# How central banks manage climate and energy transition risks[1]

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## Abstract

Central banks have begun to examine and manage climate risks, including both transition risks of moving from fossil fuels to clean energy and physical climate risks. Here we provide a systematic assessment of how and why central banks address climate risks, based on an original dataset of central banks across the OECD and G20. We show that central banks vary substantially in the extent to which they *re-risk* fossil fuel investments and physical risks and *de-risk* clean energy investments. Our analysis finds that central bank climate risk management is not associated with a country's economic exposure to transition risks but instead with its climate politics. The results suggest that central banks may not be solely independent risk managers but also actors that respond to political demands. As such, central banks may reinforce national decarbonization policy, while not correcting for the lack thereof.

## Main

The energy transition and climate change both entail risks for the global economy (1). As the global economy decarbonizes, fossil fuel investments face stranded asset risks, i.e., lost profits due to early retirement (2). Stranded asset risks threaten financial stability. Similarly, exposure to climate hazards contributes to financial stability risk. Clean energy investments, meanwhile, come with higher capital investment and greater uncertainty about technology and market performance, despite declining technology costs (3). Policy can help mitigate these risks (4-7).

Over the last decade, central banks have taken on a role in examining and managing transition risks as well as physical climate risks (8). These risks are not only firm-level risks but can amount to systemic risks. After the financial crisis of 2008/09, central banks have grown more occupied with financial and macroeconomic stability, and finance is the transmission belt of transition risks (9-11). Climate activists have welcomed the expansion of central banks' activities to facilitate decarbonization, hoping that central banks could substitute for the lack of strong

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national climate action. Monetary conservatives, instead, have been alarmed by mission creep among central banks (12-14). Since first movers such as the Bank of England began to explore the issue, central banks across the globe have started to assess and manage climate risks. New global fora foster learning and cooperation among central banks, such as the Network for Greening the Financial System (15-16).

Yet the response from central banks has not been uniform: some have adopted measures of varying type and stringency; other central banks have not taken any actions (17-20). This raises the question of what explains central bank activity in managing climate risks. We consider two sets of explanations: central banks respond to underlying economic risks, or central banks react to political demands in addressing risks (21).

Here we provide a systematic study of central bank management of climate risks. We introduce an original dataset on climate risk management measures by central banks across 47 OECD and G20 countries which is—to our knowledge—the largest country sample in related research to date. Importantly, we develop a classification system to identify actions that *re-risk* brown investments and *de-risk* green investments. Re-risking refers to embedding transition risks and physical climate risks into financial risk management practices to ensure financial stability, whereas de-risking means reducing the risk of clean energy investments, i.e., the technology, market, and policy risks of new clean energy technologies, to facilitate decarbonization. Prior research has not differentiated these two key dimensions of central bank activity which relate to phasing out fossil fuels and phasing in clean energy.

We assess several economic risks and political demands. We find limited evidence that economic risks are associated with central bank behavior. Among these risks, stranded asset risks and clean energy investment risks—main transitions risks—are not associated with central bank actions, only physical risks are to some extent. Instead, we find that central bank actions to manage risks are significantly associated with domestic climate politics—existing climate policy stringency and public opinion on climate change. Our results suggest that the magnitude of economic risks is not associated with central bank attempts to contain those risks, leaving a risk mitigation gap. Furthermore, they indicate that central banks may not be entirely autonomous risk managers but rather be responsive to political demands to maintain their legitimacy. Overall, our findings suggest that central banks may reinforce decarbonization policy, instead of correcting for the lack thereof.

## Measuring how central banks manage climate risks

Central banks have taken a range of actions to address transition risks and physical climate risks, including stress testing requirements, purchasing green bonds for their own portfolios, or requiring climate risk disclosure of the financial institutions they oversee (17-18, 22-23). We argue that we need to differentiate between actions that *re-risk* "climate bads" and that *de-risk* "climate goods" because they address different sets of risks and include different policy measures (Table 1). Prior research has acknowledged that prudential (re-risking) and promotional (de-risking) motives exist, while we show that this translates into different central bank actions (20).

