Ceres

Ceres Accelerator
for Sustainable Capital Markets

DERIVATIVES & BANK CLIMATE RISK

Financing a Net Zero Economy

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About Ceres

Ceres is a nonprofit organization working with the most influential capital market leaders to solve the world's greatest sustainability challenges. Through our powerful networks and global collaborations of investors, companies, and nonprofits, we drive action and inspire equitable market-based and policy solutions throughout the economy to build a just and sustainable future. For more information, visit ceres.org and follow @CeresNews.

About Ceres Accelerator for Sustainable Capital Markets

Ceres is a nonprofit organization working with the most influential capital market leaders to solve the world's greatest sustainability challenges. The Ceres Accelerator for Sustainable Capital Markets is a center of excellence within Ceres that aims to transform the practices and policies that govern capital markets to reduce the worst financial impacts of the climate crisis. It spurs action on climate change as a systemic financial risk—driving the large-scale behavior and systems change needed to achieve a net zero emissions economy through key financial actors including investors, banks, and insurers. The Ceres Accelerator also works with corporate boards of directors on improving governance of climate change and other sustainability issues. For more information, visit ceres.org and ceres.org/accelerator and follow @CeresNews.

FOREWORD

For decades, that climate risk is financial risk has been at the center of our work with the world's largest banks and investors. Finally, in the last few years, we've seen banks and regulators around the world not only acknowledge that fact, but also recognize that climate risk is a systemic risk.

During the past two years, U.S. financial regulators began integrating climate risk into the practices and policies that govern capital markets in order to reduce the worst financial impacts of the climate crisis. And seven of the top 10 banks in the U.S. have committed to aligning their lending and investment portfolios with net zero emissions by 2050 or sooner.

But it's not just time to act, it's past time.

Banks have no time to waste in turning those goals into action. As we outlined in two previous reports, the best place for banks to start is to focus on assessing and addressing the climate risk within their loan portfolios. Lending accounts for significant amounts of banks' capital, creating a substantial amount of risk for individual banks and the financial system. In just the syndicated loan portfolios of the largest U.S. banks, we found that more than half of bank lending is exposed to transition-related climate risk.

Yet, banks cannot stop at loans. There are other types of capital-intensive banking products and sources of bank revenue that are also exposed to climate risk. While this banking business outside the lending book hasn't had the spotlight turned on it yet, ignoring it is not an option. This is doubly true for the banking products and services that enable the construction of new energy infrastructure (whether high-emitting or low-emitting) and have the possibility of creating climate-related financial risk for banks.

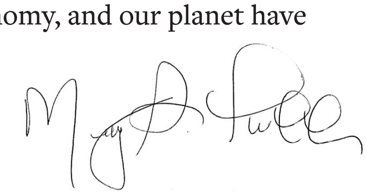
Derivatives fit both of these categories. Derivatives are financial instruments that "derive" their value from an underlying financial product or asset class, like interest rates, credit markets, or even energy commodities.

What makes derivatives particularly relevant in the analysis of financial climate risk is that they are risk transfer mechanisms—they shift risk exposure from one market participant to another. And as our capital markets showed in 2008, derivatives, as risk transfer products, can unwittingly inject risk into the banking and broader financial system. Given that banks' climate risk exposure is not yet effectively priced by the market, the risk is that this market failure could extend to derivatives as well.

While this report does wade deep into very technical waters, the message and recommendations are straightforward. The report states it plainly: "huge parts of banks' businesses are still a black box in terms of climate risk." Our analysis pulls one more business of banking business from out of that black box and puts it in the spotlight.

Based on this analysis, our report recommends that bank derivative portfolios must align with the goal of limiting global temperature rise to no more than 1.5 degrees Celsius as soon as possible. This means incorporating bank derivative portfolios into financed emissions calculations and the associated targets over the next several years. Our report also encourages investors and regulators to engage with banks on this critical and understudied asset class.

Action has to happen now, not in 2040 or 2050. While banks are pledging to do more to tackle the climate crisis, their outsized impact on fueling greenhouse gas emissions means that they must be much more ambitious and move much more quickly than they are now. They, our economy, and our planet have no other choice.



Mindy S. Lubber
Chief Executive Officer and President, Ceres Inc.

EXECUTIVE SUMMARY

In 2020, Ceres released the inaugural report in our **Financing a Net Zero Economy** series on the banking industry and climate risk, and since then interest in banks' climate strategies has exploded. In the space of two years, a global pandemic notwithstanding, we have seen massive investor interest in climate finance, the establishment of global standards through banking initiatives (including the Net-Zero Banking Alliance, the Partnership for Carbon Accounting Financials and the Basel Committee), the advent of climate stress testing and prudential supervision in many countries, and a flood of net zero commitments and 2030 sector targets from many of the world's largest banks.

This is strong progress. But there is much more to do. The overriding focus for banks must be on turning commitments into action, which means developing climate transition plans and going sector by sector, asset class by asset class, to understand what must be done for their financed emissions to reach net zero. In each area, the climate impact must be measured and understood, and the transition risks and opportunities must be identified and addressed.

