ANALYSIS

Climate change and biodiversity loss as systemic threats to financial stability in Finland

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Climate change and biodiversity loss pose threats to financial stability. The financial sector in Finland seems to have less exposure to emissions-intensive businesses than in many other euro area countries, but the risks surrounding the transition to carbon neutrality can hardly be avoided in Finland either. To date there is relatively little knowledge of the total impact of physical and biodiversity loss risks in Finland. Moreover, the impacts of climate change and biodiversity loss on the whole of Europe and the global economy may also significantly affect financial stability in Finland.

Further assessment needed on the financial stability impacts in Finland arising from climate change and biodiversity loss

Climate change, biodiversity loss and the green transition will all have a broad-based impact on the various sectors of society and the economy.[1] They also bring threats to financial stability. This article examines the potential impacts of climate change and biodiversity loss on financial stability in Finland. The purpose of the article is to assess our current knowledge on these matters and determine the areas in which we need more information.

Table 1 presents a summary of the main analyses undertaken to date concerning the impacts of climate change and biodiversity loss on financial stability in Finland. As the table shows, relatively few analyses have been carried out and published in the research literature so far. In general, the more indirect the effects, the less complete is the assessment of the climate change and biodiversity loss impacts. Nevertheless, the indirect effects [2], such as those via the European and global economies, might be considerable for Finland. The overall assessment of the climate change and biodiversity loss impacts on financial stability in Finland is thus surrounded by considerable uncertainty.

The table shows that the transition risks of climate change that are associated with the transition towards carbon neutrality have been studied more than the financial stability impacts arising from the physical risks of climate change or from biodiversity loss. The more indirect the impacts, the fewer studies there are.

Studies on banks' transition risks have thus far focused particularly on transition risks arising from

the energy sector. In addition, Karhu et al. (2023) also examined the carbon footprint of bank lending in relation to other sectors. According to these analyses, lending by Finnish banks to the energy sector seems at least to have fairly moderate transition risks. Nevertheless, the forward-looking scenario analysis up to 2025 by Kauko and Räsänen (2022) indicates that the share of corporate loans to renewable energy sources in banks' loan portfolios will fall short of the most ambitious targets of the Paris Agreement. In comparison to banks in the euro area, a relatively modest proportion of Finnish credit institutions' corporate loans are to businesses with high greenhouse gas emissions (Alogoskoufis et al., 2021).

Research on physical risks to financial stability in Finland has focused mainly on risks caused by coastal floods (Manninen et al., 2021). The flood risk areas of Finland's coastal towns and cities include housing and commercial properties used as collateral for bank loans, and these may therefore present risks to banks' balance sheets, even though the euro value of such collateral seems to be fairly low. Finland's financial stability risks from biodiversity loss is an area that has been studied by Katajarinne (2022). In addition, a joint report (2023) by the European Central Bank (ECB) and the European Systemic Risk Board (ESRB) analysed a number of issues including biodiversity loss risks arising from loans granted to firms by euro area banks. In both of these studies, the likely conclusion is that the financial stability risks caused by biodiversity loss cannot be ignored in Finland either. The impact of biodiversity loss on financial stability should, in any event, be examined further and in more detail.

The current overall assessment of the financial stability impacts of climate change and biodiversity loss is subject to considerable uncertainty, as the focus has so far been mainly on examining risk exposures and individual transmission channels. These analyses often exclude indirect impacts and possible tipping points [3], although the scenario-based analysis by Kauko (2023) on the impact of climate change on banks' net interest income does to some extent take indirect impacts into account. In addition, there is room for improvement in the availability of data. These issues are examined in more detail below.

Analyses of the impacts of climate change and biodiversity loss on financial stability in Finland

Study	Risk type	Research question	Findings
Kauko & Räsänen (2022)	Transition	How large is the energy supply	The transition risks seem moderate. Finnish monetary financial institutions (MFIs) financed in 2020 significantly

Analyses of the impacts of climate change and biodiversity loss on financial stability in Finland			
		transition risk for Finnish financial institutions?	more renewable energy sources than would be indicated by their share of EU energy production.
Karhu et al. (2023)	Transition	What are the transition risks of Finnish banks' corporate loan portfolios?	Using a Scope 1 measure of carbon footprints, the largest transition risks in bank lending are in the transport, energy and primary production sectors. Using a Scope 3 measure of carbon footprints, the largest transition risks in bank lending are in the primary production, transport, construction and manufacturing sectors.
Alogoskoufis et al. (2021)	Transition Physical	The ECB's 2021 climate stress test, the purpose of which was to assess the euro area's resilience against climate risks. Resilience is examined in various climate scenarios.	Less than 10% of loans granted by Finnish banks are moderately or highly exposed to physical risks; the rest of the loans have low exposures. As regards transition risks, some 30% of credit institutions' loans were to companies with high or very high greenhouse gas emissions. In Finland, over 60% of bank loans are protected by collateral; some 40% of the loans have physical collateral and the rest, some 20%, non-physical. In comparison with the euro area, both physical and transition risks in Finland seem relatively moderate.
Manninen et al. (2021)	Physical	How significant is the exposure of Finnish banks to coastal flood risks?	In Finland's eight coastal cities with over 50,000 inhabitants, a total of 0.8% of housing loans were for housing located in a flood risk area. Housing located in flood risk areas in these cities probably serves as collateral for housing loans totalling approximately EUR 150–350 million. In the case of commercial real estate, the coastal flood risk affects collateral amounting to more than EUR 100 million. These