[TABLE 1 HERE]

Re-risking policies are targeted at adding in climate or carbon risk metrics to central bank supervisory procedures (Extended Data Table 1). They include, for instance, requirements for the disclosure of transition and physical climate risks, the inclusion of these risks in stress testing, and

to shift lending away from carbon-intensive projects. Re-risking policies can be beneficial to countries that have a large economic exposure to stranded asset risks or to climate impacts and thus climate damages. De-risking actions are policies that facilitate low-carbon investments. Such measures include, for example, lower capital requirements for green projects, requirements for a minimum allocation of lending toward green projects, and investments in green bonds.

[FIGURE 1 HERE]

We construct a dataset on central bank policies on climate and transition risks for the OECD and G20 countries, containing policies enacted as recently as August 2023 (Methods). We classify these policies by function (re-risking, de-risking, both), cost, and type of instrument (Methods, Table 1, Extended Data Table 2). We aggregate the policy-level dataset to the country-level and calculate composite scores of their climate-related activity: a re-risking score and a de-risking score (Methods, Supplementary Note 5).

We find substantial variation in the extent to which countries re-risk, de-risk, or do both (Figure 1). First, there is a group of countries with high re-risking and de-risking scores (blue quadrant). These are mostly member states of the European Central Bank (ECB) (Italy, Germany, France, Netherlands, Belgium), the UK, and China. A second cluster of countries with relatively less activity (a score of 10 or lower) in both re-risking and de-risking scores, includes the United States, South Korea, Costa Rica, South Africa, and Russia (red quadrant). A third set of countries clearly engage in more re-risking than de-risking (Brazil, Switzerland, Sweden) (yellow quadrant). Last, a set of countries engage primarily in de-risking (Hungary, Denmark, Japan, India, Indonesia) (green quadrant). We discuss observations on trends in the policy instruments central banks use in Supplementary Note 5. This substantial cross-national variation raises the question of why central banks vary in the extent to which they re-risk and de-risk transition risks.

**Central banks and economic risks**

We focus on two basic explanations for why central banks manage climate risks: they seek to address economic risks, or they respond to political demands for climate action. The first explanation assumes that central banks are rational technocratic agencies that follow their mandate to manage economic risks. This includes specifically protecting financial stability (24) which decarbonization and climate change can disrupt (16). We here test economic explanations for both re-risking and de-risking and turn toward the political explanation in the next section.

First, we hypothesize that a central bank is more likely to re-risk, the greater the stranded assets risks are in the economy and financial system it oversees (3, 25). This follows from central banks' mandate to ensure financial stability (26-27). How to best measure stranded asset risks is an ongoing debate, and a key part of central bank engagement with transition risks is to better understand the type and magnitude of these risks (28). We consider two risk dimensions: the extent of fossil fuel assets in an economy and the relative size of the financial sector. We assume that the larger the oil and gas sector in an economy, the greater are the stranded asset risks. Similarly, a large financial sector increases the direct exposure of an economy to stranded asset risks which could threaten financial stability (29). We measure the size of the oil and gas sector by calculating the oil and gas sector share of a country's GDP and the size of the financial sector as domestic credit provided by the financial sector as a share of GDP.

We use a simple linear regression model to test the correlation of economic risks with countries' re-risking scores. Because we have a diverse set of countries in our sample, we are

careful to control for factors that could be associated with cross-national differences in central bank activity. They are central bank independence, level of democracy, whether a central bank mandate includes a price stability objective only, an economic support objective, and/or a sustainability objective, GDP per capita, GDP growth rate, trade share of GDP, unemployment rate, inflation rate, and EU membership. While our dataset on central bank activities includes 47 countries, due to missing data our regression analyses include 41. See Methods and Supplementary Note 6 for further details.

We find no statistically significant correlation between the size of either the oil and gas sector or the financial sector and re-risking scores. The central banks of economies with likely high exposure to stranded asset risks through either a large oil and gas sector and/or a large financial sector do not appear to engage more in re-risking than economies with low stranded asset risks.

To illustrate cross-national variation, we plot the relative size of the financial sector against re-risking scores in Figure 2. From here on, plots in grey indicate no correlation, whereas plots in red and blue indicate significant correlation for re-risking and de-risking, respectively. Figure 3 plots the coefficient estimates and standard errors of these two models, with the statistically significant variables highlighted by color to distinguish the two models. Supplementary Tables 1 and 2 contain the full regression results. We provide an expanded discussion of all hypothesized factors in Supplementary Note 3.