This work is underway, particularly at the sectoral level, but huge parts of banks' businesses are still a black box in terms of climate risk. Almost all bank commitments to date have focused on corporate lending, a few have mentioned investment banking activity, but hardly any have mentioned derivatives. Based on the findings of this report, lending should remain the priority, but derivatives should be (at least) as important to address as investment banking. Given that the derivatives market is $600 trillion in size, accounts for more than 10% of the revenue of the largest banks, and is highly interconnected to the rest of the financial system, it is a proverbial "elephant in the room" when it comes to banks' climate strategies.

This report focuses on the derivatives activity of the 25 largest U.S. banks, which perform the overwhelming majority of derivative transactions. Ceres and our partners at CLIMAFIN, a consulting firm with deep expertise in the relationship between banking and climate change, began with an exploratory analysis to understand where the critical climate connections might be. While data availability is a problem for many derivative asset classes, our analysis led us to five key takeaways that banks, investors, and regulators should take very seriously:

1. Derivatives have the potential to dramatically change a bank's **climate risk exposure, increasing it by up to 3x in certain cases. For comparison purposes, the credit exposure from derivatives for the top 25 largest U.S. banks** (**approximately $1 trillion**) **is equivalent to an additional** 50% **of the credit exposure generated by their syndicated loan portfolio** (**approximately $2 trillion**). This large, underexplored exposure creates an imperative for banks to analyze the climate risk in their derivative portfolios, disclose key findings, and work to mitigate this risk (see Chapter 1).

2. There are actions that banks can take now to **mitigate climate exposure by correctly pricing risk** in their derivatives portfolios. This would not only insulate them from future climate shocks, it would also position them to better take advantage of the transition-related opportunities in the derivatives space (see Chapter 2).

3. Derivatives could serve as an **amplifier of climate risk** at a systemic level, given that banks' counterparties across lending, derivatives, and other asset classes can significantly overlap. In the case of a "climate shock" where assets are rapidly revalued, losses from different asset classes could be highly correlated, resulting in potentially increased systemic risk, as well as risk to individual banks (see Chapter 3).

4. The availability and cost of **derivatives have real-economy climate effects** and can either incentivize or discourage decarbonization in high-emitting sectors. These effects should be considered in banks' climate alignment efforts, including client engagement, transition plans, and sustainable finance strategies (see Chapter 4).

5. Derivatives are relevant to a **bank's carbon accounting and climate target setting**. Unlike investment banking and other capital markets activities, actionable and practical measurement for derivatives already exist. Whether banks are setting targets to reduce financed emissions or using the forward- looking portfolio alignment tools recommended by the Task Force on Climate-related Financial Disclosures and the Glasgow Financial Alliance for Net Zero, derivatives belong in the conversation. Targets and transition plans that do not include derivatives miss a material source of transition risk (see Chapter 5).

While the details of these findings get quite technical, many of the resulting recommendations build on those of Ceres' previous reports and provide further impetus for banks to take actions that investors and regulators are already asking for. Banks should:

1. Analyze and disclose the contributions of their derivatives portfolios to their overall climate risk and opportunity.
2. Update default probabilities in Credit Valuation Adjustment (CVA) calculations to include climate risk factors.
3. Proactively advocate for smart financial regulations and policy actions in support of enhanced climate risk management of their derivatives activities.
4. Continue to engage with their borrowers to help them develop transition plans and start including derivatives activity in these engagement initiatives over time.
5. Account for derivative transactions as additional sources of financed emissions and include these in their disclosure of firm-wide total financed emissions.
6. Update their 2030 targets (and 2050 commitment if necessary) to include derivatives.

We hope that the findings of this report will spur banks to conduct further internal analysis to understand how their derivatives portfolios fit into their net zero plans. While this is complex work and may not proceed quickly, it should start as soon as banks finalize their initial transition plans for commercial lending, a milestone the leading U.S. banks should reach in 2023 or 2024. We are releasing this report now to spur banks to consider the climate impact of derivatives, so that they can be ready to act on them once the lending book risk is well understood. The report can also provide a basis for investors and regulators to ask banks questions about how this critical and understudied asset class could affect climate risk, enterprise value, and the stability of the financial system more broadly.

In this area, as in all our work, we must heed the sobering warning from the latest Intergovernmental Panel on Climate Change (IPCC) report, which states that "climate change is a threat to human well-being and the health of the planet" and that "any further delay in concerted global action will miss a brief and rapidly closing window to secure a livable future." As stark as these impacts are, they are not being felt evenly, with frontline communities being disproportionately impacted by the economic and physical impacts of climate change–a reality that will only worsen with time unless we take action.

INTRODUCTION

As the systemic nature of climate risk and their impacts on financial markets become clear, the world's largest banks have stepped up their efforts in tackling climate change. After launching just a year ago, the Net-Zero Banking Alliance, the global financial initiative created to drive commitment to net zero by 2050 and provide a framework for climate action, now includes more than 100 of the world's biggest banks, including 24 out of 30 global systemically important banks (G-SIBs), and accounts for about 40% of global banking assets. Seven of the top 10 banks in the U.S. have committed to aligning their lending and investment portfolios with net zero emissions by 2050 or sooner.

