

# Climate change and Banking regulation

How Swedish professionals think about  
regulating climate-related risk drivers

*Jakob Gustafsson*

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Master thesis 2022

Division of Environmental and Energy System Studies

Department of Technology and Society

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**LUNDS UNIVERSITET**

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## **Climate change and Banking regulation**

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Sammandrag

**Syfte:** Denna masteruppsats ämnar att deskriptivt beskriva hur bankanställda och experter på bankregleringsområdet ser på de regleringen av de finansiella risker som härrör från klimatförändringarna.

**Material och metod:** Semistrukturerade expertintervjuer genomfördes med fem bankanställda från svenska banker av olika storlek samt med fyra experter på bankreglering och en expert på översvämningar och havsnivåhöjning. Artiklar har samlats in med bakåtgående snöbollsteknik medan rapporter från myndigheter har samlats in på ett systematiskt sätt.

**Resultat:** För närvarande är bankreglering fokuserad på området regelgivning och är mer specifikt centrerad kring harmonisering av rapporteringskrav. Både privata och offentliga organisationer är involverade i detta arbete. Det finns många osäkerheter, komplexiteter och andra frågor som tillsynsmyndigheter försöker förstå för att komma vidare med reglering inom andra områden som regelgivning med kapitalkrav eller bättre tillsyn. Det råder oenighet bland intervjupersoner om vissa saker, som när fysiska risker kommer att materialiseras eller framtida tillgång till försäkring. Intervjuobjekten är ense om att regleringen bör vara riskbaserad.

**Slutsats:** Tillsynsmyndigheter arbetar för närvarande med att harmonisera rapporteringskrav. Det finns flera svårigheter som gör det svårt att ta full hänsyn till riskerna härrörande från klimatförändringar. När ny reglering tas fram, så anser professionen att den ska vara riskbaserad.

Nyckelord

Climate-related risk drivers; physical risk; transition risk; financial risk; banking regulation; interview study

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Abstract

**Purpose:** This master thesis aims to describe how bank employees and experts in the field of banking regulation view the regulation of financial risks incorporating climate-related risk drivers.

**Material and method:** Semi-structured expert interviews were conducted with five bank employees from Swedish banks of various sizes, as well as with four experts on banking regulation and one expert on floods and sea level rise. Articles have been collected using a backward snowball technique, while reports from authorities have been collected systematically.

**Results:** Currently, banking regulation is focused on the area of rulemaking and is more specifically centered around the harmonization of reporting requirements. Both private and public organizations are involved in this work. There are many uncertainties, complexities, and other issues that regulators are trying to understand to move forward with the regulation in other areas, such as prudential regulation with capital requirements or better supervision. There is disagreement among interviewees about certain things, such as when physical risks will materialize or future access to insurance. However, the interviewees agree that regulation should be risk-based.

**Conclusion:** Regulators are currently working to harmonize reporting requirements. Several difficulties make it challenging to fully account for the risks arising from climate change. When a new regulation is developed, the profession considers it should be risk-based.

Keywords

Climate-related risk drivers; physical risk; transition risk; financial risk; banking regulation; interview study

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## List of abbreviations, acronyms and definitions;

### Organizations

- BCBS: Basel Committee on Banking Supervision
- BIS: Bank for International Settlements
- EBA: European Banking Authority
- ECB: European Central Bank
- ESMA: European Securities and Market Authority
- ERSB: European Systemic Risk Board
- EU: European Union
- FSB: Financial Stability Board
- IMF: International Monetary Fund
- IPCC: Intergovernmental Panel on Climate Change
- ISO: International Standards organization
- ISSB: International Sustainability Standards Board
- LGD: Loss Given Default
- NGFS: Network for Greening the Financial System
- PCAF: Partnership for Carbon Accounting Financials
- PD: Probability of Default
- SASB: Sustainability Accounting Standards Board
- SFSA: Swedish Financial Supervisory Authority (Swedish name Finansinspektionen)
- TCFD: Task Force on Climate-related Financial Disclosures
- UN: United Nations

### Documents

- CDP: Climate Disclosure Project
- CRD: Capital Requirements Directive
- CRR: Capital Requirements Regulation
- CSRD: Corporate Sustainability Reporting Directive
- GDP: Gross domestic product
- GRI: Global Reporting Initiative
- IFRS: International Financial Reporting Standards.
- NFRD: Non-Financial Reporting Directive
- SFDR: Sustainable Finance Disclosure Requirements
- UNPRI: United Nations Principles for Responsible Investment

### Climate- or finance related terms

- BTAR: Banking Book Taxonomy Alignment Ratio
- ESG: Environmental, Social and Governance
- GAR: Green Asset Ratio
- GHG: Greenhouse Gas

Table 1: The terms, expressions and concepts that are used within this thesis as defined by a Swedish authority, EU affiliated organization or other in other case an important standard setter.

<i>Terms</i>	<i>Definition</i>
Adaptation	Adaptation measures could be preventive measures that are aimed at reducing events occurrence (reduced probability) or they could be damage mitigation measures (reduced consequences). As an example, preventive measures could be to prevent housing in flood-threatened areas or to regulate the minimum foundation level for buildings. Damage mitigation measures are canal construction, embankment, and installation of pumps (Klimatanpassningsutredningen 2017, p. 57-58).
Bank	Söderström (2017) describes that in Swedish law, a <i>credit institution</i> is either a <i>credit market company</i> or a <i>bank</i> . There is no international agreed-upon international definition of what a bank is; it can vary between different countries, even within the EU (ibid). In Sweden <i>credit market companies</i> are potentially owned by banks (Riksbanken 2015) (in Sweden, Handelsbanken Finans and Nordea Finans were two of the largest credit market companies in 2015, with the banks Handelsbanken AB and Nordea AB as parent companies). The banking groups also own mortgage institutions which are another type of credit market company Riksbanken (2015). According to Söderström (2017) ' <i>banking business</i> ' includes processing of payments as well as taking deposits which should be made available to the depositor within thirty days.
Climate	Climate is the average weather, with variables such as temperature, precipitation and wind, classically averaged over 30 years as defined by World Meteorological Organization. (BCBS 2021, p. 57-58)
Climate-related risk drivers	Climate-related risk drivers are usually grouped into physical risks and transition risks. Factors such as their unprecedented frequencies and non-linear form give rise to uncertainty (BCBS 2021, p. 19)
Financial institution	Typically deals with deposits, loans, investments, or currency exchange. It could be a commercial bank, investment bank, development bank, asset owner, asset manager, or insurance company (PCAF 2020).
Global warming	The increase in global mean surface temperature relative to pre-industrial levels. The mean is usually averaged over 30 years (BCBS 2021, p. v).

Table continues

## Continued table

<i>Terms and concepts</i>	<i>Definition</i>
Greenhouse gases (GHGs)	Two definitions of GHGs are often occurring. One is; “gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth’s surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour ( $H_2O$ ), carbon dioxide ( $CO_2$ ), nitrous oxide ( $N_2O$ ), methane ( $CH_4$ ) and ozone ( $O_3$ ) are the primary greenhouse gases in the Earth’s atmosphere.” (BCBS 2021, p. v). The other is; “The seven greenhouse gases listed in the Kyoto Protocol—carbon dioxide ( $CO_2$ ); methane ( $CH_4$ ); nitrous oxide ( $N_2O$ ); hydrofluorocarbons (HFCs); nitrogen trifluoride ( $NF_3$ ); perfluorocarbons (PFCs); and sulphur hexafluoride (is $SF_6$ ).” (ISSB 2022 <i>b</i> ). Also PCAF has almost identical definition as ISSB. In this thesis, both definitions are used, and the reader should be able to tell from the context. The latter concept is connected to terms such as ‘reduction,’ ‘increased,’ ‘targets,’ ‘goals,’ or ‘legislation.’ At the same time, the former definition is important to consider when discussing the greenhouse effect in general.
Physical risk	Physical risks are either: <ul style="list-style-type: none"> <li>• Acute risks include increased severity or frequency of extreme weather events such as; heatwaves, cyclones, landslides, floods, hurricanes, wildfires, and storms.</li> <li>• Chronic risks such as changes in precipitation, extreme weather variability, ocean acidification, chronic heatwaves, and rising sea levels and average temperatures BCBS (2021), ISSB (2022<i>b</i>), TCFD (2017).</li> </ul>
Physical risk drivers	A physical risk driver changes in climate, leading to increased physical risk (BCBS 2021, p. v). For example, higher average temperatures may not be considered a physical hazard in some regions but may cause a higher expectancy of physical risks such as heatwaves. Rising sea levels may not threaten buildings in some areas but may increase the risk of flooding under extreme conditions.
Tipping point	When transcended, a threshold changes global or regional climate from one stable state to another. That could be the melting of polar ice caps, leading to rising sea levels (BCBS 2021, p. vi).
Transition risk	Risk related to changes in, e.g., policy, technology, and market sentiment for mitigation and adaptation to climate change, a transformation to a low-carbon economy. The reduction of emissions could be by actions aiming at enhancing energy efficiency or carbon taxation (ISSB (2022 <i>b</i> ), BCBS (2021)).
Transition risk drivers	Drivers that reduce, increase, or generate transition risk while accelerating or disrupting transition towards a low-carbon economy. These include (but are not limited to) changes in policy, legislation, regulation, market sentiment, customer sentiment, technology innovation, and technology affordability (BCBS 2021, p. vi, 7).
Transmission channel	A causal chain linking climate risk drivers to financial risks BCBS (2021).

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# 1 Introduction

## 1.1 Background

The Intergovernmental Panel on Climate Change (IPCC) expects that without further action, the temperature increase would be around 4-degrees Celsius by the year 2100 (Alogoskoufis et al. 2021). That could result in an increased frequency and intensity of natural disasters (Mallucci 2022), extensive sea-level rise (DeConato & Pollard 2016) which could lead to hundreds of millions people displaced from their homes (Bamber et al. 2019). To decrease the costs of climate change of future generations, the emissions must decrease in order to limit global warming (McGlade & Ekins 2015). An increase in costs due to natural disasters and changes in order to transition into a low-carbon economy will have consequences on financial risks for non-financial firms, financial firms and financial stability (sections 2.1.1-2.1.5). While the risks for financial institutions will be grouped into traditional categories of financial risks, the aforementioned catastrophes or transitions will be defined as *climate-related risk drivers*.

There are uncertainties such as in future emissions, how much the temperature will increase on any given emissions and what the consequences of that temperature increase would be on the environment (Heal & Millner 2014). Such uncertainties makes it difficult to estimate financial risk and ensure financial stability (Weitzman 2011, Caballero & Krishnamurthy 2008), while the resilience of individual banks and the financial system is a concern for financial regulators. Banks are system important in today's society, thus they are under more regulation than ordinary firms. Therefore, the resilience of banks, in comparison to many other firms, is a public interest (see, e.g., Söderström, 2017). Currently, there is no agreement within in literature on how to best incorporate factors connected to an increased risk of disaster or transition into a low-carbon economy, into banking regulation. Proposals ranges from taking a precautionary stance (Chenet et al. 2021) to taking a risk-based approach (Campiglio et al. 2018). While such (in a way normative) research, is helpful in contributing to better incorporation of climate related risks, academia needs to further research (in a descriptive way) how banks are working to ensure their resilience towards these risks. Furthermore what the regulators do to ensure that the banks and the financial system are resilient.

## 1.2 Purpose

This thesis investigates problems when taking into account climate-related risk drivers' effect on financial risks and financial stability within Swedish financial system. This thesis aims to provide insight into how some Swedish banks and regulation experts perceive climate-related risks and obstacles and discuss regulatory strategies. This thesis takes an informative, descriptive approach, no recommendations on how future regulation should be are given.

The descriptive approach will be divided into three parts; how climate-related risk drivers are accounted for within banking regulation, if regulation should reallocate capital towards green investments and if there are challenges in implementation. The first research question, on banking practices, will be investigated by talking with two stakeholder groups; practitioners and regulators. The second research question will be delimited to investigate the regulators' and bank employees' views on whether approaches that build on supporting or penalizing factors should be implemented.

### *Research questions*

1. How are climate-related risk drivers accounted for in Swedish banking practice?
2. Should regulation reallocate capital towards green investments?
3. What are the barriers, challenges, and potential implementation pitfalls?

## 2 Theory

### 2.1 Climate change and financial risks

#### 2.1.1 Climate-related risk drivers

According to BCBS (2021) climate-related risk drivers are climate-related changes that could impact financial risks. These are commonly divided into two groups “*There is broad consensus within the literature that climate risk drivers can be grouped into one of two categories [...]*” (BCBS 2021, p. 5). These categories are *physical risk drivers* and *transition risk drivers*. The former category reflects how the direct effects of climate change drive up financial risks, while the latter category reflects how the transition to a low-carbon economy would drive up financial risks. Furthermore, BCBS (2021) divides physical risk drivers into being either *acute* or *chronical*. *Acute physical risk drivers* are the events linked to extreme weather <sup>1</sup>. *Chronical physical risk drivers* are linked to gradual shifts in climate <sup>2</sup>. Transition risk drivers are also divided into categories. As an example BCBS (2021) lists examples of transition such as; changes in fiscal- or monetary policy, innovation and pricing of technology as well as investor- and consumer sentiment towards green <sup>3</sup> products and investments (BCBS 2021). In the following paragraphs, some climate-related risk drivers that could impact housing prices, inequality, economic growth, or water supply are described. However, there is a significant amount of literature to choose from, and climate change could probably impact all firms in one way or another.

Acute physical events (e.g., forest fires) could damage physical capital such as property, while chronic physical risk drivers (e.g., sea level rise) could lead to decreasing values of assets <sup>4</sup>, but also the ability to make payments could be impacted (BCBS 2021). There have e.g., been many articles published on how disasters or sea-level rise (SLR) would impact housing prices, stock values, or national trade, of which only some can be presented. Bin & Polasky (2004) found that property values decreased after Hurricane Floyd 1999, and Ortega & Taşpınar (2018) likewise found a price penalty after Hurricane Sandy 2012. Even properties not directly affected by the Hurricanes have had decreased property values. Bin & Polasky (2004) suggests “indicate that recent experience with flooding tends to increase the perceived risk with flooding” and likewise Ortega & Taşpınar (2018) suggests “the storm triggered an upward revision of the risk of massive flooding events”. A study by Alok et al. (2020) finds that fund managers overestimate the impact of disasters on stocks located in a disaster zone but that the salience bias decreases with time and distance from the event.

Baldauf et al. (2020) investigated how beliefs about climate change impact home prices situated in danger of sea-level rise. They found a difference; in neighborhoods with more residents denying that they would be impacted by climate change - the homes sell 7% higher - than in the neighborhoods with more residents believing in climate change. Bernstein et al. (2019) found an overall discount of 7% due to inundation risk, but the discount was driven by sophisticated buyers (investors) whose actions coincide with the release of scientific evidence. However, another study found no discount with the possible explanation that “deniers” tend to be the ones buying the property in areas with the most in danger of sea-level rise. In contrast, “believers” buy properties less exposed (Murfin & Spiegel 2020). Other researchers have investigated how disasters impact inflation in food, housing, and energy - and found the inflation level to be dependent on the country’s income level, with richer countries having less or no significant inflation due to disasters (Parker 2018). Similarly, Bosello et al. (2007) found that developing regions would have higher direct losses than developed countries when investigating the effects of a uniform 25 cm SLR and Dell et al. (2012) found that developing countries were less capable of dealing with temperature increases with negative consequences on economic growth <sup>5</sup>. Another study found that

<sup>1</sup>Examples of acute physical risk drivers are the risks of; lethal heatwaves, floods, wildfires, hurricanes, cyclones, and typhoons (BCBS 2021)

<sup>2</sup>Examples of chronic (physical) risk drivers are: rising sea levels, rising average temperatures, and changes in humidity and ocean acidification (BCBS 2021)

<sup>3</sup>*Green* is commonly used as a description of investments, estate or products with relatively low negative impact on emissions.

<sup>4</sup>A fully rational and risk-neutral investor would decrease the value of a coastal property depending on the probability curves of sea level rise and the possibilities of building flood protection.

<sup>5</sup>There has been much research on distributional consequences of climate change. According to Diffenbaugh & Burke (2019), the majority of the warmest countries are poor, while the majority of the richest countries are temperate or cool - which they suggest leads to climate change leading to increased global economic inequality. Richer countries become temperate, and devel-

autocratic states (in opposition to democratic states) have reductions in imports after a disaster, which might further add to the crises (Gassebner et al. 2010). Thus, climate change could have distributional effects, and most hit autocratic poor developing countries.

Research finds that global warming, even in the range of 1.5°C to 2°C may trigger irreversible ice melting in Greenland and Antarctica, which implies several meter sea-level rises (SLR) (Fischer et al. 2018, Lenton et al. 2019). How large the SLR will be is currently not easily estimated, but results by DeConto & Pollard (2016) suggested that just the melting of Antarctica alone has the potential to contribute to over 15m rise and that this would happen within the next five hundred years in a hot-house world. Another study warned “SLR could exceed 2 m by 2100 for our high-temperature scenario, roughly equivalent to business as usual. This could result in land loss of 1.79Mkm<sup>2</sup>, including critical regions of food production, and displacement of up to 187 million people” (Bamber et al. 2019, p. 11199). While on the other hand, Tacoli (2009) called predictions of hundreds of millions of climate refugees alarmist and unlikely, she argued that policy needs to account for changes in migration patterns with examples from China and India. Similarly, Barbieri et al. (2010) argues that adaptation to climate change might be shaped by migration; in their study of the migration rate in Brazil, they found that climate change generated vulnerabilities and redefined the region's economic and demographic landscape. According to BCBS (2021), further research is needed on how population movements and decreased labor productivity will affect corporate profitability and credit risk.

