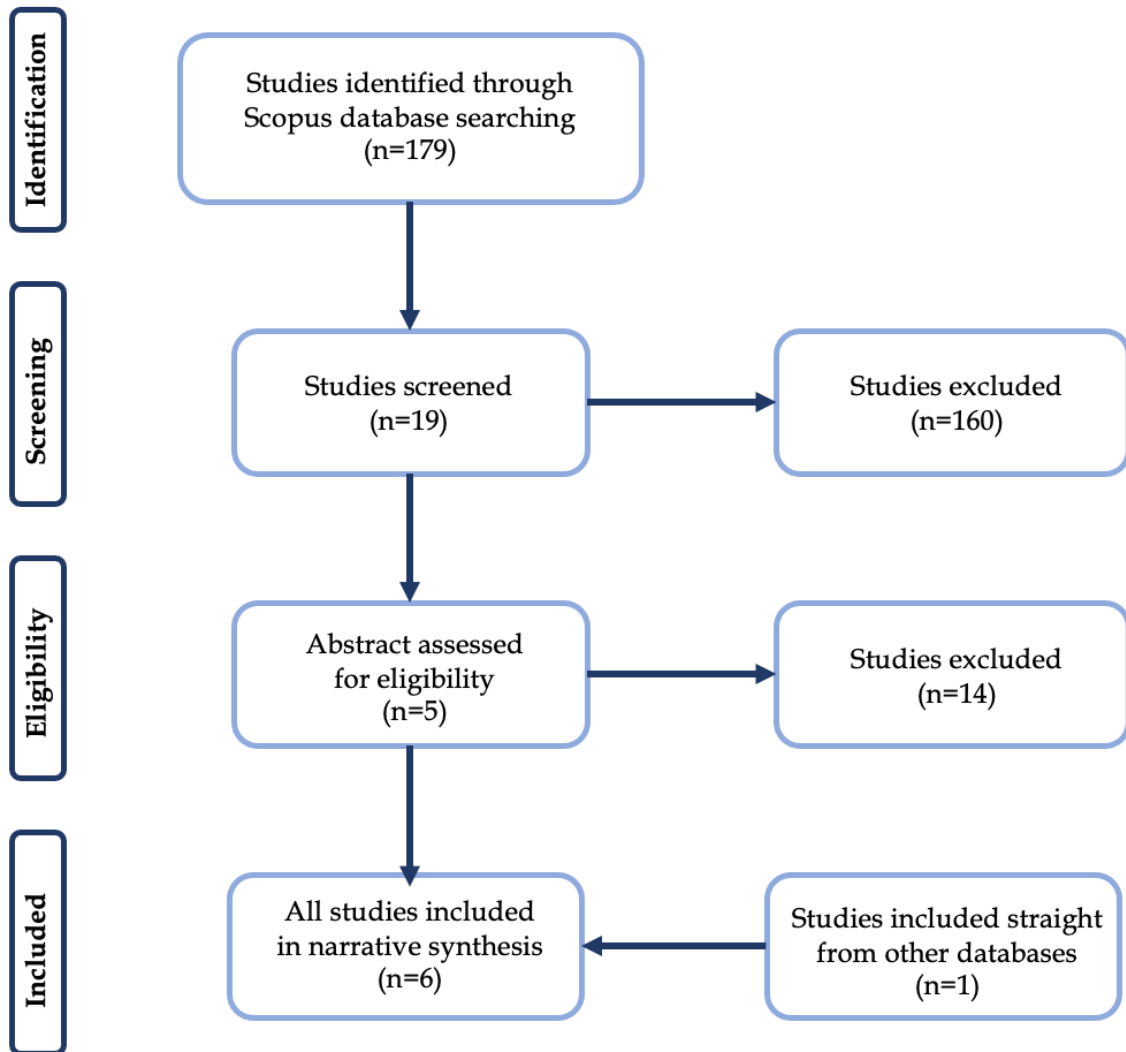
Figure 4 PRISMA diagram for the review process regarding greenwashing

In the systematic reviews, the quality assessment of the studies included in the synthesis is part of the process (Boland et al., 2014). The quality assessment aims to examine the internal quality of the studies, i.e., whether the data and results correspond to the aim and objectives (Tranfield et al., 2003). As mentioned earlier, the systematic review has long been mainly a research method in the medical field. Hence, quality assessment frameworks are primarily made for studies in that field. However, Jesson et al. (2011) provided vital dimensions that could be used when compiling quality appraisals. The list of the quality assessment questions used in this study can be seen in Appendix 2, and the answers for studies can be seen in Appendix 3.

4.4   Research material analysis

The analysis of the selected material is a vital part of the research. Jesson et al. (2011) mention that in the screening and assessing part of the process, the researchers "unpack each article". So, in the synthesis stage, each article's key findings and theories are put back together but in a new order. Hence, Jesson et al. (2011) highlighted that when making new connections between findings, it is intended to fill the knowledge gap and answer the research question. Therefore, the descriptive method can be utilised when the research material includes quantitative and qualitative studies. Thus, the research material is analysed in this study using the narrative synthesis method.

According to Jesson et al. (2011) and Popay et al. (2006), tabulation is essential to the narrative synthesis. Usually, the table collects information about the selected articles' research topics, methods, and critical findings. The purpose of the tabulation is to increase the transparency of the study, as the reader can quickly evaluate what kind of studies have been chosen for the material. The articles selected for this study are tabulated in Appendix 1. After tabulation, Popay et al. (2006) state that the results of the studies should be coded and grouped. Groups can be formed according to the differences or similarities of the research results. Finally, the codes collected from the materials are themed, and the themes are synthesised.

Popay et al. (2006) remark that the narrative synthesis process may not be transparent. This is because it is impossible to be sure when the researcher has arrived at the themes of their choice. Coding should occur without preconceived notions, but the researcher's prior knowledge and interpretation of the material will affect the outcome. The researcher must recognise the effects of the subjective perspective on the research results. (Popay et al., 2006.) The codes were mainly material-based in this study. However, I had already formed a theme related to climate-related regulation when I became acquainted with the topic.

I found the following codes in my material: *green finance, green loans, transition to green finance, climate-related regulation, green policy framework, green bonds, ESG, green investment, incentives,* and *sentiment.* After coding, the codes are classified, i.e., themed. The above codes were categorised under the following themes: *central bank mandates, incentives and sentiments, climate-related policies,* and *greenwashing.* A closer reading of the articles revealed that the article often dealt with, for example, green finance, especially from a regulatory or policy tool perspective. In addition, the articles, for example, on green bonds, dealt with the topic in more detail from the perspective of greenwashing, which is why the article under that code was themed under greenwashing. Eventually, the chosen themes emerged after a thorough review of the articles and revealed apparent similarities. However, there was a desire, for example, to differentiate between central bank mandates and climate-related policies under different themes, as mandates can be seen as a general description, while policy tools as more specific guidelines.

4.5   Description of research material

An important part of the process is to describe the collected research material for a systematic review. This chapter briefly introduces the main themes of the selected articles, publication information, and research methods used. More detailed information on each article is collected in a table in Appendix 1. The purpose of the tabulation and description of the research material is to increase the transparency and credibility of the research.

The final research material of the study consists of 22 articles, of which 16 considered green banking and seven greenwashing in the finance and banking sector. The articles are divided into four different themes:

1) central bank mandates (Baer, Campiglio & Deyris, 2021; Campiglio, 2016; Chenet, Ryan-Collins & van Lerven, 2021; Dikau & Volz, 2021; D'Orazio, 2021; D'Orazio & Popoyan, 2019)

2) incentives and sentiments (Cui, Geobey, Weber & Lin, 2018; Dunz, Naqvi & Monasterolo, 2021; Ehlers, Packer & de Greiff, 2021; Reghezza et al., 2021; Sun, Wang, Yin & Zhang, 2019; Umar, Ji, Mirza & Naqvi, 2021)

3) climate-related policies (Baer et al., 2021; Campiglio, 2016; Chenet et al., 2021; Cui et al., 2018; Dafermos, Nikolaidi & Galanis, 2018; Dafermos & Nikolaidi, 2021; D'Orazio, 2021; D'Orazio & Popoyan, 2019; Dunz et al., 2021; Ferrari & Nispi Landi, 2020; Sun et al., 2019)

4) greenwashing (Baldi & Pandimiglio, 2022; Ehlers et al., 2021; Fatica & Panzica, 2020; Tuhkanen & Vulturius, 2020; Xing, Zhang & Tripe, 2021; Xu et al., 2022; Zhang, 2022).

Some of the articles considered several different themes, like Campiglio (2016) and Dunz et al. (2021), but for the most part, each article dealt with the subject under one theme. The research material consists of articles published from 2016 to 2021, even though the period was set to be 2010 to 2022. This can be explained by the Paris Agreement's introduction in 2015. As a result, climate-related financial regulations have increased, and research regarding banking and climate change has also increased.

In economics, quantitative research methods are commonly distinguished, which was also reflected in the research material. However, selected studies regarding policies, regulations and mandates utilised qualitative methods by compiling frameworks covering current financial policies and analysing how they can limit climate change. Baer et al. (2021) studied whether the current regulation allows financial authorities to take action to curb climate change. Campiglio (2016) concentrated on assessing the possible effects of introducing the carbon price. Similarly, Chenet et al. (2021) estimated why introducing a precautionary approach toward climate-related risks could be beneficial.

Furthermore, D'Orazio (2021) examined how the new policies introduced during the pandemic take climate-related issues into account. D'Orazio and Popoyan (2019) surveyed macroprudential regulation and policy tools used in different economic zones: OECD, EU, and low-income countries. Dikau and Volz (2021) compared the climate-related policies implemented by central banks to their mandates and objectives. Further, Steffen (2021) made a comparative analysis of green financial policies implemented in OECD countries from 2001 to 2019 to assess if the policy output has changed after the introduction of the Paris Agreement.