For banks, a critical step to addressing climate risks and achieving their net zero goals is quantifying these risks. Not just because they are exposed to these risks through the companies they lend to, but also because, as financiers, banks play a leading role in financing the corporate activity that contributes to high greenhouse gas emissions and climate impacts worldwide.

Against this backdrop of accelerating and compounding climate-related financial risk, Ceres during the past two years published two reports that analyzed the exposure that the 28 largest U.S. banks faced from a slice of bank lending--syndicated loan portfolios, providing blueprints for how banks and investors should consider two major climate risks they face. Our 2020 report found that more than 50% of U.S. syndicated bank lending, or around $500 billion, is exposed to climate-related transition risk, that is the economic and financial risks arising from the policy, regulatory, consumer preference, and reputational impacts of a transition to a net zero economy. Our 2021 report found that value-at-risk from physical risk factors for the same asset class to be an additional $250 billion in exposure by 2080 (or 10% of portfolio value). So, in addition to financing a significant portion of real-economy GHG emissions, bank loans are also a major contributor to institution-specific and systemic financial risk.

Although significant, the risks we analyzed in our previous two reports are only a portion of the total story. Another critical source of climate risk is created by the client business outside of the lending book.

This report focuses on the derivatives activity of the 25 largest U.S. banks, which perform the overwhelming majority of derivative transactions. While our analysis covers all over-the-counter (OTC) derivatives with non-financial counterparties, for sake of clarity, we focus our discussion on interest-rate swaps, which represent 70% of the derivatives market. Given how material derivatives activity is to U.S. banks and to the U.S. financial system, this report quantifies the climate-related financial risks inherent in bank derivatives activity and makes recommendations for integrating derivatives into the risk management framework of U.S. and international banks.

HOW IS CLIMATE RISK TRANSMITTED?

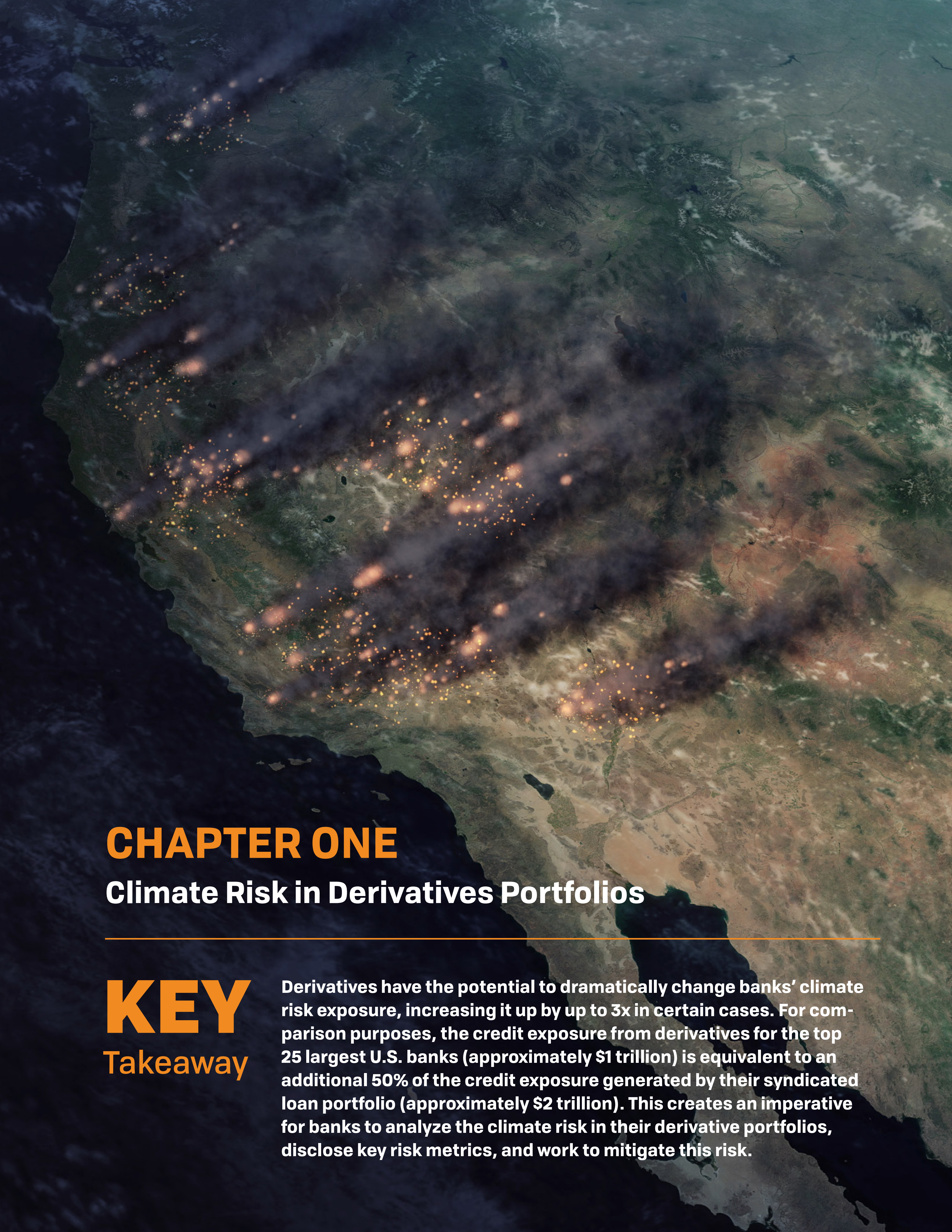
Unlike other risk factors, climate risk is systemic and, as such, it amplifies existing enterprise risks. In the context of financial services, these risks are divided into two main categories:

Transition Risk

This is the risk that business conditions, including consumer preferences, change or new technology, laws, or regulations, disrupt the commercial practices that borrowers rely on to sustain their business models. Generally speaking, high GHG emitting companies are more exposed to transition risk.

Physical Risk

This is the risk that borrowers' business models are disrupted by the physical damage to property, processes, and people caused by extreme weather events, which can be either acute or chronic, such as rising sea levels. According to the National Oceanic and Atmospheric Administration, the U.S. has been hit with 323 individual extreme weather disasters since 1980 where damage exceeded $1 billion. The total cumulative cost of these extreme weather events amounts to $2.2 trillion, with loss of life estimated at over 15,000 people.



CHAPTER ONE

Climate Risk in Derivatives Portfolios

KEY Takeaway

Derivatives have the potential to dramatically change banks' climate risk exposure, increasing it up by up to 3x in certain cases. For comparison purposes, the credit exposure from derivatives for the top 25 largest U.S. banks (approximately $1 trillion) is equivalent to an additional 50% of the credit exposure generated by their syndicated loan portfolio (approximately $2 trillion). This creates an imperative for banks to analyze the climate risk in their derivative portfolios, disclose key risk metrics, and work to mitigate this risk.

Derivatives are financial instruments that "derive" their value from an associated financial product or underlying asset class. For example, interest rates, credit markets, equities, and even energy commodities. The largest category of derivates is interest rate swaps, which are derivatives based on underlying U.S. interest rates. Such instruments are designed to let borrowers lock in the terms of future bank borrowings, allowing them to protect themselves from being hit by rising interest rates.

OVERVIEW OF AN INTEREST RATE SWAP DERIVATIVE

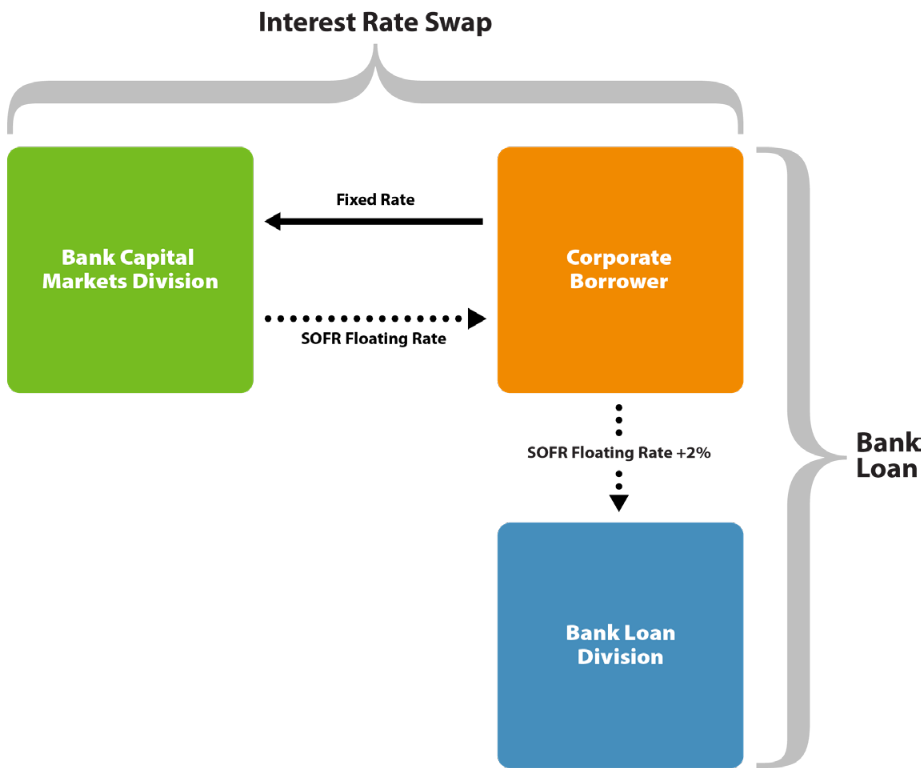


Figure 1: Diagram of a Typical Interest Rate Swap and Bank Loan

Assume a bank is providing a U.S.-based manufacturer with a five-year loan. The borrower agrees to pay the bank interest every quarter based on a base rate (for example, the then prevailing Secured Overnight Financing Rate, or SOFR) plus a credit spread of 2%. As this base rate could fluctuate considerably over the five-year life of the loan (i.e., it is a "floating" rate), the borrower may have difficulty making payments and forecasting its future interest expense. So, in order to achieve cost certainty for its interest expense, the borrower could decide to enter into an interest-rate swap contract with the same or another bank's capital markets division. Under the swap, the borrower would agree to pay a fixed rate for five years in exchange for receipt of the floating SOFR base rate (which it can then pass on to the lending division - along with the credit spread - to service the interest under the loan).