Another area researched is how possible changes in temperature and precipitation will impact agriculture. Adams (1989) wrote an early article that points to climate change's unknown effects on temperature levels, water supply, water quality, evapotranspiration, and soil erosion. However, later research, cited by international regulators, on the topic has been debated. There is not scientific unity on what the effects of climate change on such mentioned factors are (see e.g., the Cline (1996) critique on the Mendelsohn et al. (1994) article or the Fisher et al. (2012), Deschênes & Greenstone (2007, 2012) - debate). Even though there is scientific uncertainty in what the consequences on this sector will be and how different regions will be affected, the overall unity on overall negative impacts with a possibility of extreme negative impacts gives rise to increased risk for farmers. In order to decrease the effects and timing of climate change, GHG emissions need to decrease. One of the earliest propositions of transition to a low-carbon economy was by Stern (2008)<sup>6</sup>, who wrote that even though there is uncertainty in the effects of climate change, economists should not procrastinate and advocate weak policy during the phase of learning. Economists should advise politicians based on the current understanding of climate scientists rather than suggesting more research on economic consequences to be made. The policy can later be reformed, but inaction could become very costly and irreversible. A couple of years after the release of the Stern Review, Carney (2015) said that catastrophic outcomes would impose costs on future generations that the current generation has no direct incentive to fix. He argued that impacts will come beyond *the business cycle*, *the political cycle*; and *the horizon of technocratic authorities*. His speech has become famous as he was one of the first central bank leaders to emphasize climate-related risk drivers as imposing risk to financial stability. However, even though climate effects will materialize outside of the political cycle, world leaders have agreed to limit temperature increases well below 2°C. But according to Jaeger & Jaeger (2011), the 2°C target should be regarded as a focal point in a coordination game. Other possible viewpoints often presented - that the target would be the product of benefit-cost analysis (BCA) or that it would have been scientifically derived, as the threshold separating the safety domain from a domain with possible catastrophic outcomes - are misleading according to them. Rather the target has emerged by chance. Another group of researchers argues

*Ultimately, however, human-made climate change is more a matter of morality than a legal issue. Broad public support is probably needed to achieve the changes needed to phase out fossil fuel emissions. As with the issue of slavery and civil rights, public recognition of the moral dimensions of human-made climate change may be needed to stir the public's conscience to the point of action.*

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oping countries become even hotter. Distributional effects due to climate change may even occur within countries as researched by Dennig et al. (2015), Rao et al. (2017).

<sup>6</sup>The "Stern Review," first made available on October 30th, 2006, raised awareness of climate change among investors and politicians and resulted in an increased difference in annualized issuance costs between climate and non-climate bonds (Painter 2020)



(Hansen et al. 2013, p. 20) as it is future generations and nature in particular that has to be protected.

Heede (2014) compared the *high emitters of GHGs* with the *Tobacco industry*. The latter industry has had changes due to pressure from regulation and shareholders, and the author argued that carbon-intensive sectors might similarly be pressured to transition by stakeholders. Battiston et al. (2017) notes that transition will, depending on the degree of future climate policy, lead to *green* or *brown* assets increasing in value. Portfolio holders, in turn, are winners or losers, depending on portfolio composition. One article found that some transition programs might appear low-cost in the way politicians present them, but when scrutinized, they will come at a high-cost (Gillingham & Stock 2018). The authors argued that the focus should be on long-term transition; short-term policies must be evaluated on how they impact the long-term transition. Such planning linking short-term actions to long-term goals could be done by a roadmap, which helps visualize a possible timeline (see, e.g., the one presented by Rockstroem et al., 2017). However, Thomä & Chenet (2017) criticized the development of hundreds of different roadmaps as these build on assumptions that climate-related risk drivers can be modeled, which is not the fact.

According to Weitzman (2009) fat-tails in estimations of costs due to climate-related risks might make BCA appear less scientifically conclusive, while Weitzman (2011) also found that fat-tails favor faster transition than "*standard*" BCA. On the other hand, uncertainty in the distribution (see also section 2.1.4) might make BCA useless, as Kunreuther et al. (2013, p. 447) puts it "Solicy analysis cannot effectively evaluate alternatives using standard approaches, such as expected utility theory and benefit-cost analysis". They further argued that new risk management strategies better equipped to deal with uncertainty are needed, even though there is little uncertainty in that transition that needs to take place to limit global warming below 2°C. Likewise, Bolton et al. argued that the uncertain climate-related events, referred to as *green swan events* "cannot be captured by traditional risk management" (Bolton et al. 2020, p. 26). It can be concluded that the scientific community and politicians are making an effort to present why and how the transformation to a low-carbon economy ought to happen.

As the current emission pathway estimates a high risk of dangerous climate change, research suggests that carbon prices could drastically skyrocket (Cai & Lontzek 2019, Daniel et al. 2019, Weitzman 2009). This, in turn, could lead to distributional consequences, as noted in Bolton et al. (2020). Carbon prices would also imply stranded assets, i.e., assets suddenly becoming worthless. Even in models assuming future availability of Carbon Capture and Storage (CCS), a great portion of fossil fuels need to remain unburnt. If CCS would not become available, they find the portion of unburnt fossil fuels will become an additional 6% higher. The value of stranded assets ranges depending on the study and model; two valuations are 12 trillion US dollars and 9 trillion US dollars <sup>7</sup> (Mercure et al. 2018). Bos & Gupta (2019) find that around 80% of fossil fuel reserves will become stranded assets to meet the target of the Paris climate accords. Similarly McGlade & Ekins (2015) find that a large portion of the reserve- and resource base of fossil fuels should not be produced if the temperature increase should remain below 2°C. Mercure et al. (2018) found that, due to differences in extraction costs, some reserves will become stranded faster than others, with American and Canadian reserves becoming stranded faster than, e.g., Saudi Arabian. Cahen-Fourot et al. (2021) find that service sectors like real estate and public administration, as well as energy and manufacturing sectors, are exposed to fossil shocks and fossil stranding. For these sectors, in particular, these transition-related risk drivers' consequences on financial risks should be investigated. Caldecott (2017) argued that the release of much research <sup>8</sup> on stranded assets help financial institutions to understand and manage the risk of stranded assets. He argues that the correct pricing of this transition risk is a necessary but insufficient condition in addressing climate change.

### 2.1.2 Transmission channel

BCBS (2021) defines transmission channels as causality chains linking climate-related risk drivers (physical and transition) to financial risks (such as credit-, market- or operational risk). Transmission chan-

<sup>7</sup>The former value by IEA and the latter by the authors themselves, both found in the article by Mercure et al. (2018). They find that a discount rate of 10% would instead result in values of 4 and 3 trillion dollars.

<sup>8</sup>At the time of the article publication he noted in a wide arrange of working papers, research notes, speeches, white papers, and reports

nels describe how climate change materializes as a financial risk depending on how banks' counterparties, assets, and the general economy are affected by the risk drivers. BCBS (2021) classifies transmission channels as microeconomic or macroeconomic. The former category, microeconomic, consists of transmission channels that link climate risk drivers to financial risks through particular households, corporates, or sovereigns. The latter includes how financial risks would be affected if macroeconomic factors (such as labor productivity, unemployment, or economic growth) are affected by climate risk drivers. To exemplify, the climate risk driver of potential increasing temperatures could decrease crop yields for specific agriculture (microeconomic transmission channel) while also potentially decreasing overall labor productivity (macroeconomic transmission channel). According to BCBS (2021), the credit- and market risks are the financial risks that are expected to have the most impact on climate-related risk drivers through macroeconomic transmission channels. However, the authors state that there currently is a lack of research on how the macroeconomic transmission channel. In the coming section, rather than presenting how specific microeconomic- or macroeconomic transmission channels transfers specific climate-related risk drivers into specific financial risks, an overview of the literature on the topic will be presented, with a focus on financial institutions.

### 2.1.3 Financial risk

Two risk measures are central when valuing credit risk: Loss Given Default (LGD) and Probability of Default (PD). The first risk measure accounts for how much the creditor losses in case of a default. The second risk measure is the percentage risk of the customer defaulting. LGD is linked to the value of the mortgage or collateral (if such exists), even though it is also linked to other financial key figures. Such as described in section 2.1.1, both physical- and transition risk drivers could impact asset values and firms' and households' capacity to fulfill loan obligations. Transition could impact asset values (Battiston et al. 2017) or result in negative shocks to economic growth (Dell et al. 2012). Agriculture could suffer from decreased crop yields and farmland values, thus higher PD and lower LGD (Fisher et al. 2012), even though there are overall disagreements on how agriculture will be affected by (and able to adapt to) climate change. There is also evidence that suggests acute physical risks reduce corporate profitability (Barrot & Sauvagnat 2016) or disrupt global supply chains (Abe & Ye 2013, Park et al. 2013). According to Andreoni & Miola (2015), it is difficult to quantify how climate risk drivers impact corporate profitability (and, therefore, financial risks for the corporates' lenders), given the complexity of the global economic system and a lack of data and insufficient methodologies. For example, for a farmer, there is a risk of higher fuel prices due to transition and an increased risk of droughts or lower crop yields due to temperature increases. The exact nature of these risks is currently unknown, and maybe they should be regarded as uncertainties rather than risks (see section 2.1.4). In either case, they will impact financial risks and can thus be seen as climate-related risk drivers. A change in the profitability or asset values of the farmer may affect the creditworthiness; therefore, transmission into credit risk for a lender or new scientific evidence or policy may cause a price correction; and drive market risk for an investor.

Research on commercial banks in the Eastern Caribbean finds that negative shocks to both assets and liabilities followed hurricane strikes, which increases overall risk as measured with the Z-score (Brei et al. 2019). Mallucci (2022) find that the Caribbean region, frequently suffering from acute physical events and even more frequent and intense predicted by climate-change literature, will furthermore suffer from increased borrowing costs and more difficulty accessing financial markets. Thus the acute risk drivers have transmission into credit risk and liquidity risk in this region. On the other hand, Cortés & Strahan (2017) finds that banks in the United States help smooth shocks due to natural disasters by increasing lending in this region. Large banks are able to accommodate the increased demand for credit without decreased lending in other areas, while small banks tend to decrease lending in areas not affected by the disaster. This indicates that financial markets in the Caribbean have the risks of disasters driving up liquidity risk, while the same does not seem to be the case in the USA. Another study by Schüwer et al. (2019) found that banks in the south-eastern US reacted differently to Hurricane Katrina depending on whether they were part of a bank holding company or independent, as well as the business model. Independent and cautious banks (well capitalized and with high risk-based capital ratios before Hurricane Katrina) chose to even further increase their capital ratio after the hurricane in order to strengthen their buffer against income shocks and mitigate bankruptcy risks. Risk-taking banks (relatively low capitalized and low risk-based capital ratio before Hurricane Katrina), as well as banks part of a bank holding

company, did not strengthen their capital-ratios (Schüwer et al. 2019). How a bank is affected and reacts to climate-related disasters is therefore dependent on the context of the bank and not only the details of the disasters.

When it comes to market risk, there is a risk of a price correction if climate-related risk drivers that are not currently incorporated into risk management would become so suddenly. An early article by Herweijer et al. (2009) notes that insurance firms have several trillion US dollars under management and therefore are a large part of the financial industry. These firms need to be able to take climate-related risk drivers into account and find out which counterparties are vulnerable and who are resilient; particular emphasis should be placed on real estate and other climate-sensitive sectors (Herweijer et al. 2009). Recent research suggests that the financial industry has started incorporating climate-related risks into the pricing of the options market, long-term bonds, and stocks. Ilhan et al. (2021) find that climate policy uncertainty (downside tail risk) is priced on the options market with the highest costs for carbon-intense firms. Painter (2020) find that investors recognize the heterogeneous effects of climate change due to credit quality; thus, long-term bonds below high grade have a risk premium, while high-grade bonds do not have a significant risk premium. Alessi et al. (2021) compares a portfolio of firms with low GHG emissions and transparent environmental disclosures to a portfolio of firms in brown sectors without environmental disclosure. They find that *ceteris paribus*, the return is lower for the former portfolio. Investors accept the lower return for the green portfolio as it is less exposed to impacts of transition risk drivers and, therefore, *ceteris paribus*, less risky<sup>9</sup>. However, as will be elaborated on, there is research (Christophers 2019, Thomä & Chenet 2017) that suggests that not all investors take climate-related risks into account, and there is also Knightian uncertainty and modeling difficulties. Uncertainties makes it difficult to say what danger a possible climate-related increase of financial risk poses to financial stability.

#### 2.1.4 Knightian uncertainty

According to Frank Knight<sup>10</sup> (1921, as cited in Heal & Millner, 2014), we are in a world of uncertainty rather than risk. Risks have known probability, while uncertainty has unknown probability and cannot be measured into a probability. Heal & Millner (2014) further argues that some parameters within climate economics are inherently unpredictable and, thus, uncertainties. First, the climate sensitivity parameter (used for calculating temperature increases due to emissions) cannot be estimated. They conclude that it is "unlikely" that it has a value less than 1°C but not impossible, just as there is uncertainty in the tail with values over 10°C having a few percent possible in several estimations in literature. Many models indicate that the parameter-value is probably in 2°C to a 4.5°C therefore determined by IPCC as officially "likely." However, Weitzman (2011) finds that depending on which distribution this constant could have (which is unknown), a value of 10°C could be possible, and Wagner & Weitzman (2018) makes similar conclusions, adding that "*Tail behavior is often postulated rather than empirically derived*". Also Chenet et al. (2021) argue that climate-related risk drivers "*are subject to radical or 'Knightian' uncertainty*" with incalculable probabilities. Although Heal & Millner (2014) means that "*we understand little about the likelihood of worst-case outcomes.*" it is yet argued that climate sensitivity is "*one of the best-understood relationships within climate change science*". Uncertainties in other scientific variables, such as precipitation, are even greater. Hallegatte (2009) writes that models for precipitation may not be validated for a couple of decades. The same authors note that the scientific community is not agreeing on other climate factors, such as whether the increased level of Hurricanes in the North Atlantic is due to climate change or multi-decadal variability. Another example Fischer et al. (2018) notes that sea-level rise and global warming may be significantly more severe than current projections suggests.

Heal & Millner (2014) concludes that it is difficult to build models for estimating climate change. Some estimations in the literature on, e.g., how agriculture is affected by climate change, build too strongly on assumptions and should have wider confidence intervals regarding uncertainty in models and con-

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<sup>9</sup>For the reader not schooled in finance; a lower return on equity usually implies lower risk as investors are expected to demand compensation in accordance with the risk.

<sup>10</sup>Knight's 1921 definition of *uncertainty* shall not be confused with Keynes's definition of uncertainty from the same year. The latter is also sometimes used in climate finance (see, e.g., Mercure et al. (n.d.)) but has a different meaning as described by Packard et al. (2021). Others argue that Keynes's 1936 paper has the Knight distinction of risk and uncertainty (Thomä & Chenet 2017), but the uncertainty concept within Keynesian theory will not be further elaborated here.

stants. Furthermore, they argue that if climate changes were calculable, there is no way to estimate their effects. Chenet et al. (2021) argues that radical uncertainty prevents financial market participants from having a probabilistic vision of the future. While Heal & Millner (2014) illustrates the uncertainty with examples

*How would societies react to rising seas? By protecting settlements or moving them? Would movements occur in a peaceful and organized manner, or would there be strife and dislocation? In a similar vein, let's consider agriculture. Suppose we know how much future food outputs will fall in response to climate stress. What would the economic consequences of this decline be? Would the poor carry the burden, or would it be shared?*

(Heal & Millner 2014, p. 126) of why the costs of climate change are uncertain. An estimation of costs due to RSL is done by Hinkel et al. (2014), but the authors themselves note that "damages would not grow to the values shown in the model," arguing that people would be displaced. Higher protection standards are probably developed and deployed, something we cannot know how it will happen now.

Pindyck (2021) concludes that there is uncertainty in how much the temperature will rise given certain emissions and what would happen given a certain temperature rise. He argues that the tail risk, the risk of a catastrophic outcome, cannot be ignored and that society, therefore, should transition to a low-carbon economy. Even though there is a cost of transition and it cannot be calculated what costs climate change would result in given an emission pathway. It cannot be concluded that the irreversibility of climate change dominates the irreversibility of transition. Still, the former could result in a catastrophic outcome, while the latter would be more manageable. Weitzman describes this potentiality of catastrophic outcomes

*Deep structural uncertainty about the unknown unknowns of what might go very wrong is coupled with essentially unlimited downside liability on possible planetary damages. [...] It is difficult to judge how fat the tail of catastrophic climate change might be because it represents events that are very far outside the realm of ordinary experience.*

(Weitzman 2011, p. 275) Pindyck (2021) find it problematic that there are books, articles, press reports, and public statements from, e.g., politicians who make it seem like climate change can be easily modeled. Rarely, he argues, is it referred to as what "might happen" but rather what "will happen," which misses the fact that there are uncertainties and a fat-tail of possible catastrophic outcomes outside of what will probably happen. Bamber et al. (2019, p. 11999) concludes

*[...] for risk management applications, consideration of the upper tail behavior of our SLR estimates is crucial for robust decision-making. Limiting attention to the likely range, as was the case in the Intergovernmental Panel on Climate Change AR5, may be misleading and will likely lead to a poor evaluation of the true risks.*

Similarly Hallegatte (2009) suggests that end users start to consider climate uncertainty for long-term decisions.