Studies that considered the implementation of different policy tools exploited mainly quantitative methods. Dafermos et al. (2018) and Dafermos and Nikolaidi (2021) utilised the DEFINE (Dynamic Ecosystem-FINanceEconomy) model, which is one of the few macroeconomic models that allow analysing of the relationship between climate change and financial system. Whereas Ferrari and Nispi Landi (2020) exploit the DSGE model, which is commonly used when assessing the effects of quantitative easing programs, they modify it to consider green QE, which allows distinguishing green and brown bonds.

Quantitative research methods were utilised in the studies that examined how banks' sentiments about climate change and the incentives for climate-friendly measures are reflected in their actions. Dunz et al. (2021) developed a macroeconomic behavioural, Stock-Flow Consistent model, which allows for analysing of the implementation of climate-related policies and banks' behaviour. Reghezza et al. (2021) examined how the introduction of the Paris Agreement and the withdrawal of the US from the agreement were reflected in banks' lending processes by utilising loan-level DiD (difference-in-difference) and triple-difference panel regression analysis. Similarly, Sun et al. (2019) also used the DiD and synthetic control methods (SCM) to analyse whether China's green credit policy has impacted companies' environmental performance. Umar et al. (2021) studied how green lending may affect the credit risk of banks in the Euro area by analysing 344 lenders in the period 2011 to 2020 by using two credit risk measures: "an ex-ante estimate of the probability of default and an ex-post credit infection ratio". Ehlers et al. (2021) utilised regression analysis to test if the carbon risks are included in the price of syndicated loans.

Studies regarding greenwashing mainly utilised quantitative research methods. The paucity of research related to greenwashing in banking can be explained by the issue that capturing greenwashing may be challenging. Baldi and Pandimiglio (2022) compiled hypotheses about the effect of greenwashing and ESG factors on green bond yields and tested the hypotheses using regression models. Similarly, Fatica and Panzica (2020) applied regression analysis methods to analyse whether green bond issuers are more engaged in environmental activities than conventional bond issuers. Conversely, Tuhkanen and Vulturius (2020) conducted a desk review by compiling publicly available reports of green bond issuers to analyse if their environmental actions align with the green bond framework. Xing et al. (2021) utilised DiD-model to test whether companies benefit from green credit if they are engaged in green innovation activities or have environmental external disclosure. Xu et al. (2022) used the OLS regression analysis to examine how environmental regulation fosters green finance and

whether the companies are greenwashing their activities to benefit from it. Zhang (2022) studied which factors motivate firms to greenwash their operation by using regression analysis to analyse the relationship between companies' ESG scores and greenwashing activities.

The main publication channel for the articles in the material was *Ecological Economics,* which had published six articles (Baer et al., 2021; Campiglio, 2016; Chenet et al., 2021; Dafermos et al., 2018; Dikau & Volz, 2021; D'Orazio & Popoyan, 2019). Two articles, (Dafermos & Nikolaidi, 2021; Dunz et al., 2021), were published in the *Journal of Financial Stability,* and the other two, (Ferrari & Nispi Landi, 2020; Reghezza et al., 2021) as an *ECB working paper*. The rest of the journals published individual articles. A table of publication channels can be found in Appendix 4, and a table of publication years of the articles in Appendix 5.

5 RESULTS

In this chapter, I compile my material into synthesis and discuss the themes found from the material in the following subchapters: 5.1 central bank mandates, 5.2 banks' sentiment and incentives to limit climate change, 5.3 climate-related policies and 5.4 greenwashing in the activities. I examine the role of banks in mitigating climate change following my first research question. The first three themes are strongly related to the first research question since the possibility of banks being part of the green transition of the economy can be viewed from several perspectives. In this chapter, I also answer my second research question regarding the greenwashing activities in banks' operations.

5.1 Central bank mandates

Climate change has been recognised as creating climate-related financial risks (CRFRs), which also indirectly affect the main task of central banks, i.e., price stability, which promotes, e.g., economic growth and employment. Although there is a common view that central banks cannot ignore the effects of climate change, there is still no consensus on the extent to which climate change should be included in the current activities of central banks. For instance, D'Orazio (2021) explained that some find the expansion of monetary policy instruments problematic and think that central banks should continue the "market neutral" approach. On the other hand, Chenet et al. (2021) suggested that the central banks should be considered more independent decision-makers to allow more effective action to curb climate change.

Dikau and Volz (2021) found that most central banks do not have sustainability directly defined in their mandates. Therefore, they were cautious about the extent to which sustainability factors should be included in the policy framework of central banks. According to Dikau and Volz (2021), central banks could use various policy tools to promote the green transition. Still, their suitability for the mandates should be ensured so that the central bank's main task, maintaining price and financial stability, would not be jeopardised. Baer et al. (2021) argued

that current monetary policies and financial regulations could not steer private investment into a more carbon-neutral direction in the European Union and other Western countries. They appraised that as long as the central bank's role is to harmonise the financial system and prevent financial risks, they cannot favour carbon neutrality in their decision-making.

Chenet et al. (2021) stated that when the mandates of central banks are limited, the necessary policy implementations are under the responsibility of governments. They were concerned that politicians' decision-making would be influenced by the opinions of many actors, such as lobbyists of the energy sector. Thus, governments may not be able to push through effective environmental policies. Even though central banks may not have the support of governments, Chenet et al. (2021) noted that they have the support of many third-party operators, like the IPCC and the Paris Agreement. Baer et al. (2021) suggested cooperation between governments and central banks since the political authorities are needed to enable the central banks to broaden their operating models to favour green activities in their decisions.

Studies have also found differences between economic zones regarding the possibility of banks including climate actions in current mandates. According to D'Orazio and Popoyan (2019), the difference between developed and developing countries is that the central banks in emerging economies have set more goals and functions regarding climate change mitigation since they are more exposed regionally to the effects of climate change. For these reasons, low-income countries need fast and short-term effective solutions. On the other hand, Campiglio (2016) considered that these differences occur since, in emerging economies, central banking is usually under more vital public control and therefore, the new policies are implemented faster. Furthermore, Baer et al. (2021) point out that in developing countries, such as China, the state directs the market daily by allocating financial capital. In Europe, the free-market approach is used, and central banks are independent delegated authorities.

D'Orazio and Popoyan (2019) discovered how mandatory and voluntary green regulations differ between countries and regions. They found that compulsory green regulations were primarily adopted in emerging economies, like East and South Asian countries. Similar results were gathered from Brazil and Nigeria, where voluntary green regulations were adopted. On the contrary, high-income countries, such as the European Union countries, have not yet implemented mandatory regulations since the CRFRs are still just part of the discussion at the policy level.

Chenet et al. (2021) pointed out two critical problems in the central banks' mandates that make managing CFRFs challenging. The first challenge is the short-term horizon of the mandates, while the CFRFs mainly have long-term effects. Dikau and Volz (2021) recognised the same "time inconsistency" problem. According to them, climate measures extend the time horizons of economic policy from the business cycle to even longer than a generation. However, they estimated that central banks have better opportunities to manage longer time horizon measures than other actors.

In addition, it has been observed that Basel III supports short-term measures, which can retard the banks' green transition. According to D'Orazio

and Popoyan (2019), the Basel III may cause a "carbon bias", which means that the current financial framework, including investment processes, accounting, and financial regulations, allows a situation where green projects are not desirable due to the possible inconvenience they cause. One such problem is that the Basel III enables short-term carbon-intensive assets to be favoured over long-term green investments. Furthermore, D'Orazio (2021) was concerned that the G20's exposure to climate-related financial risks would increase as current macroprudential financial policies do not take climate change sufficiently into account, thus allowing lending to continue into the carbon-intensive sectors.

The second challenge that Chenet et al. (2021) identified is that the current policy framework fails to respond to the CFRFs because mitigation actions are postponed since decision-makers wait for more detailed information about the effects of the climate-related risks to financial markets. D'Orazio and Popoyan (2019) estimated that risk identification and robust stress tests are the first steps in climate risk management. Only after this can it be assessed which policy tools could be implemented. However, they stated that due to the lack of a common taxonomy and definition of "green", the green transition of banks is not proceeding as desired.

5.2   Incentives and sentiments

This section highlights how banks' incentives and climate sentiment are instrumental in the green transition of the economy. Incentives mainly refer to banks' financial incentives when financing green projects or environmental-friendly companies. In comparison, the climate sentiment of banks indicates whether it is essential that they can contribute to climate change mitigation.

Umar et al. (2021) found that green lending can reduce banks' exposure to credit risk. They explained that carbon-neutral companies have more stable earnings and cash flows, meaning their solvency remains better than high-emission companies. In addition, the recovery rates of green companies are commonly higher, and therefore, the default risks of banks decrease. This can also be explained by the findings of Ehlers et al. (2021), who assessed that high-carbon companies might have stranded assets since, for example, the financial value of fossil fuel reserves declines due to environmental regulations, leading to a situation where companies do not have sufficient assets to cover the loans. In addition, they noted that high-carbon companies might also receive additional fees, such as Carbon Tax, which lowers business profits.

Although studies show that financing environmentally friendly projects may reduce the bank's credit risk, it has been found that banks also need other incentives. For example, Ehlers et al. (2021) perceived that even though the "green banks" funded fewer high-emission companies than conventional banks, they did not inherit a higher carbon premium. Green banks are financial institutions that have signed either the UNEP FI or the Equator Principles. Thus, Ehlers et al. (2021) recommended that financial institutions have incentives fixed by regulators to urge banks to consider companies' overall emissions better in loan

pricing. In addition, they observed that banks are not yet sufficiently incorporating carbon risks in loan pricing. Banks focus only on the emissions produced by the borrower and not the entire production chain emissions, which makes the borrower's carbon footprint appear lower than reality.

In addition to the incentives set for banks, it has been noticed that banks' sentiment about climate change can accelerate the green transition of the economy. Reghezza et al. (2021) found that European banks reduced their financing of the high-carbon sector when the Paris Agreement entered into force. The same happened in 2017 when President Trump withdrew from the agreement. Reghezza et al. (2021) explained the phenomenon by the fact that banks' awareness of climate-related risks increased, and they began to expect stricter regulations. Similarly, Dunz et al. (2021) assessed that the impact of banks' sentiment could be observed in the increase of the interest rate levels of high-carbon companies before, for example, the carbon tax was put into effect.