The net result from the borrower's standpoint is that it has immunized itself from the risk of rising U.S. interest rates over the term of the loan and has more certainty when it comes to budget planning. From the bank's standpoint, the bank would act as principal on the swap and the loan (i.e., it will hold onto the credit risk of both contracts), which in the normal course of business, makes the client a safer lending risk. However, in the worst case, if the borrower defaulted, the bank could lose money on both the loan and, depending on the swap mark-to-market, the swap as well. (It is this "derivatives counterparty credit risk" that could be exacerbated by climate risk factors.)

Over-the-counter (OTC) derivatives, which are bilateral contracts between two counterparties, such as a bank and a borrower, could be a major source of climate risk for the largest U.S. banks for several reasons. First is the sheer size of the market. According to the Bank for International Settlements (BIS), the notional amount of global OTC derivatives outstanding at the end of December 2021 amounts to $600 trillion. By contrast, exchange traded derivatives, which allow a borrower to purchase derivative contracts from an exchange, usually via a broker, accounted for only $79 trillion.

As a result, OTC derivatives are a significant driver of bank financial results. According to the Office of the Comptroller of the Currency (OCC), OTC derivative products trading revenues make up between 30% to 50% of total bank holding company trading revenues.

Additionally, the derivatives business involves many of the same companies that banks lend to. For example, if a loan to an oil company has climate risk, an interest rate swap with the same company would almost certainly have risk as well. **The Network for Greening the Financial System** (NGFS) summarizes this by saying "there is a strong risk that climate-related financial risks are not fully reflected in asset valuations." This conclusion is supported by Ceres' previous reports and applies to derivatives as well. This means that the existing tools banks use to value derivatives will be unreliable unless they are adjusted to incorporate climate factors.

Lastly, in most OTC derivative transactions, the bank involved is risking its own capital and retaining the credit risk arising from exposure to the borrower under the loan. There is no "safety net" provided by securitization or intermediation, meaning that any risk likely remains with the bank for the duration of the contract. For all these reasons, derivatives are the largest stone yet unturned when it comes to banks and climate risk.

Assessment of Climate Risk in Derivatives Portfolios

So how exactly should banks calculate derivative-based climate risks? There are many potential methodologies to quantify these risks, and Ceres' suggestions aren't meant to be prescriptive. However, for internal credit approval and risk management purposes, most U.S. banks are able to translate derivatives risk exposure (expressed in terms of notional amount) into a comparable loan risk exposure (which is expressed in terms of a principal amount). Banks use different terms for this calculation, so for the purposes of this report we will refer to this methodology as "loan equivalent risk" (LER). Thus, unlike some of the other banking activities included in banks' net zero planning (such as corporate bond or equity underwriting), there already exists a methodology for converting derivatives and loan exposures into an "apples-to-apples" comparison.

Many factors can impact an LER calculation for a derivative transaction, such as the volatility of the underlying asset class (for example, U.S. interest rates are generally lower volatility and energy commodities are usually higher volatility) and the tenor of the exposure (i.e., a six-month interest rate swap will have a lower LER than a 30-year interest rate swap, all else being equal). Depending on the transaction, an LER can go as high as 100% (or theoretically higher depending on the model limitations imposed by the bank). From a climate risk standpoint, using LER is intuitively reassuring, as one would expect a 30-year interest rate swap to produce larger climate risks compared to a shorter-term hedge.

Because the LER metric can translate derivative exposures into loan-equivalent exposures, existing bank climate risk tools that are used for loans can also be used for derivatives. This includes the tools used in Ceres' 2020 analysis of bank climate risk, which evaluated exposure and potential losses from syndicated loans. Using LER, the methodology can be extended to cover derivatives of all kinds.

LER is a forward-looking metric, and is therefore a suitable approach for banks to use in risk analysis. Ceres does not have access to the banks' LER information because it isn't public. This report estimates risk exposure using public disclosures, specifically the ratio between the mark-to-market credit exposure of the derivatives portfolio (totaling ~$1 trillion) and the total principal amount of the syndicated loan portfolio (approximately $2 trillion). These are the best publicly-available proxies for climate risk exposure, as the values are generated by the banks themselves and included in regulatory disclosures.

The only assumption needed to extrapolate climate risk is that the sectoral breakdown of exposure is similar for both syndicated loan borrowers and non-financial derivative counterparties. While the derivatives portfolios of major banks may not have exactly the same sectoral allocations as the syndicated loan portfolio, Ceres believes this to be a reasonable assumption given that bank credit appetite for derivatives and lending products usually overlap (as evidenced by both products often sharing in the same security and / or covenant packages). Furthermore, Ceres' 2021 research on relationship banking found that counterparty relationships often span multiple product lines, including loans, derivatives, and advisory services, providing further evidence of overlap. Recall that Ceres' 2020 report found $550 billion in climate risk exposure from about $1 trillion in syndicated loans, and a similar sectoral breakdown for banks' derivatives portfolios would produce similar risks.