[FIGURE 2 HERE]

[FIGURE 3 HERE]

Second, we hypothesize that a central bank is more likely to de-risk if there is a growing green economy (30). Central banks often have mandates to support the domestic economy which may lead them to support high-growth sectors, thus taking on a promotional role. We consider the growth of renewable energy usage from 2018-2021 as proxy for a growing green economy because renewable energy technologies are the most mature clean energy technologies.

We find no statistically significant relationship between the growth of the share of renewable energy in total primary energy use and de-risking scores (Figure 3 and Figure 4). This means that a growing renewable energy industry is not associated with central banks reducing the risks of clean energy investments.

[FIGURE 4 HERE]

Third, we expect central banks to engage in re-risking if their economies are highly exposed to physical climate hazards, such as storms, droughts and wildfires. A core part of central bank re-risking is supervisory, i.e., understanding the magnitude of these risks and incorporating them into financial risk management practices such as stress tests. It follows that if a country is highly exposed to physical climate risks, it would adopt these practices. In fact, prior research has demonstrated a correlation between physical risks and central bank management of climate risks (19). We measure climate hazard exposure by using the exposure component of the Notre Dame Global Adaptation Initiative (ND-Gain) Country Index.

We do not find an association between exposure to climate hazards and re-risking. Instead, we find that de-risking is positively and significantly correlated with higher exposure to physical climate risks. This is puzzling and requires further analysis. One would expect that central banks

of economies with high exposure to climate hazards engage primarily in re-risking. To illustrate cross-national variation, we plot the ND-Gain Exposure index (our measure for physical climate risk) against de-risking scores in Supplementary Figure 1.

In sum, we find that only physical climate risks are significantly correlated with central bank de-risking activities. Transition risks—stranded asset and clean energy investment risks—are associated with neither re-risking nor de-risking actions.

**Central banks and climate politics**

A second set of explanations for why central banks tackle climate risks lies in politics (31-32). Central banks could be responding to political demands from either policymakers and/or the public (14, 33). While central banks tend to have high degrees of autonomy, they are ultimately accountable to politicians and the public they serve (34-35). Central banks have a record of responding to policymaker and public pressures, including in ways that extend beyond the scope of their primary mandate of price stability—specifically since the 2008 financial crisis (36-38). This suggests that central banks may be increasingly sensitive to political forces and act strategically, in their interests of self-preservation and maintaining their legitimacy (39). Legitimacy in the eye of the public is a key strategy to ensure their autonomy vis-à-vis politicians (40-43). By appealing to issues with public salience (in this case, climate change), central banks may strengthen their public legitimacy, but only as so far that engagement with matters of public concern does not overshadow their main mandate of ensuring price stability. We test two sources of political demands—policymakers and the public—separately, complementing prior research that focuses on supply-side variables, i.e., features of central banks, such as their mandates and level of independence (17, 19).

First, we use the stringency of a country's climate policy as proxy for policymaker demands. If policymakers—meaning politicians and/or bureaucrats—have enacted stringent national climate policy, they may expect central banks to follow suit and to support their policy goals (36-38, 44-45). Absent direct policymaker influence on central banks, this relationship might also exist if a central bank has a mandate to support the domestic economy or support the government's economic agenda, as in China or the United States.

[FIGURE 5 HERE]

We find that climate policy stringency (based on an OECD index) is a statistically significant and positive factor for re-risking. In other words, the more policymakers adopt strong climate policies, the more likely central banks are to engage in re-risking. We demonstrate the relationship in Figure 5. By contrast, climate policy stringency is not correlated with de-risking. One potential reason may be that stringent climate policy often performs a de-risking function by, for instance, providing clean energy subsidies and tax credits. In which case, central banks do not need to step in.

Second, we assume that the more the public is concerned with climate change, the more central banks will adopt re-risking and de-risking policies. In countries where climate change is a salient political issue and a large share of the population are concerned about the impacts of climate change, there have been public calls for central banks to act directly to address it (46). Supportive public sentiment might be a necessary condition for central banks to engage specifically in de-risking policies because such policies have already fallen under scrutiny for violating market neutrality (14, 47).

Using a cross-national survey on public concern about climate change from the Yale Program on Climate Change Communication, we find a statistically significant positive correlation between public concern and de-risking scores (Figure 3, Supplementary Table 2). This means that central banks may respond to greater public concern with de-risking the clean energy transition, but not with re-risking stranded assets and physical climate risks. We plot de-risking and public concern for climate change in Figure 6 to illustrate cross-national variation in public concern and de-risking actions.