According to Dunz et al. (2021), banks' sentiment about climate change and climate-related policies affect how the green transition of the economy is reflected in financial stability. They explained this by noting that when banks, for example, change the loan conditions of high-carbon companies before regulations and policy measures have been implemented, volatility is reduced when policies come into effect and thus is reflected in financial stability. Dunz et al. (2021) stated that the banks' sentiment accelerates the effectiveness of policy measures earlier and more intensely than if the banks had no sentiment.

5.3 Climate-related policies

This section discusses the literature demonstrating the role of policy tools in mitigating climate change. Policies are macroeconomic tools drawn up by governments and central banks. By modifying spending and tax policies, governments apply fiscal policies to influence the economy. At the same time, monetary policies are tools central banks use to control price stability and money supply and promote sustainable economic growth.

While reviewing the policy implementations in G20 countries from 2000 to 2020, D'Orazio (2021) observed that each country had introduced at least one climate-related policy measure. However, the measures implemented were mainly "soft", like disclosure requirements for financial companies. Still, more crucial measures, like stress testing, have been postponed - one of the latest reasons being the Covid-19 pandemic. D'Orazio (2021) put together recommendations of sufficient climate-related policies that can be divided into capital, liquidity, and large exposure measures, and classified by their effects on combating climate risks, increasing green financing and smoothing financial stability (see Figure 5). In this section, the climate-related policy measures proposed in Figure 5 will be discussed in more detail.

Classification		Measure	Potential impact on the objective:		
			Tackling climate-related financial risks	Incentivising green finance	Financial stability
Capital	Level and quality of capital	*CAR with DBF*	Direct positive impact	Indirect positive impact	Indirect negative impact
		CAR with GSF	Direct positive impact	Indirect positive impact	Indirect negative impact
		Sectoral capital requirements	Direct positive impact	Indirect positive impact	Indirect negative impact
	Leverage	*Sectoral leverage Ratios*	Direct positive impact	Indirect positive impact	Indirect negative impact
	Risk management and supervision	*Climate-related stress tests*	Direct positive impact	No impact	Indirect positive impact
		Internal Capital Adequacy Assessment	Direct positive impact	No impact	Indirect positive impact
		Green Asset Ratio	Direct positive impact	No impact	Indirect positive impact
	Market discipline	*Climate-related disclosure requirements*	Direct positive impact	No impact	Indirect positive impact
		China Green Credit Policy	Direct positive impact	Indirect positive impact	Indirect positive impact
Liquidity		*Standard liquidity coverage Ratio*	Direct negative impact	Direct negative impact	Indirect positive impact
		Climate-related liquidity coverage Ratio	Direct positive impact	Indirect positive impact	Indirect positive impact
		Standard Net Stable Funding Ratio	Direct negative impact	Direct negative impact	Indirect positive impact
		Climate-related Net Stable Funding Ratio	Direct positive impact	Indirect positive impact	Indirect positive impact
Large exposure		*Climate-related Large Exposures Restrictions*	Direct positive impact	Indirect positive impact	Indirect positive impact
Quantitative easing		Green Quantitative Easing	Direct positive impact	Indirect positive impact	Indirect positive impact
Taxation		Carbon Tax	Direct positive impact	Indirect positive impact	Indirect negative impact

Legend: Direct positive impact · Indirect positive impact · Direct negative impact · Indirect negative impact · No impact

Figure 5 Overview of climate-related policy measures and their impact on CFRFs, green finance and financial stability (Data in *italics* is taken from D'Orazio (2021))

Baer et al. (2021) scrutinised policy measures from three different perspectives. First, they divided the measures into prudential or promotional based on their motive. They then assessed whether the actions were informative, incentive, or coercive and, lastly, whether the executor is political (government) or delegated (central bank) authority. Baer et al. (2021) claimed that in the European Union, financial policies are mainly proposed with informational measures to attain the allocation of financial capital (promotional) and to ensure financial stability (prudential). The informational policy tool enables central banks to spread climate-related information to all market participants. They estimated that more robust promotional policies, including incentive- and coercive-based tools, are needed to achieve the climate-related goals. On the contrary, Baer et al. (2021) pointed out that more versatile policy tools are used in emerging economies.

According to Baer et al. (2021), informational measures include three main categories: "clarification of concepts and standards", "development of risk assessment methodologies", and "disclosure of risk assessment". D'Orazio and Popoyan (2019) considered that a common taxonomy and disclosure framework should be drawn up as a priority to allow more detailed policy tools to be introduced. The purpose of the taxonomy is to jointly define what is meant by sustainable and green financial activities. In addition, Chenet et al. (2021) stated that the capital allocation towards a more sustainable direction would increase if the companies' disclosure requirements regarding, e.g. their exposure and

assessment of CFRFs would tighten. Furthermore, D'Orazio (2021) added that banks' disclosure requirements could include a comparable metric, the Green Asset ratio, showing the percentage of environmentally friendly assets in lenders' balance sheets.

Although risk assessment is a vital part of informational measures, D'Orazio (2021) discovered that only a couple of the G20 countries use stress testing and scenario analyses when considering climate-related financial risks in their decision-making. However, Chenet et al. (2021) noted that current instructions by the NGFS guide the individual central banks and supervisors to use scenario-based risk analysis to take risks into account in their actions. They estimated that scenario analysis and stress testing is challenging since the CFRFs are highly uncertain. Therefore, the possibilities of different outcomes are hard to calculate. Furthermore, Chenet et al. (2021) highlighted that typically risk analyses are calculated based on past events. The effects of these new types of risks are difficult to assess based on the past.

Baer et al. (2021) identified incentive policies that aim to shape capital allocation. They argue that incentive policies may increase the attractiveness of sustainable investments (promotional) or reduce investors' exposure to CRFRs (prudential). The introduction of "green differentiated capital requirements" (GDCRs) has been examined in the literature as incentives. Dafermos and Nikolaidi (2021) reviewed the introduction of the green supporting factor (GSF) and dirty penalising factor (DPF) in the transition to a low-carbon economy. The GSF means that the banks can hold less capital for loans granted for low-carbon activities. On the other hand, the DPF refers to the banks' need to maintain higher capital on loans for high-carbon projects. Dunz et al. (2021) specified that the GSF enables lower interest rates for green companies.

While analysing the GSF, Dafermos and Nikolaidi (2021) found that it lowers the risk weight of green loans, increasing the capital adequacy ratio and decreasing the credit rationing. On the contrary, they examined that in the implementation of the DPF, the risk weight of conventional loans increases, decreasing the capital adequacy ratio and, thus, increasing the credit rationing of high-carbon loans. Additionally, Dunz et al. (2021) showed that as financing costs of green companies decrease, it is reflected in the prices of products and ultimately affects their popularity over high-emission products through rising demand.

However, the benefits of implementing the GDCRs individually remain low, but Dafermos and Nikolaidi (2021) suggested that they should be used simultaneously or together with green fiscal policies. The adverse transition effects can be reduced when the factors are implemented together, and their combined efficacy is also better. Equally, Dunz et al. (2021) noticed that the change in interest rates for green loans needs to be very high to make a difference, thereby affecting financial stability. They also noted that the interest rate channel is not a strong enough way to reallocate loans. Therefore, Dunz et al. (2021) suggested that GDCRs should be implemented simultaneously and with other regulative matters.

In addition to the policy measures presented above, D'Orazio (2021) proposed introducing adjusted liquidity requirements and green-enhanced large exposure restrictions (see Figure 5). The purpose of adjusted liquidity requirements

is to manage stranded assets caused by climate change, i.e., liquidity risks arising from climate-related risks. D'Orazio (2021) specified that a "greened" liquidity coverage ratio could be implemented to limit capital to high-carbon assets. At the same time, they introduced that "a lower stable fund ratio in a 'greened' net stable funding ratio" would increase green assets held by banks. D'Orazio (2021) estimated that introducing the mentioned measures would not require significant changes, as Basel III includes both a net stable funding ratio (NSFR) and a liquidity coverage ratio (LCR). The NSFR and the LCR are intended to be separate but complementary incentive measures, with the NSFR having prudential while the LCR has a promotional motive.

D'Orazio (2021) described that the purpose of large exposure restrictions is to increase financial system resilience and reduce the occurrence of potential vulnerabilities. Large exposure restrictions set a limit to prevent disproportionately large losses due to the failure of a single customer or group of customers. According to D'Orazio and Popoyan (2019), green-enhanced large exposure restrictions could limit banks' customers with high-carbon assets and protect banks from transition risk. They estimated that credit restrictions are a possible way to limit banks' exposure to climate-related risks. However, D'Orazio and Popoyan (2019) stated that first, it is necessary to determine a large exposure restriction to carbon assets, i.e., the appropriate limit in percentage terms.

In addition to the policy measures introduced by D'Orazio (2021), Figure 5 also presents other proposals for suitable policies that emerged from the research material. One suggestion is to utilise unconventional monetary policy tools, i.e., green quantitative easing. Dafermos et al. (2018) studied how the green quantitative easing (QE) programme could help to mitigate global warming. Similarly, Ferrari and Nispi Landi (2020) concentrated on the possible effects of introducing a temporary green QE as a monetary policy tool, where the bank's balance sheet temporarily includes more green bonds.

Dafermos et al. (2018) found out that the green QE raises the price of green corporate bonds and thus lowers their yields. After, borrowing costs decrease, and companies are no longer as dependent on bank loans as investments in general grow. They highlighted that a notable effect is that as the yield on green bonds declines relative to brown bonds, the popularity of green investments increases. Ferrari and Nispi Landi (2020) received corresponding results from temporary green QE when green and brown bonds were imperfect substitutes, while otherwise, the effects were minor.

Nonetheless, Dafermos et al. (2018) assessed that curbing climate change through the interest rate channel alone is ineffective since the decrease in green bond yield cannot make green investments attractive enough. Ferrari and Nispi Landi (2020) pointed out that the temporary green QE cannot influence long-term factors such as atmospheric carbon. Therefore, they suggested that future research should study the effects of long-term green QE since the temporary green QE had only minor effects. Additionally, Dafermos et al. (2018) noted that the green QE should be used as a long-time-period industrial policy tool instead of cyclical like regular QE.