As illustrated in Figure 2 below, **this analysis implies an increase of up to 50% in climate risk exposure on average and a two to threefold increase for the largest bank derivatives providers**. For example, as per the chart below, JPMorgan Chase has a syndicated loan exposure of $554 billion. Factoring in the derivatives-based credit exposure (or mark-to-market) of about $436 billion would almost double its climate risk exposure given the same sectoral breakdown.

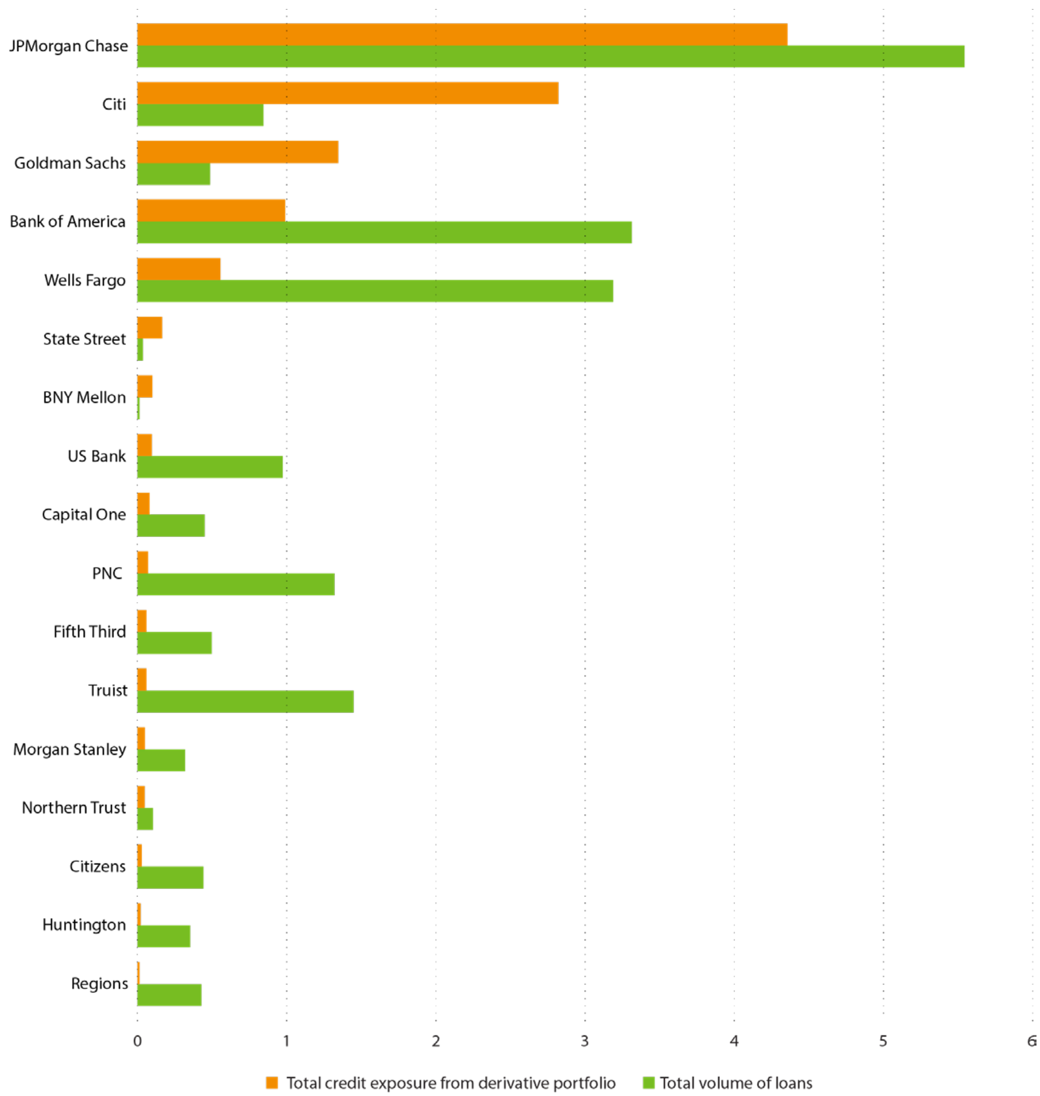


Figure 2: Total value of loans and credit exposure from derivative portfolio (in hundreds of billions).

In Ceres' 2020 report, in a worst-case scenario where investor expectations suddenly shift from a business-as-usual view (where no climate risk is priced in) to a transition scenario (where climate risk is fully incorporated into asset prices), the losses on loans to fossil fuel-based sectors averaged 40% and losses on the overall syndicated loan portfolio averaged 18% for the largest U.S. banks, even without considering second-order and systemic effects. While the data to do a similar value-at-risk analysis for derivatives is not available, the purpose of LER is to make derivatives risk comparable with loan risk, meaning that our loans-based analysis is potentially relevant for derivatives as well.