Analyses of the impacts of climate change and biodiversity loss on financial stability in Finland			
			figures seem low in relative terms, and therefore the exposure of Finnish banks to coastal flood risks is probably not very significant.
Kauko (2023)	Transition Physical	How would Finnish banks' net interest income develop in the various climate scenarios?	Banks' net interest income would increase even in the adverse scenario. Net interest income would develop most favourably in scenarios in which transition to a sustainable economy is timely and orderly.
Katajarinne (2022)	Biodiversity loss (physical risks)	What are Finnish credit institutions' exposures to sectors dependent on ecosystem services?	Of loans granted by Finnish credit institutions, 23% are highly or very highly exposed to the risks of biodiversity loss.
ECB/ESRB (2023)	Biodiversity loss (physical risks)	How dependent are euro area businesses and the corporate loans granted to them on ecosystem services? Cross-sectional analysis including Finland.	The share of Finnish corporate loans directly or indirectly dependent on ecosystem services is nearly 90%.

Transition to a carbon-neutral economy creates risks for the economy and the financial system in Finland too

Transition risks refer to risks arising from transitioning to a carbon-neutral economy. Decoupling from fossil fuels and the associated climate policy measures may significantly affect the profitability of certain industries, which in turn may increase banks' risks of loan losses. Decoupling from fossil fuels will also probably have an impact on the value of certain infrastructure and of companies with a carbon-intensive business model, which will result in higher market risk. The need to increase the protection of forests in order to expand or maintain carbon sinks, for example, is also a type of transition risk. The introduction of new technologies or changes in people's consumption preferences may also create transition risks.

The transition risk may be significant, for instance in the energy sector. The analysis by Karhu, Hirvonen and Tolkki (2023) shows (Table 1) that less than half of the stock of loans granted by Finnish banks to the energy industry are to the largest emitters. The 25 largest emitters accounted for about 95% of the energy industry's direct emissions but for only 45% of bank lending to the energy industry. In other words, a large share of bank finance is to companies that produce energy from renewable and zero-emission energy sources. Measured in terms of emissions per euro of lending, the largest emissions are generated in transport, energy supply and primary production. By combining emissions and loan data, Kauko and Räsänen (2022) show in their scenario-based analysis (Table 1) that Finnish MFIs financed in 2020 significantly more renewable energy sources than would be indicated by their share of energy production in the EU. These results may be partly due to the fact that zero-emission energy production is often very capital intensive. In 2021, the ECB published the results of a climate stress test (Alogoskoufis et al., 2021) [4] which examined the euro area's physical and transition risks (Table 1). As regards transition risks, in Finland some 30% of credit institutions' loans were to companies with high or very high greenhouse gas emissions. The figure is among the lowest in the euro area, but on the other hand, low-emitting businesses too were granted only little financing. In the light of these analyses, the Finnish banking sector's exposure to transition risk could thus be considered relatively moderate.

The EU aims to be climate neutral by 2050, whereas Finland's national Climate Act lays down the objective of carbon neutrality by 2035.[5] Regarding transition risks, the most favourable scenario over the medium term would be that the transition is made swiftly and in an orderly manner, even though this would generate costs in the short term. If measures are delayed, we will be faced with particularly severe transition risks as the prospect of a hurried and disorderly transition to a green economy increases.

The analysis of transition risks should be continued and developed further. Analytical work underlines the need for granular data, as there may be significant variation in transition risks across industries and companies, depending on their greenhouse gas emissions or transition plans. In examining banks' transition risks, data is needed at the level of individual loans, for example, in order to determine the carbon intensity of loan portfolios. As with companies, households, too, are exposed to transition risks. For example, households living in homes with a low energy efficiency may be more vulnerable to electricity price shocks, which could arise especially in a hurried and disorderly energy transition. Electricity price peaks could weaken the debt servicing capacity of these households and thus drive up banks' credit risks. In analysing such risks, data from registers of energy performance certificates are one source that can be used in analysing such risks.[6]

Knowledge of the financial stability impacts of physical risks in Finland mainly concerns flooding

Extreme weather events stemming from climate change are already causing financial loss and damage across the globe (IPCC AR6 2023). As elsewhere, their economic costs are clearly increasing in Finland, too (Gregow et al., 2021). The physical risks posed by climate change can be divided into chronic risks and acute risks. Chronic climatic events, such as a gradual rise in temperatures and sea levels, have an impact on labour productivity and food production, among other things, and in Finland on forestry as well, due to more frequent cases of pest and pathogen damage. Acute physical risks refer to extreme weather and climate events, such as storms, floods and droughts, which can cause immediate financial loss and damage.