In sum, we find that political demands from policymakers and the public are significantly and positively correlated with central banks' re-risking and de-risking activities, respectively.

[FIGURE 6 HERE]

**Discussion**

Central banks vary substantially in the extent to which they re-risk fossil fuel investments and de-risk clean energy investments. The surprising finding here is that this is not significantly associated with exposure to transition risks, such as stranded asset and clean energy risks. Instead, we find that climate policy stringency and public concern with climate change are associated with re-risking and de-risking activities, respectively.

Our study has limitations that future research should address. First, we provide a cross-sectional analysis of central bank actions that emerged only recently. As time passes, researchers need to develop time series to understand the evolution of central bank climate risk management, thus also increasing the number of observations for statistical analysis. We are also at an early stage of understanding transition risks. Developing transition risk indices would offer additional conceptualizations of risk beyond an economy's exposure to affected sectors as tested in this article.

Second, we present cross-national correlations and theorize underlying mechanisms. Future research could shed light on central bank decision-making in tackling transition and climate risks, using in-depth case studies or surveys on central bank decision-making. This will help better understand how central bank bureaucrats think about both economic risks and political demands in incorporating energy and climate-related risks into their activities. In addition, as more policies are enacted, research on the effectiveness of different policy instruments could help shed light onto which actions have the greatest impact on climate risk mitigation (see also Supplementary Note 5).

Third, central banks are the primary actors in managing financial risk and stability but not the only ones. To better assess the magnitude of the risk mitigation gap, research needs to examine the broader regulatory ecosystem, including financial supervisors and private sector actors. For example, in the United States, the Securities and Exchange Commission and the Commodity Futures Trading Commission are setting rules on climate risk disclosure, not the Federal Reserve (48-49). Also, private actors, such as credit rating agencies, accounting firms, and insurance companies, are working to develop their own climate risk management practices. New coalitions, such as the Value Balancing Alliance, advance standards setting in impact accounting and climate-related disclosures. Yet these are all voluntary forms of risk management. Understanding the broader regulatory system of risk will allow for an assessment of the regulatory gap for the economy as a whole.

Our findings also have an important implication for policy. Climate policy advocates have held hopes that central banks could correct for the lack of national decarbonization policy. Their relative independence could theoretically provide them with greater ability to adopt policies where executives or legislatures are paralyzed by political opposition. This would most likely be the case for re-risking fossil fuel investments which tends to provoke opposition from fossil fuel and related industries. Yet we find re-risking to be positively correlated with the stringency of national climate policy. This suggests that so far central banks complement, rather than act as a substitute for, regulatory or legislative policy to reduce fossil fuel dependence. This makes central banks an important additional actor in decarbonization policy. That said, it also cautions against high hopes for central banks in laggard countries to take the lead in tackling climate risks. Research has found a similar pattern for transnational climate governance by private actors: the more stringent national climate policy, the more sub-national and private actors participate in transnational climate governance (50). In short, the halo effect of national climate policy and politics looms large and likely shapes a country's overall decarbonization ambition, including efforts by independent actors, such as central banks.

The political nature of the management of climate risks raises concerns about unmanaged risks in the global economy, specifically stranded asset risks. These exist in economies with large oil and gas and/or financial sectors and low re-risking scores. We see two practical paths to begin to address the risk mitigation gap. First, increasing transparency of central bank actions on climate risk management would lay the ground for building political pressure on laggard central banks. This article has taken a first step toward that, while a more institutionalized effort would be to develop a central bank climate index. Such an index would identify leaders and laggards and show progress over time. It would provide the informational basis for a number of advocacy and market actors to build pressure on central banks. For instance, private credit rating agencies may use the index to inform country credit ratings, thus indirectly incentivizing central bank actions to address climate risks.

Second, international organizations, such as the Bank for International Settlements (BIS) or the Financial Stability Board (FSB), could move beyond identifying best practices and develop standards for climate risk management that members need to adhere to. Both the BIS and the FSB have begun to explore climate risks. For example, the BIS has examined climate risk disclosure requirements, discussing which requirements should be standard for members and which should be at national discretion. International risk disclosure requirements for central banks could potentially incentivize greater risk management by central banks in countries that lack strong national decarbonization policy.