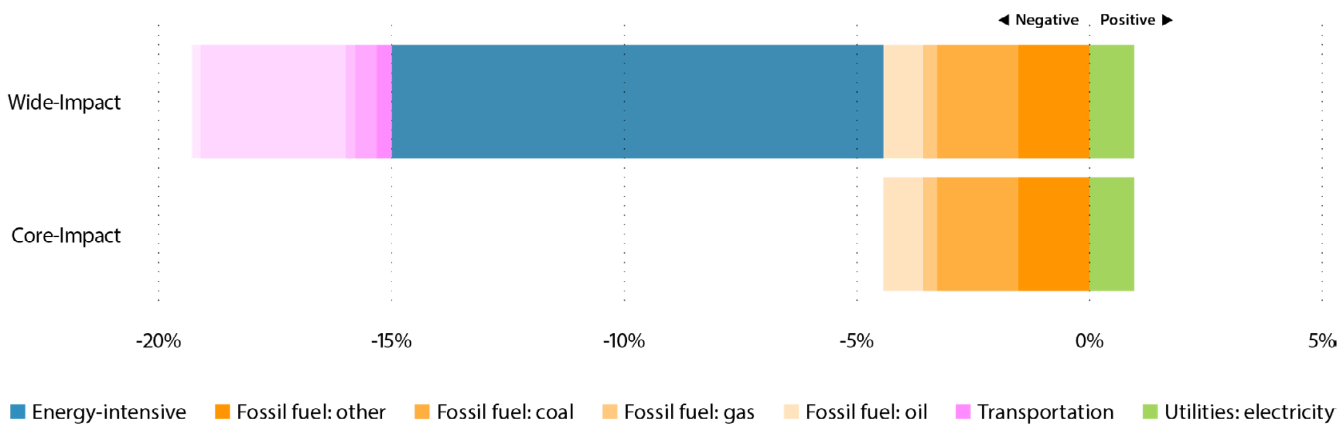


Figure 3: Projected gains and losses by sector in a worst-case climate scenario (reproduced from Ceres 2020 report).

Altogether, this means that, just like in their loan portfolios, the largest banks could have tens of billions of dollars in derivatives-based climate risk exposure. Based on LER calculations, those exposures could add significantly to the total losses banks could experience in a crisis situation (i.e., 18% of the average loan book as detailed in our 2020 report). **We strongly recommend that banks undertake a detailed risk analysis of their derivatives portfolios and consider them in tandem with other enterprise risks.**

CHAPTER TWO

Mitigating Climate Risk in Derivatives Portfolios

KEY Takeaway

There are actions that banks can take now to mitigate climate exposure by correctly pricing risk in their derivatives portfolios. This would not only insulate them from future climate shocks, it would also position them to better take advantage of the transition-related opportunities in the derivatives space.

While analysis and disclosure on climate risk is critical, alone it will not be enough. Banks must take action to mitigate the risk to themselves, the financial system, and society. In our 2020 report, Ceres discussed how banks can shift lending within sectors toward clients with robust transition plans and exposure to sustainable technologies to provide a hedge against climate risk. In other reports, Ceres and its peers have discussed the need to adjust loan-loss provisions and capital ratios to provide banks with more cushion that will help them absorb future climate shocks and prevent those shocks from becoming systemic crises.

Banks can take these mitigating actions for their derivative portfolios as well. U.S. banks are exposed to climate risks from their derivatives activity through two main financial risk channels:

1. **Market risk** is the risk caused by volatile changes in the price of the underlying asset class (for example, the value of U.S. interest rates). Climate risks can lead to market risk insofar as physical and transition risks impact the market prices of the asset class underlying a derivative.

2. **Credit risk** is the risk that the counterparty to a derivative transaction can no longer make its contractually obligated payments (either due to default or significant deterioration of its credit rating). This risk is usually provisioned via a transaction-level charge called a credit valuation adjustment (CVA), discussed in more detail below. It is important to note that climate risk can drive credit risk insofar as the derivatives counterparty is exposed to physical and transition risks.

While market risk is important, the major driver of climate risk for derivative transactions is counterparty credit risk, which means any risk mitigation strategy for banks should start there.

Physical and Transition Risk Drivers of Climate Risk

Banks typically set aside a credit valuation adjustment (CVA), specific to each derivative counterparty's portfolio of transactions, to protect the bank in the event that the derivative counterparty (i.e., borrower) suffers a credit downgrade or default. CVA is similar to the loan-loss reserves also used by banks to protect against the default of their borrowing clients under a loan. Like loan-loss reserves, as a derivative counterparty's probability of default increases, the bank will increase the CVA on derivative transactions between the bank and this counterparty. This shields the bank from a portion of the losses it could face if the counterparty defaults.