### **2.1.5 Financial stability risk**

These above-described uncertainties could pose a danger to individual financial institutions and the financial system as a whole. Caballero & Krishnamurthy (2008) argues that investors prefer high-quality assets in periods of crisis when there is Knightian uncertainty involved (with examples such as the Russian default in 1998 and the attacks of 9/11 2001). If history cannot be used to understand the crisis, the investors are faced with unknown consequences and uncertainty and tend to even more than usual prefer safe assets. Such a "flight to quality" may even further add to the crisis causing a market chock if investors are quickly diversifying from assets vulnerable to climate-related risk drivers (e.g., coastal property, agriculture, or firms vulnerable to transition risk). A recent study by Girardi et al. (2021) suggests that climate events could be such events that lead to a "flight to quality." The authors found in their research, based on the bankruptcy of Lehman and the landfall of hurricanes Katrina and Rita, that insurance firms diversified from affected sectors. And co-movement between insurers with similar portfolios impacted asset prices and thus could amplify crises as presented evidence suggests that developing countries are more vulnerable to climate change (see section 2.1.1). There are also results

suggesting that companies in countries exposed to climate-related risks have had increases in financing costs and exclusion from financial markets, which restrain economic growth in these countries (Kling et al. 2021). Economies already vulnerable to climate change may have even more difficulties financing new infrastructure and adaptation measures as incorporating climate-related risks into investors' decision-making is negatively impacting their economic development. It is a vicious circle where risks are transferred from lenders to sovereigns due to a transition change in investor sentiment. Likewise, Carney (2015) warned that if insurance firms ceased to give out insurance cover in regions vulnerable to climate change, asset prices in those regions could collapse, which would endanger the financial system as lenders are using the estate as collateral.

Just as researchers in previous sections have warned of catastrophic outcomes (e.g., Weitzman (2009, 2011), Fischer et al. (2018)), an effort by Dietz et al. (2016) to estimate future values of financial assets indicates that transition to a low-carbon economy limits tail risk. Their results indicate that the future value of financial assets has comparable expected values in a 'business as usual scenario as in if global warming is limited below 2°C. However, there are large differences in the upper tail, with the latter low-carbon scenario having much higher 99th percentile values of assets (Dietz et al. 2016). Although 'business as usual' compared to transition would change expected future values of assets, a vast drop of value if the tail outcome materializes could cause a financial crisis and, therefore of concern for regulators. One study finds that banks in England do not account for climate-related risk drivers when tracking house price indexes, as they track indexes on a too aggregate level (Garbarino & Guin 2021). The authors argue that more granular geographic data should be used as the current model could under-price credit risk if the collateral is overvalued. The materialization of physical risk drivers or better models that capture these risks could lead to fast and substantial revaluations of credit risk. Christophers (2019) argues that the investment industry does not react to new scientific information about climate change in a rational way - by diversifying - but instead ignores transition risk. Rather than portend stability, their behavior foreshadows volatility, which he argues is a concern for financial regulators. Even if investors and fund managers are aware of scientists warning of long term financial risks due to climate-related risk drivers, these could be ignored due to irrationality or a shorter investment horizon than the one transition- or physical risk drivers are expected to materialize into financial costs. Likewise Thomä & Chenet (2017) argues that ""There is no reason to believe climate literacy is particularly high among financial sector actors [...]". They argue that there is no historical precedent that could have educated individuals on how to incorporate these challenges into models. On the other hand, many investment firms consider climate-related risk drivers important and implement models to measure their implied risks. Institutional investors are seemingly taking climate-related risk drivers into account increasingly every year. These results suggest that these are incorporated into decision-making and risk management models (Krueger et al. 2020).

## 2.2 Regulation

### 2.2.1 Banking regulation frameworks

Barth et al. (2012) writes that there are two types of regulatory frameworks; the 'traditional regulation approach' and 'market-oriented approach.' The two approaches are taken from the Basel II regulation. The first and second pillars constitute the 'traditional regulation' while the third pillar is the 'market-oriented regulation.' The former focuses on direct regulation by regulators and supervision, while the latter gives weight to the disclosure of information to private sectors. The chapter by Engwall (2017) argues that three groups are contributing to the regulation of banks; *regulators*, *'market actors*,' and *scrutinizers*. While *'market actors*,' could be influential stakeholders to the firm *scrutinizers* are other parties, such as the media, contributing to banks being compliant with the law and norms. Different notations for these last groups are given by Pan (2012), who uses terms such as *self-regulatory organizations* and *gatekeepers* to give an account for how some private organizations (by Engwall termed *scrutinizers*) are also contributing to supervise the banks. Pan (2012) means that regulation could either be handled by authorities (the public) or by the private sector. Furthermore, regulation should be divided into rulemaking, supervision, certification, and enforcement, thus resulting in eight different strategies, see table 2.. Different authorities could be responsible for different tasks such as for the pub-

lic sector, Swedish Financial Supervisory Authority (SFSA, Swedish abbreviation FI<sup>11</sup>) and the Riksbank being tasked with supervision<sup>12</sup>, SFSA with certification and enforcement, while the rulemaking power lies mainly<sup>13</sup> within the Swedish Parliament. Notable contributions in the area of financial regulation in a Swedish context can be found in the article collections edited by Stockenstrand et al. (2019) and Nilsson & Stockenstrand (2017).

Table 2: A taxonomy of regulatory strategies, modified from Pan (2012), with Swedish examples in parenthesis.

	<b>Public Strategies</b>	<b>Private Strategies</b>
<b>Rulemaking</b>	<b>Rules</b> <i>Correcting unsuitable behavior</i>	<b>Principles;</b> <i>(TCFD)</i> <b>Self-regulatory organizations (SROs)</b> <i>(Association for Generally Accepted Practice in the Securities Market)</i>
<b>Supervision</b>	<b>Prudential supervision</b> <i>(Swedish Financial Supervisory Authority - SFSA or FI)</i>	<b>SROs;</b> <i>(Council for Swedish Financial Reporting Supervision)</i> <b>Gatekeepers;</b> <i>(Auditor)</i>
<b>Certification</b>	Investigation and evaluation; Licensing; Approvals and authorizations; Registration	<b>Gatekeepers;</b> <i>(Credit rating agencies)</i>
<b>Enforcement</b>	<b>Enforcement by the regulator</b> <i>(Higher capital buffer)</i>	<b>Private rights of action</b> <i>(T 559-18)</i>

A private rulemaking, *principle*, would be TCFD-aligned reporting. Task Force on Climate-related Financial Disclosures (TCFD) is a private institution, and although it is recommended to report in line with TCFD FI (2021), it is not mandatory. TCFD is thus a Self-regulatory organization (SRO), a private institution that regulates the financial market. Another important SRO in Sweden is *Association for Generally Accepted Practice in the Securities Market* or in Swedish *Föreningen för god sed på värdepappersmarknaden*. The SRO has several departments such as *Rådet för finansiell rapportering* (no English official name) and *Council for Swedish Financial Reporting Supervision* (*Nämnden för svensk redovisningstillsyn*). The former SRO develops good accounting practices and is thus involved in private rulemaking. The latter organization reviews the financial reports of Swedish listed companies, a supervisory assignment that the SFSA delegated. Private supervision is also conducted by auditors, by Pan (2012) labeled as *gatekeepers*. As coming sustainability regulation extends the role of auditors, their usage is seen as important by regulators, see section 4.2.1. One should note that different regulators have different interests when conducting rulemaking or supervision. While a regulator with the focus of ensuring financial stability must account for tail events and uncertainty (previous sections), an auditor or SRO may have a greater focus on what would probably or likely happen rather than focus on the extremes.

<sup>11</sup>The Swedish name of the Swedish Financial Supervisory Authority is *Finansinspektionen (FI)*, while the organization itself uses the same abbreviation in English language, this thesis uses SFSA for the authority which in line with e.g. Söderström (2017)

<sup>12</sup>While SFSA supervises the financial institutions' compliance and resilience, the Riksbank has part of its mandate to ensure financial stability and supervise on a more aggravated level.

<sup>13</sup>Söderström (2017) describes how the rulemaking power of SFSA under the provision of ensuring *soundness* in the financial system is somewhat limited compared to in other countries. For example, in 2014, the authority tried to impose amortization rules on loan takers. Still, the Administrative Court of Appeal in Jönköping made a statement that it does not consider it being under the authority of SFSA to impose amortization rules. In the end, the Swedish Parliament made changes to the law *lagen om bank- och finansieringsrörelse*, which gave the SFSA the right to decide on amortization. That is an example of regulator involvement in law-making.

Regarding *enforcement*, the SFSA has several tools to apply. One of them is to impose higher capital requirements on banks with insufficient risk control, a capital add-on under pillar 2. Private enforcement is when private firms issue banks for not having good enough risk control. A Swedish example can be found in the bankruptcy estate of HQ Bank and its opponents. HQ Bank sued former board members, former CEO, and auditor of 3 billion SEK. The allegation is summarized that, according to HQ Bank, the sued must have known about the shortcomings in the practices but still chose to give out dividends. The Swedish court ruled in the plaintiffs' favor HOVRÄTT (2018).

## 2.2.2 Regulation of climate-related risk drivers

Given the financial risks to financial institutions and non-financial firms, Knightian uncertainty, and possible danger to the financial system (previous sections 2.1.3 - 2.1.5), the climate-related risk drivers are a concern for regulators as argued in the cited literature. However, how to take climate-related risk drivers into account is a question with less scientific unity. Acemoglu et al. (2015) notes that there are two different views on the relationship between the structure of the financial network and systemic risk in the literature. The first view means that a "complete" financial network in which banks have limited exposure to any single counterparty would be less prone to systemic failures than an "incomplete" network in which individual banks are exposed to a handful of financial institutions. The second view regards the interconnected nature of the financial system as a source of fragility, as financial distress and insolvency can spread in the system in an epidemic-like fashion. The authors find that an interconnected "complete" financial network is least prone to contagion and raises concern that interbank interactions could be nonlinear and that large negative shocks would make limits on the exposure between pairs of financial institutions counterproductive. (Schoenmaker & van Tilburg 2016, p. 326) suggested that "The most appropriate supervisory instruments to deal with material risks related to climate change are large exposure limits and capital adequacy rules". The former is explained as exposure to certain sectors, or individual customers should be limited, e.g., to be below 25% so that banks would not be bankrupt if individual sectors or firms have materialization of risk.

Such measures that limit exposure would also render a more complete financial network as described by Acemoglu et al. (2015). Capital adequacy rules are exemplified by Schoenmaker & van Tilburg (2016) as higher risk weights based on the carbon intensity of exposures within the pillar 1 framework or a capital add-on the exposure towards carbon-intensive assets within the pillar 2 framework. However, having different capital requirements based on carbon-intensity exposure could turn out to not be risk-based, warns Campiglio et al. (2018). The climate-aligned prudential policy should not be applied to entire sectors (such as utilities) as there may be companies within those sectors with low-carbon risk. Likewise, burdening banks to assess the greenness of every specific investment project may overburden banks with assessment costs. Furthermore, they argue that changes in the prudential framework may need to be international; otherwise, companies may raise funds in another country. That may transfer risk from one system to another but not decrease the risk to the overall financial system. Both Campiglio et al. (2018), Schoenmaker & van Tilburg (2016) agree that the exposure to climate-related risk drivers should be tested by supervisors, both on the system as a whole but also on individual financial institutions. Incorporating climate-related risk drivers into stress tests has been suggested frequently in the literature (see, e.g., also Borio et al. (2014), Alessi et al. (2021)). While public regulators would make the regulation of exposures, capital requirements, and stress testing (previous section), private regulators could be further involved by increasing disclosure requirements. However, Chenet et al. (2021) argues that such *market-oriented approaches* has already been the focus of policy in the last years. There have been increased reporting requirements with the aim of increasing disclosure and transparency, thereby increasing the accuracy of market self-regulation. The authors argue instead for a 'precautionary' financial policy approach (which would fall into the realm of a *traditional approach* as described by Barth et al. (2012)), with supporting or penalizing effects on brown investments in order to guide capital investments. In contrast to the advisement of Schoenmaker & van Tilburg (2016).

### 3 Methodology

#### 3.1 Research area

To begin with, the process of determining the research area and questions lasted several months during the fall of 2021. The author studied articles covering several areas within Climate-Related Financial Risks during this period as the research area had yet to be narrowed down. Inspiration for deciding on a research area was taken from Augustsson (2018) - possible areas and subjects were identified that were not sufficiently researched while still of interest for financial stability reasons or the financial industry.

In discussing this study’s research questions and theme, the supervisors and examiner were consulted numerous times. In addition, the program planner and program director at engineering mathematics were involved in the process early, ensuring that a thesis about climate-related risks was suitable for a student with a background in engineering mathematics. Research subjects discussed early on included pricing of green bonds and doing some type of stress test. In the area of regulation, it was discussed whether to investigate how regulation has developed just as investigating possible future regulations. In this regard, at the start of this thesis, there seemed to be a lack of research concerning upcoming regulations for climate-related financial risks, which is of great importance to the various stakeholders.

*Table 3: When specifying research aim and research subject assumptions, limitations and delimitations had to be made.*

Assumption	Limitation	Delimitation
There is anthropogenic global warming.	A complete understanding of climate change impacts the society and the financial system is impossible. As noted in several papers on banking regulation there is hardly anyone knowledgeable of all regulations applicable to banks. Similarly, there is probably not anyone that has expert knowledge on the whole climate finance area.	Only study banks, instead of financial institutions or creditors. Only study climate-related financial risks, which limited focus on e.g. climate-related economic risks.
There is a risk for tipping points.	The author’s background in engineering mathematics makes it difficult to draw conclusions related to law, environmental sciences or economics.	The second research question will be delimited to investigate the regulators’ views on whether approaches that build on supporting or penalizing factors should be implemented.

When working with the thesis, the author had to make assumptions, limitations, and delimitations, as exemplified in table 3. Furthermore, this thesis will not explore the motives of stakeholders or economic theories, at least not to a great extent. The established theories used in this thesis are assumed valid as it is not the aim of this thesis to investigate this matter. However, in some cases, it may be within the scope of this thesis to elaborate; if not done, it will be considered a delimitation and further motivated.

#### 3.2 Research design

The author used qualitative data: interviews, reports, standards, and literature for this thesis.

##### 3.2.1 Sampling of interviewees

A list of relevant banks was constructed to find potential experts on climate-related risks employed by the banks. The list divided the banks into three different groups; Large banks, smaller banks with mortgage loans, and other banks without mortgage loans. Usually a researcher would like to interview until



saturation, as described by Bogner & Menz (2009), but for projects limited in time, it could be wise to instead decide on a specific number of interviews beforehand. Kvale et al. (2017) notes those not experienced in doing research (such as probably master thesis students) tend to interview too many people, leaving too little time for analyzing the collected material. After consulting supervisors, the decision was made to start with four interviews with bank employees. In the end, employees from three different banks were interviewed; one large bank and two smaller banks with- and without mortgage loans. In two interviews, two colleagues from the same bank were interviewed at once. Thus five interviewees are bank employees.

Furthermore, two interviews with regulation experts were deemed reasonable, with research subjects experienced in how climate-related risks could impact financial risks or financial stability. Yet another interview was performed with two colleagues at once. Lastly, an expert on adaptation measures and public responsibility was later interviewed to add on knowledge collected in previous interviews. To summarize, five bank employees were interviewed in three interviews, and five other experts were interviewed in four more interviews.

The interviewees identified were all considered experts for the purposes of this thesis. An expert could be defined as a person with broad general knowledge in a specific field of expertise. The expert understands what kind of knowledge different specialists have and how their knowledge relates to each other (Pfadenhauer 2009). For example, one of the interviewees is an expert on the various adaptation measures for sea-level rise and flooding. The interviewee possesses knowledge of what kind of facts different relevant stakeholders have, which is expert knowledge compared to just being specialized. The knowledge is also generalizable, as it could be generalized to other regions than the specific region the expert is situated in. However, regarding climate-related risks or adaptation to climate-related risks, he is a specialist focused on one kind of climate-related risks. Therefore, the interview is centered around the theme in which he possesses expert knowledge - sea-level rise and flooding. Four interviewees could similarly be considered experts or specialists in regulation, depending on how broadly themes are discussed.

Similarly, bank employees come from different backgrounds and have different knowledge. None of them could be considered experts on how climate-related risks are considered in the Swedish financial sector. Nevertheless, they are all experts on how climate-related risks are taken into consideration within the setting of their employer and possibly also have information from other stakeholders with whom they are in contact. Gläser & Laudel (2009) point out that everybody is an expert on their situation. The individual expert interviews with bank employees are not meant to provide information on the industry as a whole but to exemplify knowledge of how some banks currently are considering climate-related risk drivers. That is practical "know-how" that cannot be learned by reading reports, standards, or literature.