In the financial sector, physical risks are usually in the form of credit or other traditional risks. These risks may weaken the repayment capacity of many borrowers and lower the value of property used as collateral. Manninen et al. (2021) have analysed the value of real estate collateral located in flood risk areas (Table 1). According to their study, housing located in flood risk areas in Finland's largest coastal cities serves as collateral for housing loans totalling approximately EUR 150–350 million. The largest risk exposures in value terms are in the Helsinki metropolitan area and Pori. Commercial real estate collateral of over EUR 100 million is also exposed to flood risk. The figures are fairly low in relation to the aggregate stock of bank loans, which might suggest that banks' exposure to flood risks is moderate. However, further research may be needed to support this conclusion. Risk assessments for Finland are also available in the joint report of the ECB and the ESRB, which finds that in Finland and the other countries of northern Europe, flooding poses the greatest physical risks. In Finland, the risks are most severe in the northern parts of the country (ECB/ESRB, 2023).

The more indirect the impacts, the more difficult it is to analyse them. For example, physical risks

can weaken the supply of many commodities in a way that directly affects inflation. Inflation, in turn, will affect interest rates, which are of direct relevance to almost all segments of the financial markets. In an uncertain environment, companies will reduce their investments, which will have extensive and complex macroeconomic repercussions, and these may be reflected in, for example, the real estate market, also in regions where physical risks are low. In the analysis of climate change in Finland, such long impact chains have not been examined from the perspective of financial stability.

The potential non-linearities, interdependencies and compound risks of the economic impacts limit the reliability of models that have been calibrated with historical data (Määttä, 2024). Tipping points, i.e. abrupt and disproportionately sharp increases in impacts at some point in time, make it more difficult to estimate the risks. [7] There is a lot of room for improvement in the case of data on the financial stability impacts of physical risks, because economic data is often not sufficiently disaggregated by location, and it is challenging to monitor spillover cross-border effects at the granular level by combining international data.

Gradual improvement in understanding the risks related to biodiversity loss

Alongside climate change, biodiversity loss is another component of the broader picture concerning environmental crises. As with climate change, biodiversity loss also poses a risk to economic activity and financial stability.[8] Many economic activities are dependent on a variety of ecosystem services, and these are deteriorating as a result of biodiversity loss. As with climate change, the financial stability risks from biodiversity loss are typically broken down into physical and transitional risks. Physical risks refer to situations where the degradation of ecosystem services results in, for example, a weakening of the operating conditions and profitability of certain companies or industries that are dependent on these services. This could lead to disruptions in financial markets. Transition risks refer to risks arising from regulatory and policy measures to halt biodiversity loss or from shifts in, for example, technology and consumer preferences.

For Finland, there is still very little information on the financial stability risks related to biodiversity loss. Research conducted so far on the matter has focused on gauging the Finnish financial sector's exposures to the risks from biodiversity loss. A study by Katajarinne (2022) uses loan data for 2010–2021 from the Bank of Finland and data on industry-specific dependencies on ecosystem services from the ENCORE (Exploring Natural Capital Opportunities, Risks and Exposures) too [9] (Table 1). The study finds that 23% of loans granted by Finnish credit institutions

are exposed to high or very high biodiversity-related financial risks. The industries associated with the highest risks are real estate activities and agriculture, forestry and fishery, as loans to these industries account for the largest share in value terms of loans where the counterparty is highly dependent on at least one ecosystem service. The amount of loans granted to companies whose activities are dependent on surface waters has been considerable. Real estate activities, in particular, are highly dependent on water.[10]

A joint ECB/ESRB report (2023) examines euro area banks' exposures to the risks associated with biodiversity loss (Table 1), in addition to other issues related to climate change and biodiversity loss. The analysis covers direct exposures and also indirect exposures through supply chain linkages. According to the analysis, almost 90% of corporate loans in Finland are to companies that are highly dependent on at least one ecosystem service, when both direct and indirect dependencies are taken into account. The analysis also examines the sensitivity of banks' loan portfolios to potential changes in ecosystem services or natural assets. The results suggest that, in the worst-case scenario for biodiversity, Finnish banks' expected losses would be about double what they would be in the best-case scenario. This sensitivity of banks' expected losses is not very high for Finland compared with some other euro area countries.