The articles discussed above mainly examine policy measures in Europe and other high-income economies. In contrast, Sun et al. (2019) and Cui et al.

(2018) examined the green credit policy (see Figure 5), which is currently only used in China. Sun et al. (2019) studied if implementing green credit policies in China would urge companies towards more climate-friendly actions since the loan process would include assessing a company's environmental performance. In addition, Cui et al. (2018) analysed whether green credit policy would lower banks' credit risk and stimulate green lending. According to Sun et al. (2019), the green credit policy recommends that banks utilise the information of companies collected by the local environmental authority, thereby granting loans for green companies and limiting access to finance for polluting companies.

Sun et al. (2019) pointed out that high-emission companies would be forced to change their operating models to obtain external financing due to the green credit policy. Furthermore, all companies would have to consider the long-term environmental impact of their operations to continue receiving funding. In addition to companies, the green credit policy also motivates banks to increase green lending. As Cui et al. (2018) noted, banks' non-performing loans (NPL) ratio simultaneously lowers with a higher green lending ratio. This can be explained by the institutional and credit risk theory. Cui et al. (2018) estimated that the green credit policy imposes institutional pressure on banks to increase green lending. They also noted that the environmental risk is reflected in the credit risk components of polluting firms. Therefore, increasing polluting firms' interest rates will eventually reduce their solvency and activity ratio.

According to Sun et al. (2019), businesses in China have exploited the pollution prevention method rather than end-of-pipe treatment since it is more effective in the long term allowing companies to benefit from the green credit policy. Sun et al. (2019) proposed that the green credit policy tool effectively allocates funding in a more sustainable direction. Similarly, Cui et al. (2018) concluded that reducing credit risk motivates banks to increase green lending and thus, a green credit policy is a viable solution. However, Sun et al. (2019) mentioned that a green credit policy is insufficient, as companies that are not dependent on external financing will not have to change their operating models. Moreover, companies whose access to credit is otherwise challenging are also excluded from this policy.

The last presented measure in Figure 5 is a carbon tax implemented by governments, which may play an essential role in the green transition of the economy. Dunz et al. (2021) studied if introducing a carbon tax would increase green investment. They demonstrated that a carbon tax would be levied on enterprises and organisations that produce emissions through their operations. Firstly, implementing a carbon tax would affect the real economy by increasing the production costs for polluting companies and thus raising the price of these products. Secondly, this would influence the purchasing behaviour of consumers and ultimately lower the revenue of affected companies. Finally, a carbon tax would reduce the profitability of companies and thus weaken their loan conditions and solvency.

However, there has been much debate about introducing a carbon tax. In his study, Campiglio (2016) stated that a carbon price system through tax or emission permits would not significantly impact climate change since the banking sector is crucial in channelling finance towards more sustainable operations.

Similarly, Sun et al. (2019) estimated that trading emission permits have failed in China and therefore have not been effective in reducing emissions. In addition, Campiglio (2016) noted that the design of the tax rate has been controversial since it is difficult to assess which stage of production emissions should be taxed and whether the high-emission products should be included. Dunz et al. (2021) highlighted that it is conceivable that implementing a carbon tax system could still have positive impacts since the governments could, for example, channel collected taxes to green investments.

5.4   Greenwashing

This section synthesises the research material regarding greenwashing. Empirical studies have not dealt extensively with the relationship between banking and greenwashing. However, the literature has examined the possible greenwashing actions in green finance, including the markets for green bonds and green credit. Furthermore, evaluating greenwashing has been challenging when there is no common taxonomy and definition for "green".

Fatica and Panzica (2020) studied whether the issuers of green bonds are engaged in environmental activities or just greenwashing their activities. Similarly, Tuhkanen and Vulturius (2020) examined the connection between green bond issuers' climate targets, their green bond framework and post-issuance reporting to observe possible greenwashing activities. In comparison, Baldi and Pandimiglio (2022) concentrated on assessing how an issuer's ESG rating and greenwashing practices may affect the yield of the green bond.

According to Fatica and Panzica (2020), the current regulatory framework allows companies to reap the benefits of green finance without operating in an environmental-friendly manner. They were also concerned that there is currently a tendency to use green bonds to finance existing climate projects previously funded with conventional bonds, which means that funding for climate-friendly projects does not necessarily increase, even if sales of green bonds seem to increase. In turn, Tuhkanen and Vulturius (2020) highlighted that green bond issuers are not active in the post-issuance reporting regarding the processes financed and climate targets achieved by green bonds. The lack of transparency and disclosure requirements may enable greenwashing activities.

Fatica and Panzica (2020) observed that the environmental performance of companies improved after issuing green bonds. They found that the carbon emissions of green bond issuers decreased compared to conventional bond issuers after the introduction of the Paris Agreement. Also, green bonds with external review had a better environmental performance. Fatica and Panzica (2020) defined the environmental performance of green bonds by calculating the change between total and direct carbon dioxide emissions "normalised by the book value of total assets". The results were valid for companies that have issued a green bond to fund a new climate-friendly project.

Baldi and Pandimiglio (2022) examined separately bonds issued by the private and public sectors. The green bonds issued by local governments have a

lower risk of greenwashing than those issued by multinational or sovereign operators, as investors can better ensure that the agreed sustainable actions are implemented. Similar findings were gathered when Baldi and Pandimiglio (2022) studied how greenwashing behaviour in the service and manufacturing sectors differed. Green bonds issued in the manufacturing industry are more exposed to greenwashing as it is more difficult for investors to monitor the implementation of promised environmental activities post-issuance. In addition, they discovered that greenwashing practices are easier to implement in the financial sector, as their operations are challenging for an individual investor to assess.

Tuhkanen and Vulturius (2020) found that the climate targets of issuers were only set for the short term and were not ambitious. In addition, the coherence of climate targets and green bond frameworks are not sufficiently regulated or controlled by an external operator, allowing greenwashing behaviour. They proposed that similar problems also persist with post-issuance reporting. According to Fatica and Panzica (2020), green bonds that have used an external audit are more likely to have a better environmental performance than bonds that have not used one. Similarly, Baldi and Pandimiglio (2022) recommended that rating agencies should enhance their ESG ratings regarding green bonds issued by manufacturing companies, states and supranational organisations. This could reduce the risk of greenwashing in green bonds. They also stated that a classification system is needed to form a quality benchmark for green bonds and thus harmonise the green bond market to eradicate the greenwashing behaviour of issuers.

In addition to green bonds, the research material revealed that greenwashing has also been studied in China's green finance market. Xing, Zhang and Tripe (2021) studied the green credit policy of China by examining if the quality of companies' environmental disclosure or engagement with green innovation allows better access to credit. According to them, the functionality of China's green credit policy is essential for achieving transnational climate goals. Xing et al. (2021) found that companies with high green innovation performance are better able to obtain bank loans since banks can be confident that green finance is flowing towards environmental-friendly activities. In addition, when improving environmental performance, it has been observed that the financial performance of companies also improves, which encourages banks to finance green innovation.

On the contrary, Xing et al. (2021) highlighted that the quality of external disclosures does not affect the ability to obtain bank loans, as the banks estimate disclosures to include greenwashing activities. Their research divided disclosure into "soft" and "hard" categories. Soft disclosure refers to information compiled internally by the company, while hard disclosure refers to information based on comparable data that an external auditor can verify. They found that companies with "soft" disclosure may involve greenwashing, which is why banks do not offer such companies green financing. Although "hard" disclosure appears to be more reliable, it cannot be used in the credit decision process, as it is non-standardized and may, therefore, also contain greenwashing. Hence, Xing et al. (2021) suggested that green innovation is the most efficient way to assess the environmental performance of companies. However, neither green innovation nor "hard" disclosure is included in the green credit policy of China.

By analysing Chinese listed companies with environmental expenditures, Xu et al. (2022) observed that companies' industry and ownership structure impact how green finance encourages them to be more environmental-friendly. They assessed that state-owned companies have access to finance more easily; therefore, funding is not dependent on the climate action of the company. Thus, the green finance framework fosters non-state-owned companies primarily to incorporate green projects to access green credit.

Xu et al. (2022) noticed the difference between manufacturing and non-manufacturing companies' green activities. As manufacturing companies are considered high-pollutive, their environmental expenditures are also the highest, and therefore they need green funding to reorganise their operations in a climate-friendly way. Conversely, they observed that non-manufacturing and service companies have greenwashing behaviour, and thereby they misuse the green finance framework to fund their projects that are not necessarily green. Xu et al. (2022) estimated that the Chinese government is having difficulty recognising the difference between green operations and greenwashing of companies, resulting in a misallocation of green funds and an environmental regulation not working as intended.

The information provided by the companies is an essential part of the banks' financing decision process; therefore, companies can take advantage of how they display their information to banks. Zhang (2022) examined if the financial constraints of companies induce their greenwashing behaviour. They highlighted that availability and quality of data deduct the information asymmetry between banks and companies. Furthermore, companies' ESG practices positively affect their access and cost of external financing, thereby mitigating their financial constraints. Zhang (2022) found that ESG practices may lead to companies greenwashing their activities to access cheaper funding. In addition, they noted that the greenwashing behaviour increased for high-leverage and less externally controlled companies.

While studying how the carbon risk is included in loan pricing, Ehlers et al. (2021) noticed that the banks mainly count on carbon emissions directly induced by the firm. This means that the actual carbon footprint of a company is not included in the cost of the loan when indirect emissions are not considered. According to Ehlers et al. (2021), this can lead to companies greenwashing behaviour if they outsource the areas that produce the most emissions. Thus, the total carbon footprint appears more minor than reality, and companies can exploit green funding.

6 DISCUSSION AND CONCLUSIONS

6.1 Discussion

This study aimed to examine how green banking can contribute to climate change mitigation and whether the greenwashing of operations hinders the green transition. A systematic literature review was utilised as the research method to answer three research questions:

1. How can green banking contribute to mitigating climate change?
2. What kind of greenwashing actions appears in banks' operations?
3. Does greenwashing have a negative impact on the green transition of the economy?