The sourcing of climate-related risk experts was performed through various methods. The banks contacted within this thesis were: *Danske Bank*, *Ikano Bank*, *Länsförsäkringar Bank*, *Resurs Bank*, *Sparbanken Syd*, *SVEA Bank*, *Svenska Handelsbanken* and *Swedbank*. The contact of potential participants was initially made through official channels, such as calling the reception of the employer. However, this method proved yielded a low response rate. Some potential research subjects were thereafter sourced by LinkedIn messages to those who listed relevant experiences on their profile, while yet more others were contacted by asking contacts within a bank to help source suitable colleagues. Therefore, some sampling was not done through a specific bank but rather directly by contacting a particular expert. Several of these banks did not provide an interview subject, but that does not necessarily mean that the bank does not have an expert on climate-related risk drivers, as that expert could just not have been able to participate during the interview phase of this study.

The use of the alternative approaches to contact suitable candidates directly or by contact may lead to a selection bias, that only those listing relevant experience on their LinkedIn page were contacted. But only contacting banks to provide candidates could have caused the same bias. For example, it is not improbable that a sustainability manager or risk officer from a bank that works little with climate-related risk would elect not to participate. Kvale et al. (2017) notes that gaining access to interviewees is

a central problem when performing an interview study, which is an argument for using several accessible methods to gain access to interviewees. In the end, out of the participating banks, one contact was initiated through an acquaintance, another from a LinkedIn request, and the third from a call to the reception. Proving that all tested methods were useful. However, if fewer methods to initiate contact had been used, possibly the same number of interviewees could have been collected, just that more banks would have had to be contacted as the above list is not covering all Swedish banks.

Regarding regulatory experts - the *Swedish Financial Supervisory Agency*, the *Riksbank*, and the *interest organization Swedish Bankers' Association*, were asked to provide interview subjects with experience with climate-related risk drivers.

### 3.2.2 Overview of interviewees

These are the interviewees sorted in alphabetical order on last name.

- **Kristoffer Blomqvist** is employed at the Swedish Financial Supervisory Authority. His experience includes supervision of banks' credit risk as well as looking at sustainability issues.
- **Marie Darte** is chief governance risk officer (CGRO) at Resurs Bank. Her experience is within risk and governance management. The participant was interviewed at the same time as Henrik Linder. **Adam Ersmark** is working as a Senior Sustainability Specialist in Group Sustainability at Svenska Handelsbanken (SHB). Former experience includes audit and assurance, business and financial control on group level as well as in the area of asset management. The participant was interviewed at the same time as Johanna Lindlöf.
- **Camilla Ferenius** has experience from the Riksbank, Swedish Financial Supervisory Authority and different task forces appointed by the government of Sweden, European Central Bank (ECB), Basel Committee on Banking Supervision (BCBS), International Monetary Fund (IMF) and European Banking Authority (EBA). The task forces under BCBS and EBA include looking at climate related financial risks.
- **Maria Ferlin** has experience of working with financial stability at the Riksbank. She has also experience of capital asset management at an insurance company and is currently employed as senior adviser at The Swedish Bankers' Association.
- **Dick Karlsson** is M.Sc. in civil engineering who works as a senior specialist on adaptation to climate change in Gothenburg.
- **Henrik Linder** is Nordic sustainability manager at Resurs Bank. His experience is within the Environmental, Social and Governance (ESG) area.
- **Johanna Lindlöf** is currently working with sustainability issues and climate reporting at Svenska Handelsbanken (SHB). Former experience includes risk analysis in the area of asset management.
- **Christian Nilsson** is a senior advisor at The Swedish Bankers' Association. His work tasks include being a reference and negotiating part for banks about, among other things, reporting to supervisory authorities.
- **Thomas Åkesson** has experience of credit risk modeling. He is currently deputy manager of credit risk at Sparbanken Skåne.

### 3.2.3 Preparing for interviews

Before the interview, the interviewer has to prepare and become what Pfadenhauer (2009) calls a "quasi-expert." That is to prepare for different kinds of directions the interview could take by reading relevant standards and reports as well as literature. More about how this selection was made in the coming section. One preparation was to do two preparation interviews, "test interviews," before the ten included interviews. Those two interviewees agreed to participate (to finalize the interview guide and help the interviewer gain practice) under the premise that the empirical results from these interviews would not

be included in the final thesis. The two interviewees were a sustainability manager at a small bank and an operational risk manager at a small bank. The process of updating the interview guide after practice or feedback from test interviews (or coming interviews) is disclosed in Appendix A.

### 3.2.4 Conducting interviews

All the interviews were semi-structured with tendencies to be unstructured. Some themes were prepared with possible questions, which the interviewer tried to cover. In the end, much consideration was taken into what the interviewees considered important. The interviews tended to be almost unstructured discussions, with the interviewees sometimes talking for many minutes about what they considered important within a theme. Some interviewees were substantially more structured than others, with interviewees giving short answers the more the interviewer had to guide the interview. Examples of interview questions included in an interview guide is included in the appendix B.

### 3.2.5 Literature and reports

**Process of selecting reports.** The selection process, through which reports were chosen to be read in preparation for interviews, was performed in two steps. First, all reports, articles and discussion papers released by *BCBS*, *Bank for International Settlements (BIS)*, *Network for Greening the Financial System (NGFS)*, *International Financial Reporting Standards (IFRS)*, *EBA*, *European Securities and Market Authority (ESMA)*, *European Systemic Risk Board (ESRB)*, *the Riksbank* and *SFSA* released from 2016 to 2021 which could include material within the scope of climate-related financial risks, were downloaded. These amounted to 60 to 70 reports. These organizations were chosen as they have a very central role and influence in banking regulation, *BIS* and affiliated *BCBS* are influential in international banking regulation, and *NGFS* has many regulatory authorities in its network and therefore a distinct but indirect influence. *IFRS* releases accounting frameworks under which expected losses are to be calculated. *EBA*, *ESMA* and *ESRB* are organizations influential in European regulation. *The Riksbank* and *SFSA* are the Swedish regulatory organizations.

Secondly, the abstracts, keywords, and definitions were scoured, and those considered relevant were read and evaluated. The following number of reports for each financial institute or organization were considered: *the Riksbank* (5), *SFSA* (4), *SFSA and the Riksbank* & (1), *EBA*, *ESMA* or *ESRB* (8), *BCBS* or *BIS* (5), *NGFS* (3) and *IFRS* (2). Furthermore, reports from *Financial Stability Board (FSB)* as well as *Institute of International Finance (IIF) & European Banking Federation (EBF)* were also read as they were referenced by other papers and deemed relevant. Some reports were read in great detail, while only relevant parts were considered for others. Some regulatory standards were also downloaded, and parts deemed relevant for the thesis were read. Some of these preparatory documents are used in section 4. *FSB* and *BCBS* are international organizations funded and hosted by *BIS*. *ESRB* has oversight of macroprudential oversight- and *EBA* is one of the authorities responsible for microprudential oversight in the European Union. *SFSA* is the supervisory authority in Sweden, and the *Riksbank* is the central bank of Sweden. It is important to note that all these organizations are not working independently but rather collaborating, sharing information, and building on each other. *FI* (2021) mentions *NGFS*, *BCBS* and *ESRB* has organizations they are working with, and *Riksbanken* (2021) mentions *NGFS*, *EBA*, *BIS*, *IMF*, *Economic and Financial Committee EFC*, *FSB* and *ESRB* as organisations they are collaborating with.

**Literature and 'snowballing'** The literature search was performed through a backward snowballing technique. A first data set was compiled from articles and reports sent by the author's supervisors in conjunction with deciding on the research area, as well as reports gathered in the process of selecting reports. From there, the author used backward snowballing by investigating articles referenced in the initial data set. The relevance of the referenced articles was evaluated first through the title, author, and journal, then by reading the abstract. Those deemed relevant were read in full text and, if included, were used for further snowballing. The exclusion was made for papers: in languages other than Swedish and English, older versions of the same report or article, or papers not within the scope of the thesis. The snowballing was decided to be concluded on basis of saturation. Selected articles were read, although not all are cited in this thesis. Furthermore, some articles and books on banking regulation were gathered separately with the help of a librarian.

### **3.2.6 Data analysis**

The analysis of data was done through a number of steps. First of all, a pre-analysis was done after each interview. During the pre-analysis, the author listened to a recorded interview and transcribed matters of perceived importance. Later, a summary of the interviews and their core themes was compiled. Lastly, further investigation into important keywords or concepts from the interviews essential and had not been investigated enough beforehand were researched. After pre-analysis, the interview guide and interview questions were updated as described in the appendix.

Technical tools used in the transcription process were Word and Excel (Microsoft Office). The software transcription was complemented manually to ensure accurate transcripts. Other electronic software for this task was evaluated. However, it proved to have little gain compared to the effort needed to learn how to use them effectively.

The used coding technique - Structural coding, or utilitarian coding - as it is also called, is a coding method used in qualitative research. The coding works through the labeling of interview segments through a 'code' to describe its content. Codes are then used to find data sequences with themes of similar nature to help categorize and structure data for analysis. Structural coding is particularly effective in research with large sets of data Saldaña (2013). The compiled segments were collected in Microsoft Excel for further analysis.

Excel was used for the categorization of data with similar codes. Similar codes were collected in one sheet, with data corresponding to a code under each column and an interviewee for each row. This stage of the process, categorization, ended up in a catalog of themes. The first draft of possible themes was discussed with supervisors, who helped suggest another way of structuring the data. Next, the author did further analysis by comparing the different spreadsheets and ended up presenting themes under two different sections, the views of bank employees and the views of other experts. This categorization was also discussed with supervisors, which ended up in a third re-categorization and the current draft of the report.

## **3.3 Worldview and epistemology**

This section introduces this author's worldview, choice of research design, opinion on generalizability, and potential biases. These concepts will be discussed further in the last section of this thesis. Engineering is to be considered a multifaceted and diverged profession with many branches with similar traits and education. In the volume *Philosophy and engineering*. An emerging agenda with editors Bocong, many authors give their views on topics such as if there is something that could be considered an Engineering worldview, the role of the Engineer and so on. In this section, their research will be put into the context of this Engineer, so to investigate the biases of this research. To begin with, the author notes that the worldview of a researcher is not just formed by the chosen profession, such as engineering, but also nationality, religion, culture, and many other aspects. As an example Didier (2010) gives an account of how a French view of the Engineering profession differs from the American. Therefore, other experiences forming the author's worldview are brought up later on.

### **3.3.1 Worldview as a concept**

'Worldview' is a concept that essentially embraces how the researcher's experiences affect the choice of research design and how data is analyzed Creswell & Creswell (2018). A cornerstone of the worldview concept is epistemology, which concerns what the researcher considers "scientific knowledge." Thus, some researchers tend to use a quantitative design, some a qualitative and others a mixed research method. In addition to this, the worldview also includes everything that happens after choosing a research design. For example, it incorporates which data collection method is used and how data is analyzed and generalized. Additionally, the concept also includes how the researcher chooses to present the data and give accord to eventual biases within it. Therefore, as qualitative data provides the author with many such choices, an introduction to the engineering worldview will be provided using the setting

of this student. Understanding the engineering worldview has helped the author understand his biases and interpret interviewees and other authors.

### **3.3.2 Engineering worldview in context of this author**

Engineering is to be considered a multifaceted and diverged profession with many branches with similar traits and education. Engineering incorporates not only technology and different fields of natural science but also requires several other areas of expertise. For instance, modern engineers must also consider political-, economic-, ethical- and psychosocial factors when they practice their profession Bocong (2010). The program of *Engineering Mathematics* at LTH Faculty of Engineering includes several project courses where the group, typically consisting of four students, is faced with a problem they have to solve. The process usually starts with identifying the issue, continuing with research, and coming up with a solution. Lastly, the team implements the solution, commonly in a code script. This author has faced problems such as how to solve a traffic jam, determine drug dosage, forest harvesting, and distribute vaccines. In a way, the first parts of these assignments have prepared the author for writing a thesis. In another way, the explicit or implicit demands of solving the tasks create a way of thinking in terms of *'good enough'* or *'some is better than nothing'*. As explained by Durbin (2010), some "radicals" even suggest that engineers are not supplying what they would consider their best solution but instead what they believe their customer or manager wants. This author suggests that most engineers have morals that would prohibit them from suggesting a regulation or adaptation measure that, scientifically, would be considered faulty. However, engineers are hired to do a job, and if the manager says that "the efficient market hypothesis holds," or "we do not have to look at tipping points," then the engineers probably supply a solution satisfying the managers' delimitations.

### **3.3.3 Public conception of engineering research**

As a professional, one is held morally accountable for any poor decision, harm caused, or failures, e.g., through carelessness or decisions not in line with current research and proven experience Robinson (2010). Despite the tremendous moral responsibility placed upon the profession, it has been argued that the engineering curriculum depends too heavily on natural sciences, leaving the students unprepared for the profession's political and social science-related demands Durbin (2010). For example, when in a project course, given the task of determining how to distribute traffic, medicine, or vaccines, the engineering student has learned to say; *"this solution has the lowest amount of casualties according to our calculations"*, typically presenting a figure or diagram. Sometimes, the statement is followed by *"there is, however, some uncertainty that could impact your decision* with more figures presenting confidence intervals typically with 95% and 99% security. Solution provided, and it is left for other professions to review, decide and implement. However, it could be assumed that the decision-makers, supposedly, in the end, politicians or the public through elections, put their trust in the Engineer's presentation. Who is responsible for ensuring that the confidence level is right? In the field of climate finance, numerous subjects are not easily apprehendable by all stakeholders, such as 'rare but extreme events'. An example of public discussion of rare events is the famous monologue from the Swedish comedian Tage Danielsson from 1979 concerning the nuclear disaster in Harrisburg. The comedian remarked that it could not have happened as the probability of it happening was so small, and if it had happened, it could not happen again, at least not now or in Harrisburg. Another example of how the public may have difficulties taking rare events into account is how real estate prices have fallen due to a natural hazard in a different region getting media attention. People become wary of headlines in other states, even if their area is not in any danger of climate-related risks.

### **3.3.4 The role of the state and the role of the engineer**

A researcher's worldview (or, in this case, the student's worldview) can be considered a collective of experiences that have shaped their philosophical outlook, interpretation, and approach Creswell & Creswell (2018). In addition to the discussed engineering worldview of the author, several other factors broaden and nuance this author's individual worldview. Before deciding on an Engineering degree, the author completed the first semester of a Swedish law degree, constituted by predominantly legal theory. The philosophes presented as a part of the course had a wide array of views on the state's role and included

philosophers such as Hume, Locke, and Montesquieu, among others. Undoubtedly, the author was influenced by the material and, as such, believes that there is no optimal role of the state, determined by, e.g., utility functions, cost-benefit analysis, or other forms of analytic tools. The public responsibilities cannot and should not be determined by such engineering tools - according to this student. Furthermore, the role of the state will vary from one century to another and from one country to another, depending on things such as morals, ethics, and religion. Thus, the author has proceeded with caution when reading about, e.g., Malaysian legislation, as the context and view of the state may differ. The author also handle normative research with care; there, some researchers take it upon themselves to decide what should be considered "good" or "bad", often without providing necessary context or giving account for assumptions.

Didier (2010) notes that engineers often form society rather than fulfilling the needs of society, e.g., when developing nuclear power or microwaves. This author believes that engineers ought to be cautious so as not to take this role in a democracy (in comparison to technocracy). An optimal regulation or adaptation measure is not what the Engineer has calculated using cost-benefit analysis but instead a complex matter depending on what role the public wants the state to have. Some interviewees in this thesis hint that the politicians are wrong in trying to make regulators drive transition instead of implementing fiscal policies themselves. That could cause financial instability, is their conclusion. This author regards that as a relevant thing to explain for politicians, but in the end, it is the elected representatives of the public that has to decide on these matters and the transition pathway. In this author's view, such choices cannot be calculated with simulation tools and decided upon by professionals. The scientific community can likewise provide guidance, but must be careful with rulemaking. Others may disagree with this view, especially given the importance of a gradual transition and politicians' potentially limited decision horizon.

## 4 Studied reports, regulations and discussion papers

### 4.1 Overview of published material by authorities and regulators

#### 4.1.1 Viewpoints of the Riksbank and SFSA

In this section some published material by the Swedish Financial Supervisory Authority (Swedish abbreviation *Fi*) as well as from the Riksbank (Swedish *Riksbanken*) is presented. Two of the reports published by the central bank of Sweden are 'Climate risks in the policy work' and 'Climate-related risks are a source of financial risk' (Riksbanken 2021, 2019). Two of the reports published by Swedish Financial Supervisory Authority are 'Climate change and financial stability' and 'Sustainability Report 2021 – the climate in focus' (FI 2016, 2021). The viewpoints of these documents provides and introduction to how Swedish regulators consider climate-related risk drivers, and how these viewpoints might changed.