Analysis of the financial stability risks from biodiversity loss is not yet as advanced as that for the risks from climate change. The analytical methods are probably not too well established yet, which may also explain the differences between the research results presented above. However, analytical work on biodiversity loss is being developed on an ongoing basis by, for example, the Network for Greening the Financial System (NGFS), a forum formed by central banks and supervisors. The challenge is that biodiversity loss is a multidimensional concept. For example, the ENCORE tool used in the studies discussed above does not account for any local variation in the interdependencies between different industries and ecosystem services. Measuring biodiversity loss is also challenging. There is a wide range of indicators for measuring biodiversity, and there does not seem to be a clear consensus yet on which of them is – or are – the best. In the coming years, resolving data-related problems and developing standardised analytical frameworks will be the likely key areas for development in biodiversity loss risk analysis.

Risks from climate change and biodiversity loss could pose a systemic threat to financial stability in Finland too

The current overall assessment of the financial stability impacts of climate change and biodiversity loss for Finland is subject to considerable uncertainty. The situation is similar in other countries. Moreover, statistical data relevant to the analysis of financial stability risks should be developed further. Particularly in the case of physical and indirect risks, much remains to be done in the

development of statistical data and analysis.

The path to a carbon-neutral economy involves transition risks, especially in a situation where the transition is at a fast pace and disorderly, and if high emitters have been financed heavily by financial sector entities. Current data suggests that the Finnish financial sector's exposures to such companies are not as significant as in many other European countries. Finland's climate objectives are more ambitious than those at EU level, and its policy measures aim at a faster transition to a carbon-neutral economy. Although this may entail costs in the short term, it can, at the same time, mitigate longer term transition risks by reducing the probability of abrupt and disorderly measures in the future.

The physical impacts of climate change are already visible in Finland, as elsewhere, and impact studies have been published in recent years. However, the overall assessment of physical risk transmission channels is not yet comprehensive, and estimating the financial stability impacts of these risks is therefore subject to considerable uncertainty. Research covering Finland has so far primarily focused on relatively direct risk exposures, and the more indirect the impacts are, the less information there is available. The physical risks of climate change may materialise in unexpected ways, and the impacts may be greater and more extensive than anticipated.

Climate change poses significant indirect risks to financial stability through macroeconomic variables and geopolitical cross-border spillover effects. Although some of the macroeconomic impacts have been taken into account in, for example, the NGFS scenario models, these have not yet been able to examine the pro- and countercyclical effects of climate change. Barely any research has been published on the various indirect financial stability impacts for Finland. The only analysis (Kauko, 2023) close to this topic suggests that the impact on banks' net interest income would be the most favourable in a scenario where there is a timely and orderly transition to a sustainable economy, but that net interest income would increase even in an adverse scenario (Table 1).

Potential financial stability risks from biodiversity loss have also been studied very little in Finland so far, and the results available to date are highly mixed. Moreover, the impacts of climate change and biodiversity loss on the whole of Europe and the global economy may also have significant repercussions for financial stability in Finland.

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Footnotes

1. The KUITTI project on assessing the cost of inaction on climate change looked at the direct and indirect cost of climate change for Finland. https://julkaisut.valtioneuvosto.fi/handle/10024/164032 ↑
2. In this article, indirect effects refer to impacts that are not directly caused by e.g. acute or chronic weather events or by climate policy measures. Climate change may, for instance, increase supply shocks related to certain foods and price volatility may rise, which will affect monetary policy and thus possibly also financial stability. ↑
3. Tipping points refer to thresholds that, when crossed, may lead to abrupt and irreversible climate change. When such tipping points are crossed, the financial impacts may also be

large and unexpected. ↑

4. ECB's economy-wide climate stress test (europa.eu) ↑
5. According to the national Climate Act, Finland should achieve carbon neutrality already by 2035. One of the objectives is to reduce emissions of key sectors by at least 60% by 2030 compared to the 1990 levels. According to the Annual Climate Report 2024 prepared by the Ministry of the Environment, the pace of emission reductions is not sufficient for achieving the 2030 target. The achievement of carbon neutrality by 2035 would require additional measures both in the land use sector and in other sectors. ↑
6. See also: 'Energy performance of residential buildings needs to be improved' – Euro ja talous (in Finnish). ↑
7. See also: The Green Swan: Central Banking and Financial Stability in the Age of Climate Change – Green Central Banking. ↑
8. 'Biodiversity loss poses a threat to financial stability' – Euro ja talous (in Finnish). ↑
9. ENCORE (encorenature.org). ↑
10. In the materiality rating scale of ENCORE, 'high' or 'very high' dependency on a particular ecosystem service means that the loss of the service would lead to disruptions in the company's activities and to at least moderate and, at worst, severe financial losses. ↑

Key words

biodiversity loss, climate change, financial stability, Finland, physical risks