I have answered the first two research questions in Chapter 5, but next, I will rehearse the main points that emerged. Finally, I will answer the third research question using the green finance and banking concepts presented in the second chapter and the outcome of the results.

The role of central banks in mitigating climate change can be considered essential, as their actions and decisions can steer finance in a more sustainable direction. However, studies do not entirely agree on whether central bank mandates should be extended to account for climate issues. In addition, there is no clear answer as to whether central banks should continue the market-neutral approach (D'Orazio, 2021) and focus only on the current main tasks, i.e. maintaining price and financial stability (Baer et al., 2021). It was stated in the second chapter that climate risks (transition and physical) are also transmitted to financial risks through the micro and macro levels (*Overview of Environmental Risk Analysis*, 2020). Therefore, central banks cannot ignore the effects of climate-related financial risks in their operations since they will eventually be reflected in financial stability through stranded assets and other indirect effects.

It was also found that there are differences between central banks, particularly in emerging and developed countries, regarding their ability to integrate

climate action into existing policies or to adjust their policies. In developed regions, such as Europe, central banks are delegated authorities, which allows banks to choose which monetary policy measures they consider suitable within the limits of their mandates. Whereas in China, for example, the political authors play a significant role in the actions taken by central banks, which has allowed for the rapid implementation of climate measures (Baer et al., 2021; Campiglio, 2016). However, it can be argued that political and delegated authorities have complementary roles, each enabling the other to take decisions that would not be possible for the other. For instance, governments can expand central banks' mandates to a better account of environmental issues (Baer et al., 2021), as it is not always possible for political authorities to make sufficiently robust decisions regarding climate-related issues (Chenet et al., 2021).

Climate risks are reflected in the economy, and thereby, regulators and central banks should consider this when drafting new policies. However, policymakers need to note that the effects of climate change are reflected in a longer time horizon than is customary in conventional financial risks (Chenet et al., 2021). Often actions are assessed in business cycles that can last from a couple of years to 10 years, while climate change can be thought of as affecting longer than a generation (Dikau & Volz, 2021). In addition, not all potential climate-related risks can be predicted, as there is no complete certainty about how global warming will affect different areas. Therefore, the financial sector should change its thinking from "backward" to "forward" looking (Chenet et al., 2021) and develop long-term policy tools to complement or replace existing short-term tools.

It has been suggested that banks should adopt stress-testing and scenario analysis tools to assess climate-related financial risks (Chenet et al., 2021; D'Orazio, 2021). However, the studies have found that only a few banks have adopted these tools (D'Orazio, 2021), although it is known that as climate change progresses uncontrollably, the effects will eventually worsen. Hence, the early adaptation would allow for less drastic measures and cause less volatility in the market (NGFS, 2019). It was also found that the current regulations do not support the green transition of banks. In particular, the stimulus measures implemented after the Covid-19 pandemic and the Basel III regulatory framework have been estimated to favour high-carbon companies over environmental-friendly ones (D'Orazio, 2021; D'Orazio & Popoyan, 2019). Therefore, it is a concern that central banks recognise the impact of climate risks on their operations but are not managing them currently.

Some research has been done on what kind of climate-related policies could be utilised to promote the green transition of banks. For the most part, the proposals in the research material were either informational or incentive-based, intending to have a promotional or prudential effect (Baer et al., 2021). Introducing some climate-related policy tools could be comparatively easy, as they are similar to the existing ones. Such tools would be, for example, the "greened" liquidity coverage ratio and the "greened" net stable funding ratio, which are "greened" versions of the LCR and NSFR introduced in Basel III (D'Orazio, 2021).

The key observation was that no single policy tool is strong enough for the green transition of the economy to progress as desired. Nevertheless, the studies concluded that the combined effect of policy measures would be more effective

in most cases. For example, green differentiated capital requirements, i.e., green supporting factor and dirty penalising factor, could be beneficial when implemented simultaneously or with fiscal policies or other financial regulations (Dafermos & Nikolaidi, 2021; Dunz et al., 2021). In addition, it was found that banks' sentiment positively affects how new climate-related policies are adopted. Banks can, for example, voluntarily direct their funding to greener projects, thus, making the policy implementation phase smoother and more efficient. (Dunz et al., 2021.)

As an answer to the first research question, it can therefore be stated that banks can influence the mitigation of climate change as presented previously. It is possible to stay in the desired 1.5-degree pathway utilising financial intermediation. However, this still requires a common will to reach an agreement on, for example, the possible expansion of the central banks' mandates. There are already several proposed and applicable climate-related policy tools, but the time horizons of the banks' operations should still be adjusted so that the measures are functional. However, it is essential that the banks implement climate measures promptly to avoid significant market fluctuations and to maintain price and financial stability. Remarkably, the climate is changing at an accelerating pace, and the later we react to it, the more drastic methods must be implemented.

The effects of greenwashing that may occur in the operations of banks must also be assessed to evaluate the effectiveness of green banking. Greenwashing in banking has not yet been extensively studied, but some research exists regarding greenwashing in financial intermediation and green bond markets. The key finding that emerged from the research material is that the greenwashing in banks' operations is mainly indirect. For example, companies may report only the emissions from their production and not include the entire production chain. Therefore, the company can mistakenly benefit from green lending due to its "low" carbon footprint (Ehlers et al., 2021).

As emerged from studies, banks cannot reliably assess companies' environmental performance since there are no standard disclosure requirements. For example, it is common to publish ESG information, which may result in the bank's misinterpretation of the company's environmental activities (Zhang, 2022). As a result, companies can take advantage of information asymmetry and thus benefit from green finance, even if they do not genuinely promote sustainable development (Fatica & Panzica, 2020; Zhang, 2022). Moreover, banks cannot utilise external auditors since the environmental data is not comparable due to the lack of mutual disclosure requirements (Xing et al., 2021). Besides, auditors can prepare their assessments from a subjective perspective, thereby increasing the risk of greenwashing.

Fatica and Panzica (2020) mentioned in their study that they compared the company's past and current CO_2-values to assess its environmental performance. In comparison, Xing et al. (2021) proposed that appraising the level of a company's green innovations would be a reliable way to evaluate the environmental performance of businesses. To enable banks to assess the environmental performance of companies in their financing decisions or the green bond market, it should be clarified what kind of data should be collected and how it should be represented comparably. In addition, it is not clear how to measure and detect

greenwashing actions. Comparable data would allow rating companies to emerge on the market to rate companies or projects according to their environmental performance. Furthermore, banks and private investors could reliably assess whether a company is environmental-friendly or whether its operations include greenwashing.

In addition to the information asymmetry and the lack of comparable environmental data, the studies revealed activities in green bond markets that increase greenwashing behaviour. It was found that an existing conventional bond can be converted to green, which leads to the fact that the financing of green projects does not increase, even if it appears to (Fatica & Panzica, 2020). Furthermore, it was suggested that central banks could use "green" quantitative easing in the green transition (Dafermos et al., 2018; Ferrari & Nispi Landi, 2020), but if green bonds contain greenwashing, green QE will not work as desired either. However, the situation regarding green bonds is relatively good, as they are currently subject to transnational and national regulations, such as ICMA Green Bond Principle and China Green Bond Principle, which aim to reduce greenwashing.

The main problem that emerges from the results is the lack of a common taxonomy and regulations, resulting in a fragmented development of green banking and the occurrence of greenwashing. Especially after 2015, efforts have been made to increase the regulation of green finance both transnationally and regionally and through economic unions and non-governmental organisations. The main goal of the regulations and guidelines is to harmonise operations and increase transparency and comparability. In addition, it is worth noting that most of the climate-related regulations introduced in the second chapter were utterly or partially voluntary. As an answer to the second research question, it can be stated that despite the efforts, the fragmented regulatory framework makes it difficult for green banking practices to develop congruence, thus enabling greenwashing to occur in the ways mentioned above.

The third research question aimed to find out whether greenwashing in banking has a negative impact on the green transition of the economy. Based on the research material, it could be deduced that banks' greenwashing results from information asymmetry in financial intermediation. However, in the second chapter, it appeared that banks could also engage in greenwashing themselves. In terms of the green transition, it is essential that banks direct funding toward green projects and environmental-friendly businesses and organisations. However, what can be considered equally significant is that banks are reducing funding from high-carbon companies, thus reallocating funding from "brown" to "green" companies. Now, if the bank continues to finance high-carbon companies despite its environmental promises, this can be seen as greenwashing (Marchant, 2020).

In addition, Marchant (2020) pointed out that committing to various climate promises or agreements can also be classified as greenwashing if this is not converted into actions. As observed from the green finance and banking concepts presented in the second chapter, several central banks are committed to various climate agreements and other climate-related regulatory objectives. But it is common nowadays for an entity to declare a strategy to be carbon neutral, i.e., by 2030 or 2050, but the actions may contradict it. This may be interpreted as

greenwashing. However, studies also found that policy implementations during the Covid-19 pandemic and in Basel III have contributed to undermining the green transition of the economy by making the carbon-intensive sector more attractive. Thus, it can be appraised that achieving voluntary climate targets may be challenging and therefore be classified as greenwashing. So as an answer to the third research question, based on the selected studies and information gained from the second chapter, it can be concluded that greenwashing in banking has a retarding effect on the green transition of the economy.

6.2   Conclusion

Climate change can be considered one of the most worrying crises of our time, and therefore it is crucial to explore the possibilities for different sectors to mitigate it. This master's thesis examined whether green banking activities can contribute to mitigating climate change and whether greenwashing in these activities undermines this. By utilising the methods of a systematic literature review, it was possible to answer the research questions and thus provide an overview of the topic. The number of studies dealing with these topics is constantly increasing. It was observed that there is a large body of literature on sustainable banking, investment, and finance. The literature focusing on banking, specifically from a climate and environmental perspective, is still relatively scarce. Furthermore, greenwashing in banking has not been extensively studied, and the scope of research has been limited mainly to emerging economies.