In the climate report released in 2021 by the central bank of Sweden notes that climate change "*may affect the conditions*" for them to fulfill their mandate given by the Swedish government (Riksbanken 2021). Their mandate is twofold, to maintain "price stability" and to "promote a safe and efficient payment mechanism" (which they regard as including to ensure financial stability in the financial system) (Riksbanken, 2022). The report continue to note that "*Climate change and strategies for dealing with it form one of the most important social issues of our time. [...] Climate change, and the measures needed to counter it, may have far-reaching effects on our economies.*" (Riksbanken 2021, p. 5-6). The formulations in the article released two year prior may even more stronger suggest that climate-related risk drivers is a concern for the central bank:

*For the participants in the financial system – banks, insurance companies and other financial and non-financial corporations – climate-related risks can create financial risk. If these are not managed, they can entail risks for the financial system, which can in turn have consequences for financial stability. It is therefore part of the Riksbank's mandate to promote resilience to climate-related risks in the financial system.*

(Riksbanken 2019, p. 34) and "*Climate-related risks are a source of financial risk and therefore falls within the mandate of central banks and supervisory authorities that are tasked with promoting financial stability.*" (Riksbanken 2019, p. 37). The Riksbank notes that both physical- and transition risks are risk drivers which increases financial risks, which the Riksbank needs to take into account in their monetary policy (Riksbanken 2019, 2021). Furthermore climate risks needs to be taken into account in asset management and work to ensure financial stability. However the Riksbank emphasizes that their actions can only complement other actions and should not be regarded as a substitute. The primary action that should be taken to decrease emissions, the Riksbank notes, is to make emissions expensive through a carbon tax Riksbanken (2021). The SFSA notes that emissions needs to be reduced and that the introduction of a taxation tax is a likely transition event. They advocate: "*To better understand and manage the transition risk associated with future price increases, FI [SFSA] advocates that firms use internal carbon pricing and disclose this information externally.*" Already in 2016, FI (2016) wrote about firms in the financial sector not having sufficient control over the financial risks driven by climate-related risk drivers. Two possible reasons are provided, the first is that the costs is an externality (in opposition to being a question of optimal risk management for profitability). The society could be the risk owners in some aspects, such as the increased risk for a financial crisis (which is typically decreased by regulation such as capital requirements). Another reason provided by the report is that financial firms has a too short time horizon, which therefore misses the materialization of physical risks, and a reference is given to the Mark Carney speech with the title "Breaking the tragedy of the horizon" <sup>14</sup>. Therefore, they note, financial stability could be affected by climate-related risk drivers although it is too early to conclude. On the other hand, the report takes much effort in explaining how well positioned Sweden and it's firms and in particular financial firms are towards changes connected to climate change. With a title as "CLIMATE RISK – SWEDEN'S EXPOSURE IS LOW" and statements such as: "*The Swedish economy is thus one of those in Europe that is the least directly vulnerable to climate change.*", "*[...] since the risks related to extreme weather are considered to be much lower in Sweden than in many other parts of the world, the impact ought to be lower [...]*", "*Where Sweden is concerned, exposure to climate-related risk is generally*

<sup>14</sup>The speech Carney (2015)

*low, both in absolute terms and compared with other countries.*”, “*the Swedish banks generally have high and growing awareness of the credit and reputational risks associated with climate and other sustainability matters*”, “*Sweden is already a low-emissions economy today. Sweden’s carbon dioxide emissions per capita are much lower than the global average [...]*” (FI 2016, p. 13-14) and yet many other statements the SFSA back in 2016 downplayed the danger on climate-related risks in Sweden. The referenced statements are factually correct, but gives an overall impression (together with the section title) an impression that these risks is not a problem the Swedish Financial Supervisory Authority has to prioritize. Physical risks are low, the transition had already happened and the banks are aware of the correlation between climate-related risk drivers and credit risk. The following calculation: “*It is assessed that an increase in the global average temperature of 2–3 degrees Celsius could lead to economic losses equalling up to 3 per cent of global GDP*” lacks reference, which possibly should have been provided given that already in 2016 there was knowledge about the uncertainty in such assessments. Later in the report they write: “*Drawing up specific forecasts about how the financial sector, or any other part of the economy, will be affected over a horizon of several decades is hardly realistic.*” It’s a build up to the conclusion: “*FI does not currently find that specific regulation and supervision measures to manage climate or transition risk are motivated. The risks are not sufficiently large and clear to justify such specific actions.*” (FI 2016, p. 17)

More recently statements as FI (FI, p. 23): “*[...] we will also announce in the spring how we will proceed in the work to measure the climate-related risks in the banks’ credit portfolios.*” further notes that these risks needs to be measured and mitigated. FI (2021) writes that they are not allowed to prohibit investments in activities and businesses that are contributing to global warming. However “*[SFSA] can, and must, require that financial firms consider and manage relevant risks. This may mean that financial firms need to reduce their financing of activities that are not sustainable in the long run or hold more capital in relation to, for example, climate risks*” (FI 2021, p. 6) This statement that the risk imposed to financial stability could be reduced by higher capital requirements is not unique, but neither an agreed subject as discussed previously. On the other hand, the central bank regards disclosure, reporting and transition on firm level to be important if the resilience in the financial system is to be ensured:

*The Riksbank considers improved and uniform disclosure of climate-related financial information to be the first building block in the work to manage climate-related risk. Banks, insurance companies and other financial corporations need to identify and assess the climate-related risks they are exposed to and incorporate these into their business models and existing risk management.*

(Riksbanken 2019, p. 38). Similarly the SFSA notes that financial firms needs to be transparent about exposures to physical- and transition related risk drivers as well as sharing information with each other in development of methods and best practice in order to reduce downside transition risk (FI 2021). Overall the report from 2021 downplays risks much less than the report from 2016 and the statement “*need to [...] or hold more capital*” (see above) shows that they are prepared to take action to ensure the risks are managed by financial firms properly.

In regard to financial stability, Riksbanken (2021) notes that if not climate-related risk drivers are taken into account when calculating interest rates and asset prices, then large and rapid price adjustments will occur with an increased probability in the future Riksbanken (2021). In other words the central bank is warning about market prices not being efficiently incorporating climate-related risk drivers which increases market risks. Moreover, Riksbanken (2021) notes that there must be access to “usable and comparable” data in order to correctly measure, analyse and price the climate-related risk drivers impact on financial risks. An almost identical formulation is found in the two year prior article (Riksbanken 2019). The view of FI (2021) is that there currently is access to a lot of information, but the real issue is the amount of different standards making the information incomparable. Also making the effect of climate-related risk drivers difficult to price is that “*[...] firms seldom express the consequences of sustainability factors in economic terms, and the information is often backward-looking instead of forward-looking.*” Currently SFSA is investigating banks resilience towards climate-related risk drivers and the following statements shows that the central bank as well is involved in that action

*At present, it is difficult to know how the Riksbank’s work in the area of financial stability will need to be developed and what role the Riksbank can play. But some of the work involves*



*trying to assess the extent to which the major banks in Sweden and the Swedish financial market infrastructures are exposed to these risks and how resilient they are. The Riksbank has now begun to examine how climate-related risks can be integrated as part of stability analysis and monitoring.*

Also the central bank warns that the Swedish banking system is exposed to climate-related risks drivers through an increase in credit risk. Their finding indicate that approximately 12 % of the banks' corporate lending are to firms vulnerable to transition risks, and out of these 25 % went to companies with weak financial positions Riksbanken (2021). The article from 2019 gives examples of sectors the Riksbanken (2019) regards as vulnerable: "sectors that are dependent on coal, oil and steel with a high carbon footprint". The FI (2021) also notes that societies will change and that the transition to a fossil-free economy will impose risk: "The transition to a fossil-free economy is not free from risk, and many businesses need to adapt at a fundamental level to survive. Others will need to be shut down." The Riksbanken (2019) article also warns about stranded assets (which the 2021 report does not)

*It may also be a question of political decisions, according to which certain resources such as coal, gas and oil shall no longer be extracted but left in the ground. If the use of certain assets is completely prohibited due to their potential to generate far too much toxic pollution during their extraction and use, they will become so-called stranded assets and completely lose their value.*

(Riksbanken 2019, p. 35) Moreover also rising sea levels is a risk driver that Riksbanken (2021) has investigated in particular. They note that it is more and more difficult to get insurance against flooding for coastal properties in danger of sea level rise, which can lead to decreases in property values. This will increase loan-to-value ratios when the collateral [building close to the sea] is losing value. The central bank concludes in this report that the danger of floods will increase although the increase in the risk driver will depend on the severity of climate change Riksbanken (2021). In the prior article, the transmission channel from physical risk driver to credit risk is explained

*The credit given by banks to households and companies often has real property as collateral. Natural disasters can destroy this property and thereby severely reduce the value of the collateral. For loans where the borrower's debt-servicing ability deteriorates and they are unable to repay the loan in full, it is important that the value of the collateral can cover the bank's claim. If the value of the collateral deteriorates, a credit loss may arise.*

(Riksbanken 2019, p. 34) The central bank has also stated that damages caused by droughts and heat-waves is reducing the value of assets and warns that also insurance firms may have increased costs due to climate-related physical risk drivers Riksbanken (2019). Climate-related risk drivers may also reduce capital and impair liquidity, according to the central bank article (Riksbanken 2021). The article also mentions central counterparty (CCP) risk:

*The difference between Nordic and German electricity prices [the former had decreased prices due to rainfall and the latter increased prices due to increased costs on emission rights] was 17 times greater than on a normal trading day. This rapid development led to the default of one of the participants in the central counterparty Nasdaq Clearing, that had large positions on the electricity derivatives market. As a result, the other participants had to share the loss.*

(Riksbanken 2019, p. 35) Riksbanken (2019) notes that "If the physical risk increases, it may, on the other hand, lead to more substantial and faster changes to climate policy, which may increase transition risk in the short term." This linkage between transition- and physical risk drivers has been researched and written about by numerous authorities, organizations and researchers. The Riksbanken (2021) report does not write about this connection in particular but notes "the extent of these effects [transition risk drivers impacts] is very difficult to predict, but they are likely to increase the longer the transition takes", which is a recognition of the time horizon effect. FI (2016) write about the linkage between transition- and physical risk drivers (with even a graph) and how different scenarios also could lead to different amounts of stranded assets.

## 4.2 Sustainability regulations

### 4.2.1 Sustainability reporting - an overview

Today, sustainability reporting is not done through a uniform standard but based on recommendations and frameworks developed by several organizations Ferlin et al. (2021). In the following paragraphs, many organizations (such as the European Union (EU), FSB TCFD, Global Reporting Initiative (GRI), Climate Disclosure Project (CDP), Sustainability Accounting Standards Board (SASB), IFRS, International Sustainability Standards Board (ISSB), and International Organization of Securities Commissions (IOSCO)) involved in different frameworks will be addressed as well as several different frameworks for sustainability reporting. (FI 2021) considers it necessary to develop harmonized sustainability reporting in order to enable comparisons between different companies for, for example, customers and to increase awareness of sustainability work within companies. They also point out that several companies considered sustainability reporting resource-intensive and that the existing frameworks are diverging in their design. In the following sections, it will be apparent that several organizations, through adaptation and collaboration, have begun work on harmonizing their standards. (FI 2021) emphasizes that their survey shows a desire from the industry for the government and authorities to contribute to harmonizing the regulations to create clarity. For climate-related risks, the standards that directly link their reporting are highly relevant, as are sustainability standards in general. (FI 2021) emphasizes that reporting emissions and how companies work with sustainability and emissions helps other companies to evaluate their conversion risk. Many of the different frameworks go into each other, as shown in figure 1. As will be clarified, Corporate Sustainability Reporting Directive (CSRD) and IFRS sustainability reporting are expected to be close to each other and the previous Non-Financial Reporting Directive (NFRD) regulations. Some new parts are added for Swedish companies, while others are already covered by Swedish legislation that is more comprehensive than NFRD.

#### Sustainability reporting in EU and Sweden

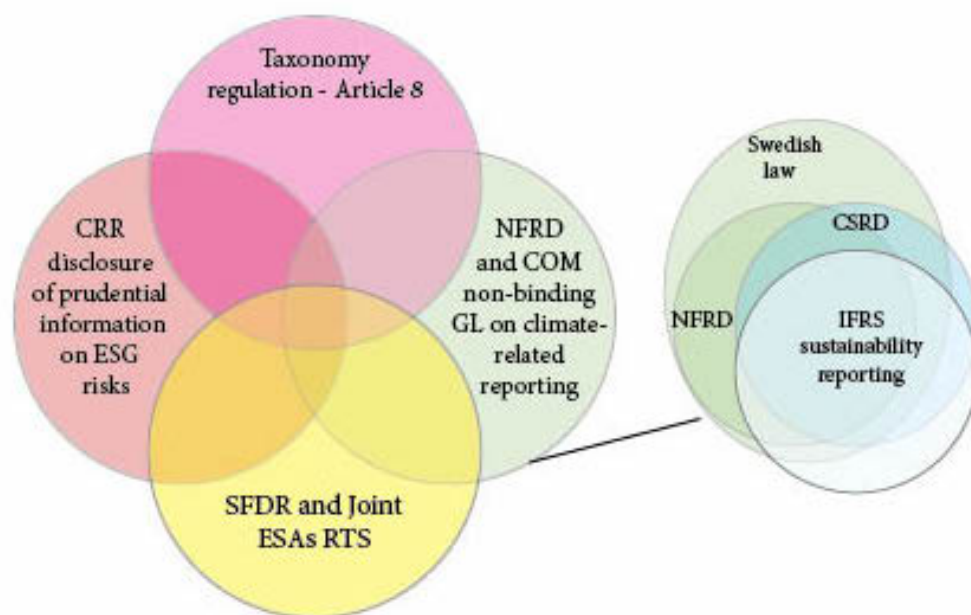


Figure 1: The overlap of different sustainability reporting- and climate-related risks standards. Modified from EBA (2022) and Riksbanken (2021).

#### **4.2.2 TCFD**

The FSB established TCFD in 2015 for the development of an improved standard for reporting climate-related financial information Ferlin et al. (2021). There was a need for a standard that could convey more accurate and comparable information. The standard, released in 2017, includes reporting on direct and financed emissions Riksbanken (2021). In addition, goals for managing climate-related risks (and goal fulfillment) and climate-related opportunities must be reported Ferlin et al. (2021), Riksbanken (2021). It provides recommendations to both financial and non-financial companies. (FI 2021) describes how TCFD has come to cooperate with other large framework providers for voluntary sustainability reporting, such as the Global Reporting Initiative (GRI) and the Climate Disclosure Project (CDP). GRI is in turn currently developing future sustainability standards with the Sustainability Accounting Standards Board (SASB), which could also come to include elements from TCFD (FI 2021). (Ferlin et al. 2021) points out that the EU Commission's "guidelines" call for accounting under the TCFD. Several countries, such as New Zealand and the United Kingdom, have already made accounting according to the TCFD mandatory. (FI 2021) encourages the customers they supervise to report according to TCFD to gain experience before more mandatory requirements come and states that financial companies encourage companies in which they invest to apply the standard.

#### **4.2.3 EU: Taxonomy Regulation & The Sustainable Finance Disclosure Regulation (SFDR)**

The EU taxonomy Regulation will become active from January 2022 and contains detailed information about what activities should be termed sustainable through a classification system Ferlin et al. (2021), Riksbanken (2021). The Sustainable Finance Disclosure Regulation (SFDR) has become active already in mars 2021 and forces fund managers, insurance brokers, and securities companies to inform clients and investors about sustainability information Ferlin et al. (2021). They must also disclose sustainability information about their financed activities Riksbanken (2021).

#### **4.2.4 EU: NFRD and CSRD**

The Non-Financial Reporting Directive (NFRD), is an EU directive implemented in 2014 Ferlin et al. (2021). The directive obliges certain, often large, companies to formulate a sustainability report. The company must include several sustainability factors within the report, including social- and sustainability factors Riksbanken (2021) and climate change Ferlin et al. (2021). In Sweden, around 1,600 companies are liable for preparing these reports as a result of the implementation of the NFRD in Swedish legislation Ferlin et al. (2021).

Work is now underway to replace NFRD with a more comprehensive directive for sustainability reporting. The new directive, Corporate Sustainability Reporting Directive (CSRD), is planned to come into force in 2023. According to (Riksbanken 2021), there are three major changes compared to NFRD. Firstly, the directive would also cover companies in the EU that previously stood outside the commitment of formulating a sustainability report. Secondly, CSRD would also require auditing by an external auditor. Thirdly, it will include harmonized rules for disclosure to increase comparability between companies. CSRD has not yet been decided on but is expected to align with previous frameworks in the area, e.g., TCFD Riksbanken (2021).

#### **4.2.5 Swedish sustainability legislation**

In Swedish legislation, the NFRD is valid through the Annual Accounts Act 1995:1554, which states that companies must provide sustainability information Riksbanken (2021). However, the majority of the companies covered by the requirements of the annual report use voluntary frameworks and standards, which they believe are necessary for 'compliance'. In Sweden, TCFD can be considered to be the most important voluntary framework for the companies supervised by SFSA (FI 2021). As mentioned, CSRD constitutes three noteworthy differences compared to NFRD. It should be noted that the first of these, that the number of companies included increases, does not affect Swedish companies in particular since Swedish legislation covers significantly more companies than is required by EU legislation Riksbanken (2021). According to the Swedish Annual Accounts Act (SFS 1995: 1554), companies must prepare a

sustainability report if at least two of the following three conditions are met, regarding the two previous accounting years;

1. average number of employees, during both years, have been over 250.
2. the balance sheet, for both years was over 175 MSEK
3. the net sales, for both years, was more than 350 MSEK.