## Methods

***Overview.*** This paper undertakes regression analyses of an original dataset. This section first describes how we created the dataset, including the sample of countries, data collection, dataset aggregation, and outcome variable calculation. Then it details data collection for all covariates and describes the linear regression model.

***Countries included in the dataset.*** Forty-seven countries are included in our dataset. They include the OECD countries plus all other countries in the Group of Twenty (G20). The countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Czechia, Denmark, Estonia, European Union, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Republic of Korea, Latvia, Lithuania,

Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States. As of 2022, OECD and G20 countries together constitute more than 84% of global GDP and 83% of global $CO_2$ emissions (51-52).

***Data collection on central bank actions.*** The starting point of the data collection on climate risk-related central bank actions was the Green Monetary and Financial Policies Tracker created by the E-Axes Forum in 2021 (53). This tracker covers G20 countries, EU countries, and some countries in Latin America. This dataset includes the country, the implementing institution (whether it was the central bank or other financial regulator), the year of the policy, policy description, webpage link to the source, and a policy type classification. The policy type classification focused on whether the policy was a monetary policy, financial policy, or other, and then had sub-classifications based on these three categories, to further identify the policy group (e.g., collateral policy, credit operations, asset purchases, supervisory guidelines, stress tests, surveys, etc.).

While this Tracker provided useful information, we wanted to expand the dataset to include more recent policies (post-2021), a more expansive country sample, and create a classification system of policies to differentiate between re-risking and de-risking goals, so we constructed an original dataset from scratch. In the summer of 2023, we went through the sample countries one by one to collect our own set of central bank climate-related actions. Via web searching on the central bank's website and national news sources, we searched for specific keywords to identify any possible climate-related policy enacted by the central bank. These keywords were: climate change, climate finance, climate risk, sustainable, sustainable finance, and green asset. Our search usually yielded more exhaustive findings that might not fit the scope of the dataset (e.g., internal sustainability efforts the central bank is doing to make their office buildings more energy efficient), but this way we felt confident our dataset was not missing any key policies. We also cross-checked our policy dataset with the E-Axes Forum Tracker.

Our policy-specific dataset includes 168 observations across the 47 countries, and identifies: the country; the year of the policy (91% of the policy observations are between 2019-2023); the name of the policy; the policy description; the data source (webpage link); whether the policy includes a requirement of other actors (e.g., a regulatory rule for banks to comply with, or a request for information) or only pertains to the central bank operations (e.g., information published by the bank or a change in how the bank manages its funds); whether the policy aims to re-risk, de-risk, or both; the policy function class (information, economic, structural); and the relative "cost" of the policy to the central bank (the relative degree to which the action is costly to the central to enact, as interpreted by what is going to have a material impact on the financial system and what might have a resource cost to the central bank to enact). (See Supplementary Note 5 for an expanded discussion of this cost concept). To review some examples of these specific policies and the policy classification systems, please see Table 1 and Extended Data Table 1.

***Dataset aggregation and dependent variable creation.*** To conduct the country-level analysis of risk management activities by central banks, we aggregated the policy-level dataset by country to create aggregate re-risking and de-risking scores (Extended Data Table 2). We assigned each policy observation a point value based on its relative cost for central banks and/or complying entities, in order to weight higher cost actions more heavily. Low-cost actions have a point value of 1. Medium-cost actions have a point value of 2. High-cost actions have a point value of 5. And very high-cost actions have a point value of 10. The rationale behind this weight (over simply tallying

up observations) is that a central bank might engage in several low- or medium-cost actions, such as publishing its own climate risk management guidance or even setting up an internal climate change working group, but these actions do not have immediate economic effects on the country's financial sector. An expanded and detailed discussion of this data aggregation process and the underlying rationale for this approach is provided in Supplementary Note 5.

We then aggregated the policies' point values based on whether the policy is for re-risking or de-risking. In the final country-level aggregated dataset, each country has a re-risking score, a de-risking score, and a total score (re-risking + de-risking). Supplementary Figure 2 maps out the total score for each country in the dataset. For the European countries that are under the jurisdiction of the European Central Bank, we added the EU scores to the national scores. This then captures both the policies of the national central bank of the European country as well as what the European Central Bank implemented.

We calculated alternative versions of the scores as well in order to perform robustness checks. Instead of a (1,2,5,10) scale for the observation weights (based on the policy cost), the alternate versions of these scores apply a different weight scale: (1,2,3,4), (1,3,5,7), and (1,5,10,15) (see Supplementary Note 10 for these analyses).