First, main themes related to green finance and banking were compiled to ground the research problem and support the collection of research material. Regarding green banking, it was essential to address how climate-related risks are transmitted through financial transmission channels to financial risks. This provided the basis for the first research question particularly, as it increased the understanding of how climate change is reflected in banking and which banking channels can be used to manage it. Greenwashing was discussed in the last paragraph of the second chapter, where greenwashing was first defined in general and then from the banking perspective. Furthermore, the climate-related regulation for the banking sector was tabulated and examined whether they took greenwashing into account. This section was exploited for the second and third research questions.

Next, two search strings were prepared to collect the research material. The first search string captured studies regarding green banking, and the second search string greenwashing in banking. By modifying the search strings, more articles could be found. For example, adding the keyword "green bond" to the first search string could have provided relevant results. Several databases were used in the research, but if desired, the Web of Science search engine could have been utilised to broaden the study. In addition, it was found that the banks' database search engines are rudimentary, which may have led to relevant articles being undetected. However, considering the resources and the purpose of the study, a suitable sample was collected to answer the research questions and get

a clear overall picture of the subject. Furthermore, to ensure the transparency and reliability of the research, each step of the research process is described and tabulated in appendices.

The most relevant studies were selected according to the research problem and the inclusion/exclusion criteria. After thorough reading and coding, they were divided into four themes: central bank mandates, incentives and sentiments, climate-related policies, and greenwashing. The literature comprehensively discussed the possibilities of green banking for preventing global warming. In the studies, green banking has been addressed from several different perspectives, which is why the first three themes in the results mainly answer the first research question. In the concepts of green banking and the results, the key observation was the banks' mandates and whether they can be expanded to consider climate-related issues. In addition, it was found that various climate-related policy tools have already been studied to some extent, which could indicate that the topic is essential and that the introduction of the measures would be considered topical in the near future.

It was found that there is still relatively limited literature addressing greenwashing in banking activities, which is reflected in the sample size of the research material. However, the research results and the second chapter provided good insights into the topic. Based on the information, it was possible to answer the research questions and thus close the identified research gap. The key observation was that, despite the efforts, the common taxonomy and the disclosure requirements for banks and companies are still incomplete. These facts allow the term "green" to be used loosely and to describe investment products and projects that do not genuinely consider the environment and climate. Furthermore, it is challenging for banks to assess the environmental performance of the objects to be financed since climate-related data is not comparable and company-provided information is unreliable.

Based on the research, I identify some areas for further research in the field of banking and finance. The key finding is that greenwashing in banking has not been widely studied, and the research area mainly focuses on emerging economies. Therefore, in the future, both indirect and direct greenwashing actions of banks in developed economies, such as in the European Union, should be studied so that the green transition of the economy would be effective and the proposed policy tools would achieve the desired goals. As pointed out, climate change concerns generations and therefore, research should continuously address known and rising issues.

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Xu, Y., Li, S., Zhou, X., Shahzad, U., & Zhao, X. (2022). How environmental regulations affect the development of green finance: Recent evidence from polluting firms in China. Renewable Energy, 189, 917–926. https://doi.org/10.1016/j.renene.2022.03.020

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APPENDIX 1 Research material

Author, title, journal	The purpose of the study	Method and sample	Findings
Baer, M., Campiglio, E., & Deyris, J. (2021). It takes two to dance: Institutional dynamics and climate-related financial policies. Ecological Economics, 190, 107210.	The aim of the study is to examine how institutional dynamics may effect on and be affected by the financial policies related to climate.	They study the effects especially in Europe by first constructing three-part framework: 1. motives for policy implementation, 2. policy instruments and 3. implementing authorities. After that, they implement this framework to Europe to answer the research question. And in the last section, they propose explanations for the findings in previous section.	They argue that European countries are not able to implement climate-related financial policies since there is weak public control regarding private financial markets and on the other hand, "presence of strong independent technical authorities with delegations concerning financial markets". For example, some financial policies (i.e. green supporting factor) have been rejected since they might have uncertain prudential implications.
Baldi, F., & Pandimiglio, A. (2022). The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. Global Finance Journal, 52, 100711.	The study is aiming to find out if the ESG scoring and possibility of the greenwashing of the issuer company are influencing the yield of green bonds.	Using the theoretical framework, they formulate 5 different hypotheses that they test with regression models. The sample is twofold: 1. 199 observations including green bonds issued by public sector in 2012-2019 and 2. 199 observations including green bonds issued by private sector in 2013-2019. They use different econometric models, that are based on the multiple regression technique estimated with OLS method.	They found out that the companies operating in manufacturing can more easily exploit greenwashing since the processes are hard to assess by investors and even by firms in financial sector.

Campiglio, E. (2016). Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy. Ecological economics, 121, 220-230.	The study is providing a perspective where macroprudential financial regulations and monetary policies should be used when considering the low-carbon investments/green transition of financial sector rather than carbon pricing.	They first introduce current situation regarding green finance gap and explain how banks' credit creation and allocation works. After that, they review the problems regarding carbon pricing and introduce recent and possible macroprudential policies and regulations considering green investments.	They propose that the carbon pricing could lead to the situation where banks would eventually retreat from lending to low-carbon activities. Therefore, the study suggests that the implementation of new policies, that are not based on prices, should be considered. They also point out that the policies could be practical especially in emerging economies, where central banking allow more public control.
Chenet, H., Ryan-Collins, J., & van Lerven, F. (2021). Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. Ecological Economics, 183, 106957.	The study is suggesting a new way to consider the climate-related financial risks (CRFR) by constructing a framework where CRFR is fully integrated into the policies.	The study uses probabilistic modelling as a research method. They first introduced literature considering financial risks and uncertainty, and after that examined how these relate to CRFR. After that, they justified precautionary financial policy approach to CRFR and last how this should be implemented to current regulatory and monetary policies.	They suggest that the precautionary financial policy approach should be used when considering CRFR since these risks are uncertain and thereby the backward-looking probabilistic financial risk modelling is not suitable anymore. PFP approach gives the policymakers chance to implement policy interventions today even though the financial risks are not yet materialised.
Cui, Y., Geobey, S., Weber, O., & Lin, H. (2018). The Impact of Green Lending on Credit Risk in China. Sustainability, 10(6), 2008.	The aim of the study is to examine if increasing the green lending due to the green credit policy, would reduce the credit risk of banks in China.	Their sample includes 24 Chinese banks in 5-year period. They utilised a two-stage least square regression analysis (2SLS) and random-effect panel regression (RE) as a research method. The non-performing-loan (NPL) ratio reflects the credit risk of loan.	They suggested that the green credit policy is simulating banks to reallocate their loans toward green companies. Their findings indicated that higher green credit ratio lowers banks' NLP ratio and thereby it can be concluded that the credit risk is lower with higher green lending activity.

D'Orazio, P. (2021). Towards a post-pandemic policy framework to manage climate-related financial risks and resilience. Climate Policy, 21(10), 1368-1382.	The study is aiming to find out, if the financial policies implemented after the Covid-19 pandemic, are considering the financial instabilities and risks caused by climate change.	They reviewed pandemic-related financial policies, that were implemented in the 2020 in G20 countries. The data was collected from three sources and eventually, the sample included 737 different policies. In addition, they conducted climate-related policies from G20 countries in the period of 2000-2020.	They found out that the pandemic-related financial policies in G20 countries did not consider the climate-related issues, like green lending. It was noted that the measures used promoted lending to carbon-intensive sectors and thereby retards the green transition. In addition, it can be said that the current climate-related recommendations and principles in G20 countries are too "soft" and therefore not sufficient in slowing down the climate change.
D'Orazio, P., & Popoyan, L. (2019). Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies?. Ecological Economics, 160, 25-37.	The study is aiming to find out if prudential regulation is suitable tool for policy makers to promote the green transition and mitigate climate-related financial risks.	First, they provide a review of current and novel prudential approaches that are promoting greening of finance and being incentive for the decarbonization of banks' balance sheets. After that they gather all the current green prudential regulations and tools at the OECD and European level. At last, they present how the previously introduced green prudential instruments are implemented in action.	The study found out that the emerging economies are more actively implementing mandatory green prudential instruments. In addition, they noted that the most suitable green instruments are related to banks capital management. However, they also pointed out that it is not possible to green the financial system by "one-size-fits-all" approach.

Dafermos, Y., & Nikolaidi, M. (2021). How can green differentiated capital requirements affect climate risks? A dynamic macrofinancial analysis. Journal of Financial Stability, 54, 100871.	The study concentrates on finding the effects of capital requirements of banks in the promotion of green transition. Two different green differentiated capital requirements (GDCR) have been introduced previously and the study will concentrate on those: 'green supporting factor' (GSF) and 'dirty penalising factor' (DPF).	They use the DEFINE model, that enables the analysis between climate change and the financial system. They are hypothetically studying how the implementation of GDCRs would effect on macroeconomic, financial and environmental variables within the next couple of years.	They found out that the GDCRs are effective for transition and physical climate-related financial risks if they are used simultaneously. However, these effects are not very strong and therefore they should be implemented as a supportive factor when mitigating climate risks for the financial system.
Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability and monetary policy. Ecological Economics, 152, 219-234.	The study is providing an insight how climate change will effect on financial stability and how the green quantitative easing program could be influential.	They use ecological macroeconomic model (DEFINE model) that is based on the stock-flow-fund model to examine the effect of climate changes damages on the prices of financial assets and the financial position of firms and banks. Their model is based on global data and simulation is conducted for period 2016-2120.	The first part of the findings of this study provides information how climate change may harm financial stability. The second part of the findings introduce how the green quantitative easing program can be used to harmonize the financial stability and limit the global warming. However, the QE program by itself only is not enough when considering the tools of financial sector in the reduction of global warming.
Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. Ecological Economics, 184, 107022.	The study is reviewing how climate related risks and the mitigation and adaptation policies are suitable for central banking mandates.	They compile an analysis of mandates and objectives of 135 central banks and monetary unions using IMF's Central Bank Legislation Database and after that compare these to the climate-related practices that have already adopted in.	52% of the investigated central banks are mandated to contribute to the sustainability of growth and development or to support the government's policies regarding sustainability issues. However, 48% of banks and monetary unions included in the research, have not any sustainability mandates. Nonetheless, many of the analysed financial institutions are