#### **4.2.6 IFRS Sustainability reporting - International Sustainability Standards Board (ISSB)**

The International Financial Reporting Standards (IFRS) Foundation, which is the dominant standard-setter for financial information, has created a sub-organization, the International Sustainability Standards Board (ISSB), to develop a global sustainability reporting standard (Ferlin et al., (2021) and ?, (?). The new standard is to be compatible with IFRS Financial standards and also as similar as possible in the design FI (2021), Riksbanken (2021). SSB has been welcomed by the International Organization of Securities Commissions (IOSCO) Ferlin et al. (2021), as a 'major stakeholder in banking regulation'. FI (2021) further believes that IOSCO has also taken an active role in ensuring that the standard will meet requirements for credibility and content. A first publication was made at the UN climate conference at COP26 in November 2021, titled *sustainability-related financial information prototype*. However, the standard is not yet complete and thus has not been adopted by the EU. It is expected to be completed in 2022 Riksbanken (2021). In March, there were two new publications. The standard is currently divided into two parts, one with an emphasis on sustainability information (IFRS S1) and one on climate-related risks (IFRS S2). It is expressed that comments are welcomed to be submitted until 29 July 2022 (ISSB, 2022a; ISSB, 2022b). In the development of the standard, discussions have taken place with SASB and the current version is based on work from TCFD (ISSB, 2022a, ISSB, 2022b). The first draft contains several parts reminiscent of TCFD. In its current form, it does not seem to make any major difference for Swedish financial companies that already report according to TCFD if the EU were to make this regulatory framework mandatory. However, in the end, it is not within the scope for this thesis to investigate nuances in law in great depth.

#### **4.2.7 CRR disclosure of prudential information on ESG risks**

Capital Requirements Regulation (CRR) - *The regulation on prudential requirements for credit institutions No 575/2013 (version 30/09/2021)* is regulating capital requirements and disclosure. It can be seen as the European implementation of Basel recommendations. Article 449a states that large institutions are to disclose information on both physical risks and transition risks. Moreover, article 434a mandates EBA to develop a technical standard that specifies disclosure format and associated instructions. The EBA released its guidance on the requirements of article 449a on 24 January 2022. The EBA has built on recommendations from TCFD but has gone further in an attempt to develop best practices. It also has several, for this author, interesting features such as the a green asset ratio (GAR) and a banking book taxonomy alignment ratio (BTAR) that discloses to counterparties how the bank is aligned with the EU taxonomy. But also that the bank (or other credit institution regulated by CRR) should disclose how it is investing in adaptation measures that would help its counterparties gain resilience towards climate-related risks: "*By showing how the institution is investing in climate adaptation activities, the institution provides information on how it helps its counterparties mitigate climate physical risk.*" As requirements are to help enhance the financial stability, and not just be a burden for the financial institutions, it seems that this latter disclosure is to guide banks develop best practices, or maybe even motivate them to use this measure. Will banks be more motivated to use adaptation measures to protect their customers (rather than buying bank insurance) if they have to disclose adaptation measures in a comparable manner to the public? That is a suitable project for future research within business administration, with e.g. legitimization theory.

## 5 Empirical analysis

### 5.1 How are climate-related risk drivers accounted for in Swedish banking practice?

As described in section 2.2.1 there are, according to Pan (2012) eight different categories of banking regulation. Therefore, the regulator must decide upon how rulemaking, supervision, and enforcement are to be done, as well as whether any certifications are needed. Furthermore, each part can either be handled by the private- or public sector. The expert interviews focus heavily on two categories: rulemaking and supervision. Several participants express that this journey has just begun; thus, this could be a reason for less focus on certification and enforcement. Several interviewees express that it is difficult for regulators to enforce requirements when they are in a learning stage themselves. However, how adherence to the rulemaking could be ensured will probably become a focal point at a later point in time. On the other hand, it is clear from the studied material that CSRD gives an expanded role to the auditor. Thus, despite the interviewees not focusing on how the enforcement will happen, it does not necessarily mean that such questions have not been considered at all. Moreover, it is likely that coming legal requirements will have the same enforcement methods as those already existing, where SROs, Auditors, and SFSA already have enforcement tools in place.

One interviewee points out that harmonizing reporting standards and frameworks so that the reporting of climate-related risks will be standardized and uniform is the most critical factor for coming regulations. In addition, the comparability of reporting between nations and within them is a condition for facing climate-related risks.

*It is essential to find a way to standardize reporting because if everyone discloses the information at their own picking, it becomes challenging to compare different parts of the financial sector. Also, across nations, if Swedish companies and banks will disclose their risks differently than other firms, it would become very askew.*

Another regulation expert says: “The supervisors, regulators, and banks need to speak the same language. That is necessary in order for stress tests and supervision to be good. Otherwise, one will compare apples with pears<sup>15</sup> you need to have the same definitions.” Furthermore, another interviewee notes that standardization must be both through voluntary and mandatory standards and that there is ongoing work to harmonize the disclosure of information on climate-related risks and sustainability. Another participant said that it is not only banks and financial corporations that must disclose their climate-related risks and sustainability but also other stakeholders, e.g., all bank customers, as banks need to assess risks related to them. If the risks are not modeled correctly, both capital requirements and loan pricing would be incorrect, which are causes that could lead to financial instability. The banks also need to report their risk correctly in order for supervisory authorities to properly supervise: “We need the information to compare and see if banks have enough capital and liquidity to handle a stressful situation.” However, another interviewee commented on the complexity of such reporting; that banks need to send their annual report with their reports at the same time as all other businesses. It would be problematic for the banks to use one-year-old reports when they analyze their risks. On the other hand, it cannot be expected that all companies share their data with the banks in the same way as a daughter company does in order for consolidated financial statements to be made. According to one expert, the fact that daughter companies or customers can be part of different legal restrictions hinders the understanding of risks present within the system if reporting happens through different frameworks. In other words, these actions, which at first glance can be seen as market-based aiming at self-regulation, are also necessary in order to establish definitions for a traditional prudential regulation or supervision.

The following sections will present which type of private rulemaking, public rulemaking, private supervision, and public supervision will be expected. Furthermore, some smaller notes on other regulatory strategies. In accordance with the above statements, the following sections will be more about accounting and disclosure than risk modeling.

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<sup>15</sup>A saying which is like “apples and oranges” in some other countries

### 5.1.1 Private rulemaking

Private regulation predominantly concerns *disclosure*. In interviews, the participants reference a plethora of different standards and standard setters, e.g., TCFD, Partnership for Carbon Accounting Financials (PCAF), SASB, GRI, and ISSB. Many of the interviewees emphasize how harmonization of different standards is something they welcome. Several interviewees comment on the communication between SASB, GRI, and ISSB as something they consider noteworthy. The connection between private standards and public rulemaking is brought up by several participants. For example, the fact that CSRD is in line with TCFD. Alternatively, that IFRS financial standards have been implemented in EU legislation, and ISSB's standards likely will as well. Even though TCFD and ISSB are very similar (since the latter standard is in many ways founded on the former), there are, however, dissimilarities in which terms the interviewees speak about the standards. TCFD is mentioned in discussions concerning risk management, though ISSB is brought up in discussions about harmonization. Moreover, due to IFRS having been accepted as the global accounting standard, there is hope that ISSB shall take that same role. One interviewee notes that banks have become better at sustainability reporting with time and that the quality of reports has increased.

In regards to reporting of financial risks due to climate-related risk drivers, many interviewees describe TCFDs and PCAFs frameworks as very important. Concerning the latter, one interviewee said *"I believe PCAF to be the new TCFD moving forwards for banks and financial business."* Another participant expressed that: *"One notices that many networks reference PCAF as if it was a bible for how to calculate. That TCFD describes what one ought to report; that one should describe transition risk and physical climate risk. But if one is to calculate a baseline for emissions, one should use PCAF"* TCFD is depicted as the guide for strategy, target-setting, and risk management but also as not very tangible. The arrival of PCAF helped facilitate the implementation of certain parts of TCFD more easily. The general view of the participants is that they have respect and trust in these private standards. Several interviewees highlight SFSAs encouragement for banks to report according to the framework. One interviewee even said, *"We do as the Swedish Financial Supervisory Authority wants, and we have always done so."* Another interviewee emphasizes that reporting according to voluntary standards *"is a matter of credibility."* This indicates that such endorsements from SFSAs, even if of little legal significance, impact how legitimate private standards are. Another interviewee points out that in both the Netherlands and the United Kingdom, reporting according to TCFD is mandatory; thus, the standard holds recognition from the authorities the interviewee notes.

Two interviewees who are experts in regulations emphasize that large parts of the Swedish financial sector now focus on TCFD and either have plans to soon be able to report in accordance or have already started reporting parts of their portfolios per the regulations. Reporting entire portfolios according to TCFD is challenging and a big step for many. Nevertheless, most banks are committed to meeting TCFDs recommendations, said one interviewee. The banks are gradually increasing the extent of the parts of their portfolios they can report: *"Everything that will need to be reported cannot come at once, though it will come a little at a time."* Another interviewee believes that most Swedish banks will be able to report according to TCFD in their annual reports within a few years. It is now central to build systems to collect, aggregate, and present the data required for TCFD reporting. One interviewee points to the connection between the standard and the supervision conducted by SFSAs. Gradually, the requirements from SFSAs will likely be stricter on the extent these risks must be accounted for in risk management. Then the standard is vital to grasp what expectations will exist in the industry. Finally, it should be mentioned that a bank employee noted that CSRD, which is an upcoming regulation, is in line with TCFD. Consequently, this means that parts of TCFD will be required by law; hence it is within one's interest to prepare for it.

Today, several banks take a materiality perspective in TCFD; the areas that the bank internally perceives as the most severe are prioritized to be reported first. For example, one bank could report its property portfolio linked to transition- and physical risks while other banks consider the carbon tax more prominent. The types of transition- and physical risks that the banks identify are very different. A property portfolio can be exposed to physical risks linked to flooding and sea-level rise. It can also be exposed to transition risks linked to energy efficiency, as well as what the public considers as good energy efficiency and legislation concerning it. Moreover, corporate lending to the fossil fuel sector or industry could be

sensitive to a carbon tax, and lending to the agricultural sector is sensitive to a changing climate.

An interviewee points out that when all companies report by IFRS financial standards, it has made the work of SFSA easier. The information in the financial statements can be trusted, an expert expresses. There is thus a belief that the uniformity has led to best practice and experience for both the accountant and the auditor, in this case, the bank and SROs and auditors, to have led to high reliability. This is linked to ISSB, where a new global standard can improve quality. Creating something that will be recognized globally is complex, where recognition of other organizations' work and communication with other organizations is critical. An interviewee mentions that ISSB has had dialogues with IOSCO and is based on TCFD, who in turn had dialogues with FSB. ISSB has also communicated to the Basel Committee to ensure that Pillar 3 and ISSB's framework are in line. However, further investigating how endorsements affect the willingness to accept frameworks based on legitimization theory or institutional theory is beyond the scope of this thesis. It is noted that work on harmonization in this area is ongoing, which some interviewees are aware of and follow. Several prominent organizations are involved, and the results are, to some degree, based on TCFD's recommendations. With the current spread of different frameworks, an interviewee suggested a risk for greenwashing, where one chooses to report according to a framework that provides the opportunity to appear favorably. Another interviewee said that it is impossible for banks to have time to read all the different frameworks that come as they come at a swift pace from different parties. Therefore, coordination and uniformity are necessary criteria. One of the interviewees concludes, "*It needs to come globally as well in order for it to be standardized.*"

### 5.1.2 Public rulemaking

Public rulemaking, i.e., laws, is also mentioned in the interviews and could broadly be divided into disclosure or capital requirements. Rulemaking within the disclosure area is a couple of years ahead of rulemaking in capital requirements. There have been many initiatives on different requirements of how climate-related information should be reported. The interviewees' views on these will be investigated in the coming section. Finally, capital requirements are debated and will be discussed here but elaborated on in the coming section 5.2.

One of the interviewees spoke about all the new mandatory reporting requirements that have come in the last couple of years. The interviewee commented that requirements have to be meaningful as they drive up costs for the banks. As an example, the new disclosure regulation contains new criteria, and when banks are to report on those, it needs to put much effort and resources into understanding the requirements and what is needed for compliance. Perhaps even hire consultants specializing in that kind of regulation in order to be compliant. The dilemma that meaningful regulation also could overburden banks with costs has been noted on literature (Campiglio et al. 2018). One of the interviewees mentioned the new technical guide from EBA about reporting ESG risks according to CRR. The interviewee said that only the largest banks would be affected, and much of the information probably is not in the bank systems today but must be gathered and analyzed to be compliant.

Another interviewee mentioned the two new criteria, GAR and BTAR, and said that they might even be used for how to allocate capital requirements in coming regulations. The same interviewee noted that the EU Taxonomy is also very important because a couple of years ago, the banks themselves decided what should be classified as green or brown. The interviewee does not specify its effects, but it goes towards comparability, which is probably why the interviewee welcomes the Taxonomy. The expert also elaborated that:

*I believe that I have heard that many banks may have waited for regulation. The work on measuring how green portfolios are was stuck until the Taxonomy came. The banks waited for it to be finished so as not to do the work of setting up their own definitions and then risk having to redo all work when the taxonomy was finally published.*

Another participant said: "*One has to minimize the risk of greenwashing. Identifying what is green is critical so that the trust of the entire financial sector is upheld. So that one does not create uncertainty about what is green.*" A third interviewee said: "*The banks will have to go through their entire balance sheet to see how much lending is aligned with the EU Taxonomy, how much of the bank's assets are green.*"

The interviewee continued *"In this regulation, there is a mandatory part, a minimum level, and a voluntary part that builds on sectoral subdivisional codes."* Between the lines, it is clear that the interviewee is approving of the fact that not everything is mandatory; that there are some requirements though the authorities can show their intentions or wishes on future regulation by including voluntary parts. Overall the Taxonomy is welcomed by interviewees as something that will reduce greenwashing.

One of the interviewees says regarding the future of the taxonomy:

*I am interested in how the taxonomy will continue to develop new rules about what should be considered "green," "brown," or something in the middle. There is a lot in the middle, and how the taxonomy will treat that will be interesting to see. It is a fine line between making a regulation that contributes to the better or just a market-disturbing regulation.*

Lastly, the change from NFRD to CSRD with a larger set of affected firms will be beneficial, said a couple of interviewees.

Although many of the interviewees focus on disclosure, and that seems to be what needs to be in place first, other regulations will probably follow:

*I do not personally believe, and many others do so with me, that disclosure solves everything. That the market could receive perfect information and after that make the perfect pricing. Reporting somewhat contributes to the pricing as well as more information and is a condition to be in place before another regulation is implemented.*

One expert in banking regulation said and implied that other regulatory tools need to be implemented after the lack of information has been dealt with to ensure financial stability. The same expert also expressed that: *"For it to even be a possibility of any good regulation, there needs to be data, plain and simple information."* Concerning whether today's reporting is adequate for climate-related risks to be priced in today's market, another interviewee said:

*I do not think the general market is ready. There can be parts of different markets that understand and are advanced enough to price these risks appropriately. However, overall I would say no, not yet. I do not believe that the market, as such, generally prices sustainability risks correctly. On the other hand, it is hard to prove the opposite.*

The first statement show, in line with Chenet et al. (2021), a mistrust in markets' ability to self-regulate. The second statement by another interviewee provides one interpretation of the disagreement in the literature on the subject of climate-related risk drivers are priced (section 2.1.3). A third participant described the difference between the regulations that focus on reporting and capital requirements. The former focuses on risk management at individual banks and hence does not contribute so much to financial stability. While the latter is a way for authorities to handle risk at a greater level. There are a few problems when trying to make capital adequacy regulation; this will be elaborated on in the section 5.3. One of these difficulties is which time horizon is to be used:

*If one includes risks that lay very far ahead in time when determining capital requirements, and those never come to materialize, it just would have caused enormous cost for the banks. It is clear that accounting for risks 50 years ahead is not reasonable. It has to be a balance: what is reasonable to include in capital adequacy?*

Another regulatory expert emphasized a great political drive to produce the capital adequacy requirement for climate-related risks. That regulation should help drive transition that the requirements should incorporate sustainability aspects. In the future, there might come capital adequacy requirements, suggested one expert, but it won't be easy to make them detailed. Even if risk drivers are different depending on geography, meters above mean sea-level, the EU cannot make capital adequacy requirements that detailed. One expert on regulation say: *"I do not believe that the regulation will be granular, in any case not as detailed as 'You shall look at a postcode level' or that capital requirements would end up differently depending on which side of the street the estate is located. That I have very hard to believe."* Again, this is the mentioned problem with climate-aligned prudential policy being either blunt or costly (Campiglio et al. 2018).



Finally, it should be mentioned that discussions of other forms of regulations that will affect climate-related risks are held, primarily that of consumer protection. One of these issues concerns whether or not interest rate caps could be implemented. In the future, banks might have to have higher interest rates in risky areas and, therefore, be affected by consumer regulations, an interviewee said. Another participant meant that consumer protection for insurance buyers significantly impacts how protected banks are against climate-related risks. As mentioned in theory, if insurance is ceased that could result in those assets, used by lenders as collateral, losing in value.

### 5.1.3 Private supervision

Private supervision is supervision by, e.g., SROs and auditors. There are no participants from such organizations included in this study, and although further research in this area could be interesting, that would probably require even more knowledge within accounting, economics, or law than this thesis required and thus be suitable for research by someone from a different academic background.

One regulatory expert interviewed in this thesis emphasizes the importance of auditors in the financial sector for facilitating efficient supervision by SFSA. The supervisory authority can thus be less critical of the annual reports since there is *“fairly big trust in that the auditors have done their job.”* Thus, this could be the reason for CSRD’s increased responsibilities for auditors to include climate-related information so that the supervisory authority can have confidence in the reliability of the information. On the other hand, the auditors may not be able to do scenario analysis on extreme events, which may be needed in order to evaluate scenarios’ risk of a financial crisis.