***Data collection on explanatory variables.*** Based on the different initial hypotheses, we collected a broad set of possible explanatory variables at the country level. To capture stranded asset risks, we used both a measure of the size of a financial sector and the approximate carbon exposure of the country's GDP. First, we used the World Bank DataBank's domestic credit provided to the private sector measure, as a share of GDP, from the most recent full coverage year in 2019 as a proxy for financial sector size (54). This measure is a commonly used proxy for financial depth, which captures the financial sector's size relative to the domestic economy (55). We also calculated the economic value contributing to a country's GDP from the oil and gas sector for the year 2021, using the GLORIA model (Global Resource Input-Output Assessment), a multi-regional input-output database that capture input and intermediate goods trade across the world (56). This dataset includes not just economic value produced and traded, but also value added by each economy into the value of final goods. This measure best captures the economic value the oil and gas sector contributes to an economy. For data on the growth of the renewable energy sector across countries, we used yearly data from the IEA on renewable energy's percentage share of primary energy supply and calculated the growth rate from 2018 to 2021 (57). We used the 2022 Exposure component of the Notre Dame Global Adaptation Initiative (NG-Gain) Country Index to capture a country's physical risk of climate change impacts (58). To measure climate policy stringency, we used the OECD's Climate Policy Stringency of adopted policies index for the most recent year available, 2020 (59). To capture public sentiment about climate change, we used data from the Yale Program on Climate Change Communication (YPCCC)'s survey, conducted in 2022, that produced population breakdowns of sentiment on climate change, by percentage (60). We grouped the Alarmed and Concerned audiences together to capture the share of the population concerned about climate change. This survey is the most comprehensive cross-country sampling of public sentiment about climate change to date, but it still is missing a handful of countries from our dataset, most notably China and Russia. We substitute in a data point for China from a comparable 2022 survey from the IMF (Public Perceptions of Climate Mitigation Policies: Evidence from Cross-Country Surveys) which includes the share of the population that feels climate change will affect them or their family now up through the next ten years (61). We discuss this process more in Supplementary Note 6.

For the set of control variables, we used the World Bank DataBank's 2022 values for a country's inflation rate, unemployment rate, GDP growth rate, GDP per capita, and trade share (as a % of GDP) (62). We sourced a 2022 democracy index from The Economist Intelligence Unit, and a central bank independence index from the Quality of Government Institute, a dataset published by Ana Carolina Garriga in 2016 (63). We also created a secondary database on our sample countries' central bank mandates. The data on mandates was collected from the websites of each central bank. We gathered direct text from the central bank, summarized the core objectives, and verified these mandates using secondary sources. From these mandates, we created three binary indicators for the controls: 1) whether the mandate is for price stability only, 2) whether the mandate includes a clause (can be secondary in objective) to support the domestic economic policies of the country, and 3) whether the mandate includes any text explicitly that points to sustainability objectives. For any country observation for the control variables where the data point was not available given the year we use, we used the data value for the most recent year available, in order to ensure completeness of the dataset and not unnecessarily drop countries from the regression analysis (specific observations are noted in Supplementary Note 6).

An expanded discussion of our dataset is in Supplementary Note 6. We collected alternate data sources for these explanatory and control variables as well (see Supplementary Table 4 for a discussion of these alternate sources and why we selected these specific variables for this analysis).

***Regression analysis.*** We conducted the regression analysis of this study in R. We created a linear regression model with robust standard errors, using the main dependent variables and the above-described explanatory variables and controls. In the regression analysis, our sample is 41 observations. From the 47 countries in our dataset, the countries dropped from the regression analysis due to missing observations are: Estonia, Iceland, Latvia, Luxembourg, Russia, and Slovenia. The missing data is due to the variable for public sentiment about climate change, discussed above and in Supplementary Note 6. The regression sample of countries together constitute more than 79% of global GDP and 81% of global $CO_2$ emissions (51-52).

Our use of OLS is justified in Supplementary Note 7. To test the robustness of our main findings, we carry out a number of checks. We test for multicollinearity in our main model, run our main specification using alternate versions of the dependent variable, and run an alternate model with a different measure of renewable energy growth. (See Supplementary Notes 8-11 for results of these robustness checks.)