			already including green activities.
Dunz, N., Naqvi, A., & Monasterolo, I. (2021). Climate sentiments, transition risk, and financial stability in a stock-flow consistent model. Journal of Financial Stability, 54, 100872.	The study is aiming to increase the understanding of the effects of the implementation of Carbon Tax and Green Supporting Factor. How these factors could help in new green investments or alternatively how the factors could introduce new sources for risks. In addition, the study is trying to find out how banks' climate sentiments affect to the green transition.	They develop a macroeconomic model "Stock-Flow Consistent model" to forecast the climate sentiment of banks in high income countries. After that they examine how CT and GSF impact on the green transition by studying the loan contracts to analyse the risk transmission channel from credit market to the economy.	Their findings suggest that the CT and GSF can both foster the green transition of economy. The GSF promotes new green investments via better interest rates for green companies. However, this factor includes three trade-offs that arise from policy's transmission channel. The implementation of CT signals directly to brown firms via the fiscal channel by increasing their production costs. The implementation of CT is not simple since it can affect on banking sectors' financial stability by "higher share of NPLs and lower demand for new loans due to the fall in GDP".
Ehlers, T., & Packer, F. (2021). The pricing of carbon risk in syndicated loans: Which risks are priced and why? BIS Working Papers, 946, 29.	The aim of the study is to analyse if the carbon emissions of companies are included in the loan pricing of syndicated loans. In addition, they analyse if "green" banks have higher carbon risk premium than conventional banks.	They utilise Trucost database to export the annual carbon emissions of companies having syndicated loans. The sample includes 567 firms from 31 countries in period 2005-2018. They use regression analysis methods to analyse the results.	They found out that the carbon risk premium increased for high-emission companies especially after implementing the Paris Agreement in 2015. However, the carbon risk is not highly priced, and banks do not consider the overall carbon footprint of a company. In addition, "green" banks did not have higher carbon risk premium for high-emission companies than conventional banks.

Fatica, S., & Panzica, R. (2020). Green bond as a tool against climate change? Luxembourg: Publications Office of the European Union.	The aim of the study is to assess if green bonds are actually reflecting the environmental engagement of issuer.	They extract data related to bond primary markets from Dealogic DCM. Their sample includes green and conventional bonds issued by non-financial corporations until 2019. They utilise environmental and financial data of corporations from DataStream asset4 and match these with bond data. They use regression analysis methods to process their data.	Their findings indicate that green bonds issued to finance new climate-friendly project are reflecting the environmental engagement of the issuer. The carbon emissions of the issuers decreased especially if the activity had been evaluated by an external auditor. Additionally, the environmental performance improved after the introduction of Paris Agreement in 2015.
Ferrari, A., & Nispi Landi, V. (2020). Whatever it Takes to Save the Planet? Central Banks and Unconventional Green Policy. ECB Working Paper No. 20202500.	The aim of the study is to examine how the Green Quantitative Easing could be helpful in mitigating global warming.	They concentrate in their study on the temporary Green QE. They make an analytical framework, that includes green sector (non-pollutive firms) and brown sector (pollutive firms). In the framework, the flow of harmful emissions increases the pollutants, which decreases the productivity of the economy and eventually consumption.	They found out that the Green QE is quite effective when green and brown bonds are imperfect substitutes. However, the effects last for a short time and therefore they conclude that the temporary QE is not applicable instrument when long-term disadvantages are to be affected.
Reghezza, A., Altunbas, Y., Marques-Ibanez, D., d'Acri, C. R., & Spaggiari, M. (2021). Do Banks Fuel Climate Change? ECB Working Paper No. 2021/2550	The study is aiming to find out, if climate-related regulatory policies are affecting the pollutive companies access to credit.	They analysed whether lending practices (regarding green and brown loans) of European banks changed after two events: implementation of Paris Agreement in 2015 and US withdrawal from the agreement in 2017. They examine the possible changes by matching extensive data set of loans and firm-level greenhouse gas emissions.	After the implementation of Paris Agreement, the loans towards polluting firms decreased 3% in relation to non-polluting firms. Similar findings occurred, when considering the affects after Trump's withdrawal from the agreement.

Steffen, B. (2021). A comparative analysis of green financial policy output in OECD countries. Environmental Research Letters, 16(7), 074031.	The study is aiming to provide a compilation of green financial policies used in OECD countries and study how countries differ in implementing these policies.	They made a comparative analysis of green financial policy output in OECD countries from 2001 to 2019. They concentrated especially assessing if the implementation of policies changed after the Paris Agreement.	Their findings show that the policy output have increased significantly after the Paris Agreement. However, they found out that the dedicated implementation of these policies varies between countries.
Sun, J., Wang, F., Yin, H., & Zhang, B. (2019). Money talks: the environmental impact of China's green credit policy. Journal of Policy Analysis and Management, 38(3), 653-680.	The study is aiming to provide an insight how the green credit policies in China have motivated firms to low-carbon activities and what kind of pollution curbing activities firms favour.	They used two methods: synthetic control method (SCM) and difference-in-differences analysis. The sample was constructed from three sources: pollution data from the Database of Environmental Statistics, Firm-level economic information from the China Industrial Enterprises Database and the data for SCM was from China's National Bureau of Statistics. The study concentrated on water pollution and there were not included any state-owned firms in the sample.	They found out that the green credit policy would be effective way to force firms to introduce more sustainable production methods. However, they noticed that these policies were not able to change the pollution adaptation of firms that have low external financing requirements or firms with low cash flow.
Tuhkanen, H., & Vulturius, G. (2020). Are green bonds funding the transition? Investigating the link between companies' climate targets and green debt financing. Journal of Sustainable Finance & Investment, 0(0), 1–23.	The study is examining if issuers' reporting of its actions is in line with green bonds and issuers' climate targets.	They assess 20 largest European corporate green bond issuers in 2018. They used information publicly available from companies' documents and websites, including policy documents and annual reports. In addition, they analysed companies' climate targets and emissions by exploiting the data from CDP Climate Change reporting and SBTi's database.	They found out that in most cases there is mislinkage between issuers' climate targets and green bond frameworks. In addition, they noted that green bond issuers are not required to actually meet their set climate targets.

Umar, M., Ji, X., Mirza, N., & Naqvi, B. (2021). Carbon neutrality, bank lending, and credit risk: evidence from the Eurozone. Journal of Environmental Management, 296, 113156.	The study is analysing how the carbon-neutral lending may affect the credit risk of banks in Eurozone.	They analyse 344 lenders in period 2011 to 2021 by using two different credit risk measures: "an ex-ante estimate of the probability of default and an ex-post credit infection ratio".	They found out that the sustainable / carbon-neutral lending lower the credit risk for all size banks. Due to this finding, banks might have more incentives concentrating in sustainable lending.
Xing, C., Zhang, Y., & Tripe, D. (2021). Green credit policy and corporate access to bank loans in China: The role of environmental disclosure and green innovation. International Review of Financial Analysis, 77, 101838.	The study is examining the green credit policy in China by concentrating on if the external environmental disclosure and green innovation enables companies to receive more bank loans.	They make empirical analysis for 1086 Chinese listed manufacturing companies in 2012 to 2017. They exploit difference-in-difference model to test their hypotheses and propensity score matching DID-model to evade the bias occurred in conventional DID-model.	They found out that companies with green innovation benefit from green credit policy. On the other hand, they found out that the external environmental disclosure does not increase access to credit, as it may include greenwashing, which is why banks do not trust reports.
Xu, Y., Li, S., Zhou, X., Shahzad, U., & Zhao, X. (2022). How environmental regulations affect the development of green finance: Recent evidence from polluting firms in China. Renewable Energy, 189, 917–926.	The aim of the study is to examine how the corporate-level environmental regulation are affecting green finance.	Their sample includes listed Chinese companies, that have expenses regarding environmental activities in period 2010 to 2018. They use ordinary least square model and regression model to test if environmental regulation is boosting the development of green finance.	The study found out that the environmental regulation is promoting green finance, but they also found out that manufacturing companies are greenwashing their operations to utilise the green finance.
Zhang, D. (2022). Are firms motivated to greenwash by financial constraints? Evidence from global firms' data. Journal of International Financial Management and Accounting.	The study is examining what factors are promoting the ESG greenwashing for companies.	They analyse use 200 000 large-cap companies from 47 countries to analyse the relationship between ESG score and greenwashing behaviour. After that they process the data using regression analysis methods.	They found out that company's financial performance is determining their greenwashing behaviour. Especially if they have financial constraints, company is more likely greenwashing their ESG disclosures. In addition, highly leveraged companies are more likely to engage in greenwashing due to increased financial pressure.