### 5.1.4 Public supervision

An accounting expert said that SFSA primarily focuses on transition risks today and their connection to company portfolios. The area includes how transitions, such as carbon tax, will affect bank lending to businesses exemplified in the focus area. The interviewee said that physical risks would be investigated, too, even if they are not as acute. Several participants thought that the supervision from SFSA will increase in the future in tandem with the increased demands: *“I also connect it to the fact that authorities in the future will likely demand such stress tests to ensure one’s resistance. Today there is mainly talk of the need for banks to understand the risks present.”* Another expert similarly expressed: *“I almost expect there will be requirements that supervisory authority and banks are to perform different types of stress tests or scenario analysis with focus on sustainability or aspects of sustainability incorporated within the models.”* The interviewee meant that there would be a shift from requirements of understanding of *vulnerability* to also understanding *resilience*. The same participant exemplified this: *“One commonly speaks of extreme but plausible situations. When investigating these scenarios, it is usual to look backward, e.g., ‘What would happen if the latest financial crisis, 2008 to 2009, repeated itself today?’”* A complexity, according to one expert, is the regulatory uncertainty: *“Now there is a rather large variety of different initiatives; thus, it is not obvious what would apply in 2-3 years.”* However, the same expert said that it would possibly be only 5-6 years until the uncertainty is cleared up, and SFSA will move forward with stress tests and stricter requirements.

Many interviewees pointed out that despite uncertainty about what future regulations will look like, everyone does their best according to the circumstances. *“There is now extensive global work, at both central banks and supervisory authorities, to decide the course of action in light of the circumstances. It is not the case that everyone is waiting on the Basel committee, but everyone rather continues in line with today’s regulations.”* Another expert said that different supervisory authorities have different resources, something that affects the work done: *“ECB have vast resources and supervise large banks that in turn have considerable resources. Hence, it is perhaps suitable that they are the first to do stress tests.”* SFSA cannot be fully compared to ECB in terms of resources and ability to perform advanced stress tests. However, an expert said that even if ECB performed stress tests, it would not lead to any capital add-ons. Another interviewee continued by saying that evaluating climate-related risks based on supervision is incredibly complex:

*The supervisory authority has to evaluate the bank’s own evaluation to determine whether*

*the bank did right. It is, however, hard to define what is right or wrong today due to the presence of many different standards. We will have to see what the future brings in terms of harmonization, new standards, and increased access to data.*

There is an understanding that neither banks nor regulators have a complete understanding: *"it is viewed as a learning process."*

### **5.1.5 Private certification**

Several participants discussed their views on what role certification, e.g., credit rating agencies or auditors, will come to play. They discussed this in terms of how climate-related risks will be included in credit evaluations that have been bought from these companies and the auditors' task to ensure a company has adequate reporting. Two interviewees determined that climate-related risk evaluations ought to be done by the banks and not by credit rating agencies. One of the interviewees reasoned about the complexities of time for private persons. For example, if someone's house or forest is vulnerable to climate-related risks, it should be a factor to consider with long-term loans, e.g., mortgages. In contrast, the person should be eligible for a short-term loan, e.g., buy on invoice. Thus, when credit rating agencies scores a customer, they should not include such information. However, perhaps a warning akin to 'this is a forest property' allows banks to determine the factor's influence in their risk management process. The other interviewee reasoned that the data from credit rating agencies are not developed enough yet, see further in section 5.3.1.

### **5.1.6 Public enforcement**

Concerning the sort of already existing enforcement, such as supervision, interviews with private actors would have provided broader information on which measures they possibly apply. A few interviewees provided the information that has been presented regarding public enforcement. As mentioned in the prior passage, there are no measures taken today since supervisory authorities are still learning. On the other hand, one interviewee said that banks have to start to handle their risks: *"Should SFSA discover a bank has entirely deviated from reporting principles in a systematic way, they have not only not considered the risks they ought to, but have also operated in an unsound manner, and then they [SFSA] must act."* However, the same interviewee meant that the auditors should have discovered if a bank deviated from its duties in such a way that it would be so severe. A more common tool for SFSA is to intervene through their investigation process, and if they find, in the collected material, that banks have broken the rules, they can enter a sanction process: *"Depending on the outcome of a sanction process, SFSA can use several different tools, e.g., issuing warnings, withdrawal of licenses, or fining the offending party."*

## **5.2 Should regulation reallocate capital towards green investments?**

### **5.2.1 Desirable effect: transition to low-carbon economy**

There is a broad unity among interviewees in regards to that transition to a low carbon economy needs to take place; otherwise, all stakeholders will be negatively affected <sup>16</sup> One of the interviewees said that it is of utmost importance that the transition is orderly. The transition needs to occur, but an orderly transition pathway should be the aim. The interviewee described that the worst that could happen was if we would end up in the scenario that NGFS describes as 'too little and too late': *"then we would reach tipping points which would affect the whole earth: storms, hurricanes, heat waves, polar ice melting, and rising sea-levels."* One of the other interviewees said:

*It is the tragedy of the commons, these are risks where negative consequences affect everyone, and no one is to blame. There is no punishment for the individual agent who caused global warming. I think we need a fiscal policy to drive the transition. Otherwise, we will end up with irreversible climate change, which it may already be, though more definitely so. That would be quite a different world for everyone.*

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<sup>16</sup>As described in a coming section, there is, however, some disagreement in how fast transition needs to happen and how fast physical risks will materialize.

One of the other interviewees says that if the climate-related physical risks are allowed to increase, the public would need to take it upon itself to carry some of the risks: “*Then the state will have to take a significantly larger responsibility. If a physical hazard has happened, there will be political pressure to go in and help out in times of crisis.*” To summarize, the interviewees spoke in terms that transition is needed, though most regards this as a need for politicians to take greater responsibility.

### 5.2.2 Desirable effect: financial stability

Many interviewees said that regulators should, above all, focus on financial stability. Some interviewees expressed worry about new regulation resulting in system instability either through trying to push transition or incorporating great uncertainty in models used. A bank employee said that: “*One wishes to be careful so as to not disrupt any aspects of stability in the discussions currently being held.*” While a regulatory expert emphasizes that: “*It is not only that this is great uncertainty we have to incorporate into our models, but also that it is truly a risk that one calculates.*” The interviewee elaborated:

*Financial stability is very important, since financial crises cost. For example, if Swedish banks lack resistance, it hits back on the Swedish economy. Thus, financial stability is a condition for the long-term well-being of the Swedish economy, and then Swedish banks are essential for this. There is a need for stability to facilitate an entry to that perspective.*

Another interviewee expert on regulations said: “*Both EBA and Basel committee has said that bank regulation should be risk-based, for it to be credible, it needs to be. It should show the underlying risks, not be used for redirecting capital to control investments. It is not built to do that. So implementing 'green supporting factors' - absolutely not.*” A statement that is much in line with the views of Campiglio et al. (2018). Several participants suggested that politicians aim to have regulations incorporate more sustainability or investigate capital requirements. The participants highlighted how politicians push for a green supporting factor at an EU level; after having pushed through that, banks have to report taxonomy alignment, amongst other things. At a Swedish level, several of those interviewed highlight appropriation directions that the Ministry of Finance give to SFSA. One interviewee expressed how SFSA that are given focus areas is significantly more politically governed and has a greater political focus than the Riksbank. One participant suggested that a change of government possibly could result in less focus on climate change<sup>17</sup>. Politicians indirectly try to make supervisory authorities responsible for the question they themselves should be accountable for, indicates experts. One interviewee said:

*The financial sector cannot on its own establish an orderly transition, as it is the companies that emit emissions. I mean to say that the companies that emit carbon dioxide need to transition. However, the financial sector is not responsible for this; rather, the financial sector is an overlay for what happens to the real economy. [...] If no political decisions are made, at all, concerning the emissions of carbon dioxide, and thus nothing is done, then the financial sector could do an infinite amount of things, and we would still not reach the Paris agreement.*

Another interviewee commented on regulations' responsibility:

*The supervisory authorities' task is to see to individual banks' resistance to stress, as this is a necessity for banks being able to support both in terms of financing and in case of a climate crisis. It is most undesirable to have a banking system with too little capital so that we, in the middle of a climate crisis, find ourselves in the same situation as in 2008; for the state to have to use all its money to save the banks and not be able to remedy climate-issues. Hence, we wish to have a resilient system, plain and simple.*

In general, interviewees thus focus on the dangers climate-related risk drivers pose to the financial system as a whole (section 2.1.5) than that individual banks should have underestimated financial risks (section 2.1.3).

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<sup>17</sup>at the time of the interview, the Swedish Social Democratic Party sat in the government alone but had support from the Left Party and Green Party

### 5.3 What are barriers, challenges and potential pitfalls of implementation?

The last research question covers what obstacles there are for an effective regulation to occur. Five areas are identified: availability of data, resources, and knowledge; different notions of when physical risks will materialize; uncertainties in the future actions and responsibilities of different stakeholders; and finally, the underlying uncertainty.

#### 5.3.1 DATA

Almost all interviewees expressed that data, or lack thereof, is the most evident problem in implementing new systems and regulations. They gave a number of explanations in a wide array of areas. Such that banks do not have information in their systems about how vulnerable their customers' estates are. This is important for mortgages to households and to make good risk evaluations for businesses. One of the interviewees complained that it is almost impossible to measure financed emissions, for although the customers have to give a purpose statement when taking a loan, the bank cannot trust that the money is actually used for what the customer said it would be. One of the interviewees said: "*Today, there are very few companies that report their carbon footprint. One can buy such data from a supplier, though it is very problematic to use it since it is difficult to say that one is comfortable with the data that has been bought.*" Another interviewee said that: "*The access to relevant data is a challenge. There is plenty of data, though one needs relevant data, and that is not so easily accessible today.*" Data is also a concern for the harmonization issue earlier discussed in the first research question, namely that data is not comparable today even if banks work internationally. For example, China has its own taxonomy, said one participant. A final problem is the lack of historical scenarios, which leads to difficulties when trying to perform stress tests. A few interviewees gave examples of how historic crises could be used by examining how they affected the bank and then exaggerating the effects. For example, it is known how farmers have been affected in historic drought periods, one interviewee explains, so a bank could modulate how farmers would fare in a scenario with a drought three years in a row. Or they know how smaller cities fare in a scenario of flooding and thus try to simulate that scenario for larger cities. Even though several articles within regulatory literature suggested such stress-testing approaches, the limited understanding of how exactly the agricultural sector will be impacted by climate change makes the likelihood of such scenarios uncertain. Rather this can be seen as a way of due to uncertainty working with scenarios instead of traditional risk measures.

#### 5.3.2 Knowledge and resources

One of the foremost reasons for difficulties in requiring banks to report their risks in full, perform stress tests, or capitalize is the lack of knowledge and resources. In the section 5.1.4 it was described how different supervisory authorities have different opportunities to supervise depending on resources. The lacking resources of some banks are also problematic:

*I am of the feel that this is most certainly a question of resources in many smaller banks. They don't have the means to be able to report their climate-related risks, whereas larger banks have greater resources and thus are capable. Therefore, smaller banks may need help with reporting standards and best-practice development. However, large banks may be able to start looking into this to be at the forefront.*

The interviewee elaborated by explaining how smaller banks needs 'best practice' to be developed by regulators and large banks as they cannot afford this development themselves. Small banks do not have the resources to test through trial and error or research how different sectors are impacted by climate change. Another expert said something similar, though, in regards to banks customers:

*It is tough for small customers and minor companies to make estimations of transition risks and transaction plans for the future, quantify transition risk, and make other assessments. For these customers, the banks will need to use third-party providers and suppliers of data that make estimations from a model. This will not be perfect, though it will provide the best information available. Everyone will need to have an understanding of and be humble that this is not entirely robust or credible.*

However, another interviewee said that it is not the supervisory authorities' responsibility to help smaller banks perform their analysis. Whether it is a resource- or justice question that SFSA should not place its resources on helping smaller banks with best practices or if it is a question of whether they, as a supervisory authority, should be independent is not elaborated on further. One participant is of another view: "All authorities try to open dialogues with the banks they supervise: 'What do you do? How do you do it? Why do you do it in that way? Why not in this way?'" Another regulatory expert emphasized how everyone in the business has questions and that there is not really anyone in possession of complete knowledge. The expert continued with how everyone is pondering these questions, whether they are a bank, insurance company, or authority.

### 5.3.3 Disagreement on materialization time.

Another obstacle to enabling regulation is the great disagreement regarding when these risks will actualize and what time horizon regulation ought to have. A few interviewees expressed how physical risks will become a problem for financial stability only in a long time; this is expressed in terms of 40-100 years, 50 years, and 50-100 years as possible time horizons. Two out of four participants that discuss this mean that there is not so urgent as to hurry a new regulation, and these interviewees seem to rather worry about transition risks. They are concerned that too fast regulation or transition could create price fluctuations in the market or that a fast regulation gives banks little time to develop compliant computer systems, thus making the regulation impossible to accommodate and rendering the regulation useless. Another interviewee said that the risks already have started to materialize and points to the deluge in Central Europe as a recent example. The transition will happen and needs to happen; thus, it is not the regulation's task to hinder it for it to be reasonably paced. One participant that sees physical risks as concerning, in the long run, emphasized that they have to be handled today:

*How should risks that lay far ahead be handled? Well, in regards to financial stability, then they need to be accounted for now. A private institution might not believe so; they don't want the long time horizons in their business model. Then it becomes the supervisory authority's job to tell them to still account for them for the sake of financial stability.*

Another interviewee said:

*Physical risks say that it is something to be expected in 50 years, like sea-level rise or something similar. So that is one part; the other part is transition risks, i.e., politicians make decisions to lessen the risk that will actualize in 50 years by, e.g., prohibiting something. That is something that could happen tomorrow; thus, it is a very short time horizon. It could, as an example, suddenly become very expensive if all petrol-driven cars were prohibited by tomorrow.*

The same interviewee later elaborated with:

*Many agents have already started to price these effects. For example, if one owns a beach property susceptible to the sea-level rise that will happen in 50 years time, it will not keep its value for 49,5 years and then suddenly lose it. The property will instead start decreasing in value now, and this puts one at risk of what's called a 'stranded asset,' i.e., having it become worthless.*

Two interviewees point to NGFS work to create scenarios that connect transition- and physical risks together. One of the interviewees said that going of NGFS scenarios: "It is absolutely a plausible risk that a transition, e.g., a transition to a sustainable economy, happens too quickly and unorderedly, thus creating more harm than good, e.g., in terms of high societal costs. Hence, it is a balance of what action is taken by regulators as well as politicians and standard setters." Determining how this balance is to be made is something all decision-makers wrestle with, according to another expert. Another participant reasoned about how discounting future losses and uncertainty is to be done. One expert said: "We already need to account for climate risks since we do not know for sure. 'Better safe than sorry' is perhaps a true regulator's motto in a way; to be precautionary." Due to the Knightian uncertainty, especially in the risk of tail behavior, making assumptions about how large the sea-level rise could be at any given time in the future is a difficult task.

#### 5.3.4 Stakeholder

Another issue of disagreement amongst the interviewees is which risk belongs to what agent. A particular dispute was seen regarding what risk insurance companies are responsible for and which risk the public should take responsibility for when it comes to physical risks. The participants identify flooding as a problem area even though similar problems exist for storms or wildfires; this may be due to contextual reasons based on which interviewees participated in this study and their experiences. One of the interviewees explains that in the current legislation, the responsibility for securing one's property against climate change is ultimately the asset owners. This statement is in line with what the state-ordered investigation concludes Klimatanpassningsutredningen (2017). The interviewee continues "*The municipality is not allowed to take adaptation measures for individual houses because that would create a precedent that would not be affordable for municipalities.*" Although it is explained that the municipality has a responsibility to make sure roads, the municipality's assets, and municipal services are protected. One of the interviewees concludes that in the end, a lender could also be considered a risk owner because "*If the bank lends money to someone that suddenly has a high probability of flooding, and the asset would therefore not be worth anything anymore, then, in the end, the bank would also suffer losses.*" The municipality, or the public, also seems to have some interest in protecting areas with a large number of inhabitants; see, for example, the adaptation measures taken in Gothenburg. When discussing the responsibility of the public, an expert says that actions taken by the public need to follow the equality principle and the proportionality principle. That is to treat everyone with the same conditions equally, but an area with many inhabitants could motivate more actions than an area with few inhabitants. However, in one of the interviews, it seems that this can be considered a gray area:

*Twenty real-estates, is that an interest of the public? Some say yes, others no... How about seven estates? People say no to that... Some people say that the limit is around thirty estates in one area... but in the end, this has to go to a court to be resolved. The municipalities should themselves should not create precedent because if a court, in the end, changes that, then there would be multiple people treated unfairly.*

There is much uncertainty about how many estates need to be protected by a certain adaptation measure for the measure to be motivated by the *proportionality* principle. Thus, making banks' evaluations of customer resilience towards flooding and sea-level rise pretty much guesswork in areas with thirty or fewer estates.