## Data availability

We created two datasets for this analysis. The first is a policy-specific dataset that includes the individual re-risking and de-risking policy measures for all central banks in our dataset. The second is a country-level dataset that aggregates the policy observations into aggregate re-risking and de-risking scores. This dataset also includes the independent variables for our regression analysis. Both datasets are described in the Methods and in the Extended Data Tables 1 and 2. We currently do not make the datasets publicly available due to additional ongoing analysis by the authors, but we make them available upon reasonable request.

## Code availability

We will provide the code for the regression analysis upon request.

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## Author contributions

E.S. conceived the study and led the development of theory and corresponding analysis, with the guidance of J.M. and J.J.F. E.S. collected the data, designed the methodology, executed the statistical analysis, and produced tables and figures, with the guidance of J.M. and J.J.F. E.S. and J.M. wrote the manuscript.

## Competing interests

The authors declare no competing interests.

## Additional information

Supplementary Information is available for this paper.

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## Tables

**Table 1. Defining re-risking and de-risking**.

| | Definition | Risk type | Policy examples |
|---|---|---|---|
| **Re-risking** | Internalizing risks of fossil fuel investments and physical climate risks into financial risk management practices to ensure financial stability. | Stranded assets risks (transition risks) & Physical climate risks | Re-risking policies tend to be supervisory in nature, e.g.,<br>- Targets added for its own investment portfolio to achieve net-zero, and restricts investments in fossil fuels (Finland)<br>- Publishes report on carbon footprint of its corporate bond holdings (Sweden)<br>- Banks must now incorporate climate-related risks into their stress tests (Brazil) |
| **De-risking** | Reducing the risk of clean energy investments. | Clean energy risks (transition risks) | De-risking policies tend to incentivize finance for clean energy investments, e.g.,<br>- Lower capital requirements for environmentally sustainable corporate and municipal lending (Hungary)<br>- Invests in green bond investment fund for central banks to increase share of green securities in its own funds portfolio (EU)<br>- Publishes guidance for a green financial system, to incentive more capital for green sectoral development (China) |

## Figure Captions

**Fig. 1 Re-risking and de-risking scores by country**. This graph plots each country's calculated re-risking and de-risking scores. Scores higher than 10 indicate that the country engages in substantial activity in that policy group, while scores 10 or lower indicate rather marginal efforts. The two-digit ISO country code indicates country names. There are four clusters evident from this plot: countries that engage substantially

in both re-risking and de-risking (blue quadrant), countries that mostly re-risk (yellow quadrant), countries that mostly de-risk (green quadrant), and countries that engage marginally in both or either group (red quadrant).

**Fig. 2 Stranded asset risks and re-risking**. This figure plots central bank re-risking activity against a proxy for relative size of a country's financial sector, the domestic credit provided to the private sector, expressed as a percentage share of the country's GDP.

**Fig. 3 Estimate plot of regression models**. This figure plots the coefficient estimates from the two linear regression models supporting our main findings. The re-risking model is shown in red, and the de-risking model is shown in blue. The red circle or blue square points indicate the coefficient estimate values, with the lines on either side of the observation showing the 95% confidence intervals. The highlighted boxed variables indicate a statistically significant variable in the model, color-coded to indicate which model (red for re-risking, blue for de-risking). Next to the findings discussed in the main text, we find that GDP growth rate is a negative statistically significant factor for re-risking, and that being a member of the EU is a statistically significant factor for de-risking. We discuss these findings in Supplementary Notes 1-4.

**Fig. 4 Renewable energy growth and de-risking.** This figure plots central bank de-risking activity against the growth of a country's renewable energy sector, specifically the percentage change from 2018-2021 of a country's renewable energy share of the country's total primary energy supply. The size of the observation point represents the 2021 value of the renewable energy share of total primary energy supply for each country, with the smaller circles indicating a lower share and the larger circles indicating a larger share.

**Fig. 5 Climate policy stringency and re-risking**. This figure plots re-risking against the Climate Policy Stringency index, an OECD index of adopted climate policies with a range from 0-10, 10 being most stringent. The observations are colored red to indicate significant association with re-risking.

**Fig. 6 Public concern about climate change and de-risking**. This figure displays the relationship between de-risking activity and a public sentiment measure from the Yale Program on Climate Change Communication, the percentage share of the country's population that is concerned about climate change. The observations are colored blue to indicate significant association with de-risking.

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