APPENDIX 2   Quality appraisal questions

Table 2 Framework for assessing the quality of studies (Adapted from Jesson et al., 2011)

Dimension of quality assessment	Questions	Measure
Publication type	• Where is the article published?	• Academic journal • Technical report • ECB working paper • BIS working paper
Impact factor of the journal	• What is the impact factor of the journal in which the article is published?	• 1.1-2.0 • 2.1-3.0 • 3.1-4.0 • 4.1-5.0 • >5.0
Introduction	• Are the aim and objectives of the study clear? • Is there a link to theory or to previous studies?	• Aim of the study is stated • Objectives of the study are stated • Linked to the theory and/or previous studies
Method	• How was the method chosen? • How and why the sample was selected?	• Selection of chosen method is justified • The selection of sample is presented and justified • Discussion of the effects of the method on the results
Data	• How, where and by whom was the data collected? • How trustworthy, reliable, and valid is the data?	• Collection of data is comprehensively described • Selected data is reliable and applicable
Analysis	• How was the data analysed? • How precise and trustworthy is the analysis?	• Description of the original data • Logical • Analysis is trustworthy and precisely done
Results	• Do the results relate back to the research question? • Do the authors discuss the methodological limitations of their study?	• Clear description of how the results arrived • Discussion of the strengths and weaknesses of the study • Discussion of the theory and its suitability for research

APPENDIX 3 Quality assessment for articles

Article	Quality assessment
Baer, M., Campiglio, E., & Deyris, J. (2021). It takes two to dance: Institutional dynamics and climate-related financial policies. Ecological Economics, 190, 107210.	• Academic journal • IF >5.0 • The aim and objectives of the study is stated • Linked to theories and previous studies • The framework created is justified and clearly presented • Collection of policies used is comprehensively described and also reliable and valid • Analysis is trustworthy and precisely done • Clear description of how the results arrived • Discussion of the strengths and weaknesses of the framework introduced
Baldi, F., & Pandimiglio, A. (2022). The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. Global Finance Journal, 52, 100711.	• Academic journal • IF 2.1-3.0 • The aim and objectives of the study is stated • Linked to theories and previous studies • The research gap is well justified • Selection of chosen method is justified • Selection of presented sample is presented • Analysis is trustworthy and precisely done • Discussion of the strengths and weaknesses of the study - Selected data is not very extended
Campiglio, E. (2016). Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy. Ecological economics, 121, 220-230.	• Academic journal • IF >5.0 • The aim and objectives of the study is stated • Linked to the theories and previous studies • The structure of the study is clear • Theories are linked clearly and logically together • Analysis is trustworthy and precisely done • Clear description of how the results arrived • Discussion of the strength and weaknesses of the study
Chenet, H., Ryan-Collins, J., & van Lerven, F. (2021). Finance, climate-change, and radical uncertainty: Towards a precautionary approach to financial policy. Ecological Economics, 183, 106957.	• Academic journal • IF >5.0 • The aim and objectives of the study is stated • Linked to previous theories • Current policy framework is precisely introduced • Logical • Analysis is trustworthy and precisely done • Discussion of the strengths and weaknesses of the study

Cui, Y., Geobey, S., Weber, O., & Lin, H. (2018). The Impact of Green Lending on Credit Risk in China. Sustainability, 10(6), 2008.	• Academic journal
	• IF 3.1-4.0
	• The aim and objectives of the study is stated
	• Linked to previous theories
	• Selection of chosen method is justified
	• Clear description how results arrived
	   - Original data is not described
	   - Collection of data is not comprehensively described

D'Orazio, P., & Popoyan, L. (2019). Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies? Ecological Economics, 160, 25-37.	• Academic journal • IF >5.0 • Linked to previous studies and theories • The aim and objectives of the study is stated • Current macroprudential tools are precisely introduced and linked to theories • Selected data it reliable and applicable • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived • Discussion of the strengths and weaknesses of the study
D'Orazio, P. (2021). Towards a post-pandemic policy framework to manage climate-related financial risks and resilience. Climate Policy, 21(10), 1368-1382.	• Academic journal • IF >5.0 • Aim and objectives of the study is stated • Linked to the theory • The selection of sample and method is presented • Selected data is reliable and applicable • Description of original data • Analysis is trustworthy and precisely done • Clear description of how the results arrived
Dafermos, Y., & Nikolaidi, M. (2021). How can green differentiated capital requirements affect climate risks? A dynamic macrofinancial analysis. Journal of Financial Stability, 54, 100871.	• Academic journal • IF 3.1-4.0 • Linked to previous studies and theories • The aim and objectives of the study is stated • Collection of data is comprehensively described • Selected data is reliable and applicable • Analysis is trustworthy and precisely done • Discussion of strengths and weaknesses of the study • Suggestions for future studies
Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability, and monetary policy. Ecological Economics, 152, 219-234.	• Academic journal • IF >5.0 • Aim and objectives of the study is stated • Linked to the theory and previous studies • Selected data is reliable and applicable • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived

Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. Ecological Economics, 184, 107022.	• Academic journal • IF >5.0 • Aim and objectives of the study is stated • The selection of sample is presented and justified • Selected data is reliable and applicable • Logical • Clear description of how the results arrived • Discussion of the strengths and weaknesses of the study
Dunz, N., Naqvi, A., & Monasterolo, I. (2021). Climate sentiments, transition risk, and financial stability in a stock-flow consistent model. Journal of Financial Stability, 54, 100872.	• Academic journal • IF 3.1-4.0 • Aim and objectives of the study are stated • Linked to previous theories • Selection of the chosen method is justified • Analysis is trustworthy and precisely done • Clear description of how the results arrived - Extensive research and thereby readability partly unclear
Ehlers, T., & Packer, F. (2021). The pricing of carbon risk in syndicated loans: Which risks are priced and why? BIS Working Papers, 946, 29.	• BIS working paper • Aim and objectives of the study are stated • Linked to previous studies • The selection of sample is presented • Selected data is reliable and trustworthy • Analysis is trustworthy and precisely done • Clear description of how the results arrived
Fatica, S., & Panzica, R. (2020). Green bond as a tool against climate change? Luxembourg: Publications Office of the European Union.	• Technical report • The aim and objectives of the study are stated • Linked to previous studies and theories • The selection of sample is presented • Selected data is reliable and applicable • Analysis is trustworthy and precisely done • Clear description of how results arrived - No discussion about weaknesses of the study
Ferrari, A., & Nispi Landi, V. (2020). Whatever it Takes to Save the Planet? Central Banks and Unconventional Green Policy. ECB Working Paper No. 20202500.	• ECB working paper • Aim and objectives of the study is stated • Linked to previous studies and theories • The selection of sample and method is presented • Selected data is reliable and applicable • Description of original data • Analysis is trustworthy and precisely done • Clear description of how results arrived • Discussion about the weaknesses of the study

Reghezza, A., Altunbas, Y., Marques-Ibanez, D., d'Acri, C. R., & Spaggiari, M. (2021). Do Banks Fuel Climate Change? ECB Working Paper No. 2021/2550	• ECB working paper • Aim and objectives of the study is stated • Linked to previous studies and theories • The selection of sample and method is presented • Selected data is reliable and applicable • Description of original data • Analysis is trustworthy and precisely done • Clear description of how results arrived - No discussion about the weaknesses of the study
Steffen, B. (2021). A comparative analysis of green financial policy output in OECD countries. Environmental Research Letters, 16(7), 074031.	• Academic journal • IF >5.0 • Aim and objectives of the study is stated • Linked to previous studies and theories • The selection of sample is presented and justified • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived - Selection of the method is not justified
Sun, J., Wang, F., Yin, H., & Zhang, B. (2019). Money talks: the environmental impact of China's green credit policy. Journal of Policy Analysis and Management, 38(3), 653-680.	• Academic journal • IF 2.1-3.0 • Aim and objectives of the study is stated • Linked to previous studies and theories • Selection of sample and method is presented and justified • Selected data is reliable and applicable • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived • Discussion of the weaknesses of the study
Tuhkanen, H., & Vulturius, G. (2020). Are green bonds funding the transition? Investigating the link between companies' climate targets and green debt financing. Journal of Sustainable Finance & Investment, 0(0), 1–23.	• Academic journal • IF 1.1-2.0 • Aim and objectives of the study is stated • Linked to the theory and previous studies • Collection of data is comprehensively described • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived Discussion of the theory and its suitability for research

Umar, M., Ji, X., Mirza, N., & Naqvi, B. (2021). Carbon neutrality, bank lending, and credit risk: evidence from the Eurozone. Journal of Environmental Management, 296, 113156.	• Academic journal
	• IF >5.0
	• Aim and objectives of the study is stated
	• Linked to the theory
	• Selection of chosen method is justified
	• Logical
	• Analysis is trustworthy and precisely done
	• Clear description of how the results arrived
	  - Collection of data is briefly described
	  - No discussion of the weaknesses of the study

Xing, C., Zhang, Y., & Tripe, D. (2021). Green credit policy and corporate access to bank loans in China: The role of environmental disclosure and green innovation. International Review of Financial Analysis, 77, 101838.	• Academic journal • IF >5.0 • Aim and objectives of the study is stated • Linked to previous studies and theories • Selection of chosen sample is presented and justified • Description of original data • Analysis is trustworthy and precisely done • Logical • Clear description of how the results arrived • Discussion of the strengths and weaknesses of the study
Xu, Y., Li, S., Zhou, X., Shahzad, U., & Zhao, X. (2022). How environmental regulations affect the development of green finance: Recent evidence from polluting firms in China. Renewable Energy, 189, 917–926.	• Academic journal • IF >5.0 • The aim of the study is stated • Linked to theories • The selection of sample is presented and justified • Collection of data is comprehensively described • Logical • Analysis is trustworthy and precisely done • Clear description of how the results arrived • Discussion of the strengths and weaknesses of the study
Zhang, D. (2022). Are firms motivated to greenwash by financial constraints? Evidence from global firms' data. Journal of International Financial Management and Accounting.	• Academic journal • IF 1.1-2.0 • The aim and objectives of the study is stated • Linked to previous studies • The selection of data is presented and justified • Discussion of the strengths and weaknesses of the study - Analysis and description of results are narrow

APPENDIX 4　　　　Publication channels of the articles

Publication channel	Article(s)
Ecological Economics	Baer et al. (2021); Campiglio (2016); Chenet et al. (2021); D'Orazio & Popoyan (2019); Dafermos et al. (2018); Dikau & Volz (2021)
Climate Policy	D'Orazio (2021)
Journal of Financial Stability	Dafermos & Nikolaidi (2021); Dunz et al. (2021)
Environmental Research Letters	Steffen (2021)
Journal of Policy Analysis and Management	Sun et al. (2019)
Journal of Environmental Management	Umar et al. (2021)
ECB working paper	Ferrari et al. (2020); Reghezza et al. (2021)
BIS working paper	Ehlers & Packer (2021)
Global Finance Journal	Baldi & Pandimiglio (2022)
Sustainability	Cui et al. (2018)
Publications Office of the European Union	Fatica & Panzica (2020)
Journal of Sustainable Finance and Investment	Tuhkanen & Vulturius (2020)
International Review of Financial Analysis	Xing et al. (2021)
Renewable Energy	Xu et al. (2022)
Journal of International Management and Accounting	Zhang (2022)

APPENDIX 5 Year of publication of the articles

Year	*Number of studies*
2016	1
2018	2
2019	2
2020	3
2021	11
2022	3