In discussions about climate-related risks and their impact on banks', coming adaptation measures were mentioned as something the bank needed to look into. In the regions identified as vulnerable to flooding and sea-level rise, as described above, dialogue between the bank and other stakeholders concerning the need for adaptation was pointed out as important/necessary. One of the interviewees has discussed with a municipality spokesman who meant that the municipality is only responsible for protecting its own buildings. Therefore, they do not have to pay for protection for the privately-owned property. Still, many privately owned properties may become safeguarded if protections are built to protect nearby estates, the bank employee reasons. Another interviewee remarks "*This is like the economic concept, free-rider problem.*"

However, one interviewee remarks that expected adaptation measures are something banks are investigating but is not always welcomed by the stakeholder most affected, the real estate owner. "*In Falsterbronäset, the municipality had a lot of angry citizens when building a protection wall. They do not want to have a wall disturbing their sea view, although I would say it is better to build a wall than to have a flooded living room.*" Another interviewee reasons that this is an example of high vulnerability, but if residents are well-capitalized, the municipality or its citizens will afford to build adaptation without bank co-finance. To summarize, the banks see possible adaptation measures taken by other stakeholders as something they need to adjust qualitatively in their credit risk valuations. However, it is not a strategy they consider using themselves to reduce their credit risk. There is a lot of guessing about how the availability of insurance will be in the future and the responsibilities of the insurance firms. It's noteworthy that experts on these matters from the same financial industry have different opinions on how insurance should be relied on when doing risk estimations and disclosure. One of the interviewees sheds light on difficulties the property owner might face should insurance companies decline the property insurance

renewal: *“The day one cannot insure one’s property, one suddenly finds oneself in investment matters where one’s investment no longer is an investment because one cannot sell it.”* Another interviewee says: *“The banks also need to rely on the properties being insured. Insurance firms also have an essential role to play in the financial system. The problem comes the day when the insurance firms cease to give out new insurance. How should the bank react then? That is the question that needs to be discussed more.”* Another third interviewee reason that it should not be taken for granted that insurance will always be available in the future, pointing to the fact that in the US, the insurance firms stopped giving out insurance in areas deemed to have an increased frequency of tornadoes and flooding. One of the interviewees points out that many banks collaborate with an insurance firm and may share ownership. It may be that the bank and insurance firm may need to make a joint stress test.

According to one of the interviewees, who often speaks with *Insurance Sweden*, the industry organization for insurance companies, there is not yet an issue of unwillingness to provide insurance; however, this can be attributed to the costs still being low enough not to pose an issue. There is also an element of brand image for the companies: *“The insurance companies wish to be a good party. They do not want to say no to many; then they risk losing many other customers as well.”* Although it is not yet a matter of declining insurance, the interviewee does not exclude this as a possibility in the future. Another interviewee says that individual insurance firms are saying that they probably will cease giving out insurance in specific areas or start with diverged pricing. Further, declaring that it will become costly to buy insurance in vulnerable areas. Another expert says that:

*There are examples of insurance firms that have ceased to give out insurance for houses that are built-in vulnerable areas, and in that regard, this process has already started. The next step, close at hand, is to stop the renewal of insurance to other houses in that vulnerable region. Because insurance is usually given one year at a time, and it is up to the insurance firms to decide if they want to renew the insurance after that.*

Such a trend could pose severe consequences for coastal areas, leaving them unprotected from an insurance standpoint. The interviewee emphasizes the insurance companies as key players moving forward. A bank employee talks about financial mitigation and how difficult it is to implement as a strategy against climate-related risks compared to other risks. The interviewee explains that there are better products for mitigating currency or interest rate risk than climate-related risks. TCFD reporting and other incentives aiming to better connect climate-related risks to financial risks is a way forward. Another Interviewee means that insurance is a given mitigation strategy:

*We have investigated how insurance can be used going forward. First, it is our understanding that an insurance firm cannot terminate household insurance. Consumers generally have strong protection in Sweden against both insurance firms and credit institutions. Secondly, we, as a bank, are also insured against the risk of a consumer defaulting on their insurance. Today, there are no terms of termination or other terms that could empower insurance firms to start terminating contracts for houses that will have a higher risk of flooding in ten years.*

However, a third interviewee notes that: *“The insurance firms will probably be the first firms to start pricing in climate-related risks. They have a better understanding of the risks than the banks, as they pose many questions in conjunction with the contract writing”.* One of the interviewees notes that: *“The day the insurance firms cease to issue new insurance on a specific location or takes away flood insurance on new insurances, then it would probably be quite difficult to take out a bank loan for houses in that area too. We demand all our customers be insured in order for us to issue a mortgage.”*

### **5.3.5 Uncertainties and complexities**

Beyond the previously mentioned problems, several interviewees identified the fundamental uncertainty surrounding climate change as problematic. It is the interconnection between physical- and transition risk, non-linearities, and tipping points that interviewees find incredibly complex. One interviewee also highlighted feedback loops and emphasized the many layers of uncertainty. Another participant said that: *“There is great uncertainty, and this creates, in turn, great difficulties for the banks.”* One expert said: *“The current situation is very sensitive, what assumptions are made, and these can be rather big as there are a lot of unknowns. But as long as one is aware of what assumptions are made, then*

*one can take that into consideration. One simply has to consider the results in light of what assumptions are made.*” Regarding non-linearities, one interviewee said: *“A flooding similar to the one in Central Europe this summer may be ten times worse in 10 years due to some sort of exponential influence on the climate depending on minor temperature changes.”* Generally, interviewees that expressed uncertainty also favor regulation to be as swift as possible, whereas interviewees that think that there is time left before realization of physical risks do not emphasize uncertainty nor the possibility of extreme outcomes.



## 6 Discussion

### 6.1 Discussion on research questions

#### 6.1.1 How are climate-related risk drivers accounted for in Swedish banking practice?

(Pan 2012) divided the regulation into eight different strategies such as *public supervision* or *private rule-making* (see section 2.2.1). Currently, many of them are employed by regulators: there are discussions about what kind of enforcement should be used, what kind of regulation, and what kind of supervision. Public organizations are very much involved but also delegate responsibilities to SROs, auditors, and gatekeepers. Auditors are to provide legitimacy to sustainability reports, and third-party providers supply data and certification, thus lowering the risk of greenwashing. It is wise to use a wide array of tools if they are helpful, and each tool serves its purpose. However, it makes the regulation very difficult for individual stakeholders to comprehend. Several interviewees want to harmonize rules and global standards as there are many different standards and rules today. But there also needed much more information, so new rules on disclosure are needed. Both private rulemaking, such as FSB working with TCFD and IOSCO working with ISSB, and public rulemaking take place. A harmonizing of private and public rule-making within both BCBS communicating with ISSB and EU legislation CSRD building on TCFD. More focus on rulemaking within the "traditional approach" will probably follow when these risks are better understood. One regulatory expert notes that self-regulation is not expected to manage pricing on its own. Coming regulations outside of *rulemaking* have not been focused on to a large extent. Several interviewees mean that everyone is currently in a learning process, and it's difficult to know what is right or should be enforced. One interviewee mentions the enforcement methods currently available for the Swedish Financial Supervisory Authority, suggesting these may also be employed within this area.

One expert says that coming regulation would not be so granular as saying capital should be calculated on a postal code basis. Regulatory experts have expressed urgency to have some kind of regulation in place sooner rather than later. However, the banks are concerned about a regulation that will have a too short implementation time or be market disruptive. The regulation should also correspond to actual risks, not risks that most certainly will disappear because of adaptation.

#### 6.1.2 Should regulation reallocate capital towards green investments?

A debated question is whether financial regulation should have higher capital requirements for assets with high emissions. According to interviews, it seems that the regulatory experts want regulation to focus on financial stability. One of the interviewees has a strong opinion on this and says that supporting factors should absolutely not be implemented. However, two interviewees say that politicians want diversified capital requirements, and in the end, it is a political choice. It will be interesting to follow how these forces will interact and, in the end, agree on something. Within the disclosure area, banks are to disclose information on some non-risk related areas, which could be intended to help mitigate climate change. In the figure 1, it is clear that there is a wide arrange of disclosure requirements, from risk disclosure to sustainability disclosure, although there are interlinkages. It is difficult to know if all sustainability reporting is needed to assess transition- or reputation risk or if climate change mitigation is part of the justification.

#### 6.1.3 What are some of the advantages and disadvantages with different kinds of approaches and methods, for incorporating climate related risks into these risk frameworks?

Lastly, a couple of obstacles to managing climate-related risks efficiently were found. These are; lack of data, lack of knowledge or resources; disagreement on materialization time; uncertainties in stakeholder responsibilities; uncertainties in availability of insurance; and other uncertainties. As an example, some bank employees indicate that banks are relying on insurance, with one even saying that insurance firms are not allowed to terminate a consumer insurance contract. A regulatory expert is on the same page, implying that insurance firms have a role in the financial system and could be relied on, at least for some time. There is a radical uncertainty or "an uncertainty explosion," which models try to adapt to in different ways by making assumptions. Many interviewees hope that more data in the future will lower the uncertainties and provide more knowledge. Interviewees also have different thoughts on the

materialization of physical risk drivers. While the mentioned *'better safe than sorry'* motto reminds us of the 'precautionary' approach with penalizing factors proposed by Chenet et al. (2021), this does not seem to be the intention of the interviewee, who prefers a risk-based framework. A problem with taking a risk-based approach is who decides on what risk level is appropriate. Is it politicians or professionals?

## **6.2 Limitations and bias**

The author focused on reports from European authorities and interviewed Swedish professionals. It could have been interesting to read about the motivations of other authorities outside of these jurisdictions for implementing other kinds of actions. But in the end, it's not certain those arguments would be valid in the European context, so with a limited time frame, European reports were prioritized. As the literature was collected by backward snowballing, this had implications on what articles were read and presented. Another author may have chosen to focus on incentives all over the world and write about how regulations should or could be implemented instead of what is to be implemented.

Methodology books and articles on how to conduct interviews often point out that the interviewers' skills are very much a factor that affects the results. There are numerous strategies that could be used, and knowing how and when to use them is not easy. Furthermore, knowing when the interviewee says their own opinion or what they believe the interviewer wants to hear (or is socially correct). It is also so that if the interviewer cannot manage to stir the interview in the right direction, a considerable part of the interview could go to discussing irrelevant themes. In the last interviews, the author was more confident with these skills. If all interviews were to be remade at this stage, the result would certainly be different. The author also had to consider bias when presenting the material. Such issues are considered by giving a particular view too much focus or 'the last word'.

The interviewees talked a lot about risk drivers they had experience with. Such as floodings, droughts, and GHGs emissions. Standards and regulations relevant for those subjects, therefore, become close at hand. If the interviewees had been sampled differently, forest fires or technology shifts could have been other focus areas, which may have pointed out other regulations and themes as relevant. Possibly also, other obstacles would have been emphasized.

## 7 Conclusion

In this thesis, I have analyzed ten expert interviews in order to investigate coming regulations and obstacles. The current focus of regulation is on *rulemaking* with the harmonization of standards and data a pressing issue. The public is developing its own standards and laws but also delegating responsibilities, legitimizing and collaborating with private standard-setters, such as ISSB. However, there seems to be an agreement in literature, reports, and interviews that more regulation needs to follow when data is available. For example, implementing climate-related risks into regulations for capital requirements or disclosing credit risk could be a future step mentioned in the literature, and interviewees point out that politicians push for green supporting factors. However, the incorporation of climate-related risk drivers into banking practice is currently done through increased regulation on disclosure. The second research question can be answered that interviewed professionals do not want diversified capital requirements. There have been identified several barriers, challenges, and pitfalls of implementation;

1. there is a lack of risk data, e.g., small firms being unable to do transition plans;
2. there is disagreement in the industry on when physical risk will materialize, what role the insurance firms have to play, what responsibilities the public have, as well as if the regulation should help mitigate climate change even if it would reduce financial stability short term;
3. there is a lack of knowledge and resources among smaller banks and regulators for them to do comprehensive stress tests.

How regulation and public intervention should 'generally' be made has been a thoroughly debated subject for decades. Add complexity-, uncertainty- and a lack of data on how climate-related risks will materialize, and no wonder why there exists a normative debate on how regulation should take these risks into account. In this thesis, I have taken a descriptive approach when pointing out debated subjects and issues.

Setting up new regulation is a delicate task due to great underlying uncertainty in how severe physical risk will become, the transition pace, and what kind of adaptation stakeholders, public and private, will put in place. More reporting regulations will soon be implemented, and thereafter other regulations will follow. That could be implementing climate-related risks into capital, regulatory frameworks, or mandatory scenario analysis. As an interviewee puts it, this is a 'learning process', and it will probably remain so until the actors sort out which risk is 'owned' by which party. One of the obstacles for banks to measure their true resilience is an unclear law space, future adaptation measures taken by other stakeholders, and the availability of insurance.

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## Appendix A, interview updating

The interviews lead to further insight into the subject. For this author, new to qualitative research, it also enhanced the interview skills. These experiences resulted in updating the interview guides through two or three steps. After each interview, the pre-analysis is started. The evaluation of themes and questions is done by:

- i starting with a less detailed transcription of important segments;
- ii writing an interview summary of the interview
- iii and making notes of interviewers performance.

The next step is to update themes and questions according to what was learned in the evaluation. This could potentially, when necessary, also lead to the creation of new interview themes. Almost every time, potential interview questions were updated, leading to an improvement in interview quality. Before this study started, two test interviews were held with a sustainability manager and a credit risk analyst. These interviews are not part of the study but a first evaluation of the interview guide and practice for the author on interviewing.

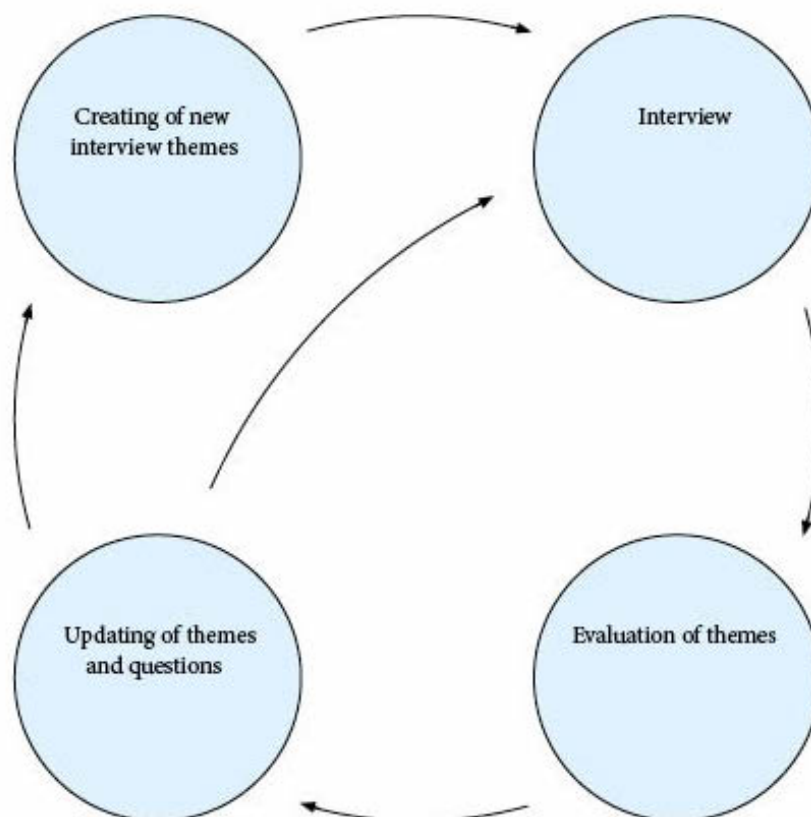


Figure 2: The four step process developed for creation and updating of interview guide in this study .

## Appendix B, interview guide

In order to answer research questions, several 'interview themes' or 'academic questions' were identified. To answer an academic question, several interview questions may need to be posed, and an interview question may also provide information on several 'academic questions'. Here is a list of examples, not absolute, of such 'academic questions' with corresponding 'interview questions'.

1. How far have surveyed organizations come in identifying climate-related risks?
2. How far have surveyed organizations come in quantifying climate-related risks?
3. How do organizations work with climate-related financial risks?
4. What type of data do the organizations need?
5. Evaluation of government initiatives

*Table 4: Examples of questions that could be posed during an interview. The interviews were held in Swedish and these are translated examples from interview guides rather than translations from the actual interviews.*

<i>Academic question</i>	<i>Interview question</i>
1, 2	Could you tell us how climate-related risks have affected or are expected to affect your job?
1	What climate-related risks have you identified as important for your credit risk evaluations?
1	Has the bank gone further in evaluating some of these than others?
4	What type of data do you use, and do you have access to all the data you need?
1, 2	Are the climate-related risks that you have identified the type of credit risks, market risks, liquidity risks, or operational risks?
2	Are climate risks included as a factor in any of the models you use to estimate, for example, credit risk or liquidity plan?
1, 2	What standards and regulations do you work with concerning climate-related risks?
2	Do you do climate stress tests on climate stress tests, and how do they affect you?
5	It has been suggested from some quarters that the banks that perform poorly in a climate stress test should have higher capital requirements; what do you identify as the advantages and disadvantages of such a solution?
3	How do you cooperate with authorities, other banks, or organizations on these issues?
1, 2, 3	Do you think it should be more precise in regulation on how climate-related risks should be identified, evaluated, and reported?
4	Should credit rating agencies take climate-related risks into account when setting credit ratings?
4	Do you use any type of third-party data?
4	How do you work to get relevant customer data?