Since bank derivatives activity is designed primarily to de-risk borrowing clients, CVA is usually a cost charged to the borrower by the bank on a per-transaction basis (all else being equal, the lower the counterparty's credit rating, the higher the CVA charge). However, certain transactions or client derivative portfolios could have a risk-reducing net effect for the bank. This could occur in a case where the bank owes the borrower on a transaction or portfolio mark-to-market basis (i.e., the market has moved in the client's favor). In this case, the CVA calculation could be positive (i.e., a bank no longer needs the full amount of reserves or is willing to provide an incentive to the borrower to enter into a portfolio risk reducing transaction with the bank). Today, this type of incentive can be regularly observed in the market as banks motivate borrowers to reduce market and credit risks. This existing risk mitigation mechanism provides the foundation banks can use to mitigate climate risk in their derivatives portfolios.

Intuitively, heightened exposure to climate-related transition and physical risks would impact a derivative counterparty's probability of credit downgrade or default over the long term. However, most bank CVA models have not been updated to include climate risk factors. To the degree that exposure to climate risk is not accounted for, the probability of default of the counterparty will be underestimated. This underestimation would lead to insufficient CVA reserves and could put banks at greater risk in the event of a sudden climate shock. (As an aside, we understand that many banks now include a credit support annex (CSA) to obtain collateral in support of credit risk mitigation. While this will improve recovery in a default, it will not ameliorate the probability of default – which is what we are discussing here.)

Just like adjustments to reserve ratios and loan-loss provisions can help insulate banks from climate risk, **developing climate-adjusted CVA pricing models is one of the most important actions a bank can take to mitigate the climate risk of its derivatives portfolio**. It is worth noting that if climate risk was fully incorporated into asset prices and credit ratings by the market, existing CVA models would be adequate to capture it. Given the overwhelming evidence that the market is not pricing climate risk correctly, banks need to adjust for this market failure in a more targeted way.

While these improved CVA models will result in higher CVA reserves (and thus a one-time negative adjustment to trading revenues), we show below that, compared to the losses banks could face in a systemic crisis, the current cost of properly pricing climate risk into CVA is modest.

There are also substantial benefits to being able to explicitly assess climate risk drivers' impact on market and credit risks in this way. Perhaps the most important of these additional benefits is that it will make it easier for banks to understand what sustainable finance looks like in the context of a derivatives portfolio.

For example, when using a current, or "legacy" CVA pricing tool, the CVA calculations for a five-year interest-rate swap (IRS) with a high-GHG emitting oil and gas borrower and a similar IRS with a low-GHG emitting solar power producer would be the same (assuming they had similar credit ratings). Any portfolio rebalancing to incorporate sustainability would have to be done on an ad hoc basis.

However, when calculating CVA for the same two borrowers using an "enhanced" climate risk-adjusted CVA model, the CVA cost for the oil and gas company would be higher, reflecting the marginal cost of increased climate risk to the bank. The enhanced CVA calculation for the solar power producer, meanwhile, would likely result in a CVA benefit (rather than a cost) in order to incentivize the borrower to transact with that bank. Because the enhanced CVA model is better aligned with the bank's sustainability goals, it can support new derivatives business opportunities, while also helping the bank lower its transition risk exposure.

Banks that have climate risk-adjusted CVA models will be able to rebalance towards sustainable finance and seize these transition-driven opportunities more effectively. **Enhancing CVA, therefore, facilitates both critical climate risk mitigation strategies - portfolio rebalancing and loss absorption capability.**

For an illustrative assessment of the potential impact of climate risk on bank CVA, this report uses the CLIMAFIN scenario-based analysis methodology (see Appendix) to quantify climate risks in U.S. bank derivative portfolios. The analysis assumes that the sectoral distribution of non-financial counterparties in the derivative portfolio is similar to that of the syndicated loan portfolio.

Our analysis is high level and illustrative (as a precise analysis would require non-public data on the composition of a bank's derivatives book). We also assume that the baseline value of CVA is based on default probabilities corresponding to a business-as-usual (BAU) scenario (i.e., climate-driven transition risk is not already priced in). We then consider the impact on CVA of changes in default probabilities for counterparties in climate-relevant sectors introduced by the NGFS disorderly transition scenario, which has been estimated by international regulators such as Bank of England to have a larger negative impact on banks than business-as-usual or an orderly transition scenario.

WHO IS CLIMAFIN?

The technical analysis in this report was developed by CLIMAFIN, a consulting firm founded by three leading researchers, each with deep expertise in the relationship between banking and climate change:

- **Stefano Battiston** SNF Professor of Banking, University of Zurich
- **Antoine Mandel** Professor of Applied Mathematics at the Sorbonne and the Paris School of Economics
- **Irene Monasterolo** Assistant Professor of Climate Economics and Finance, Vienna Economics and Business University and Visiting Research Fellow, Boston University Global Development Policy Center.

The CLIMAFIN methodology is the outcome of more than 10 years of scientific research and is being used by European regulators, including the European Central Bank (ECB) and the European Insurance and Occupational Pensions Authority (EIOPA).

Conceptually, the evolution of the default probability is driven by changes in the value of the assets of the counterparty across scenarios, while the value of liabilities remains fixed across scenarios. Figure 4, below, illustrates the results of this analysis by displaying changes, in absolute terms, in CVA induced by the sectoral changes in default probability computed for the NGFS disorderly transition scenario.

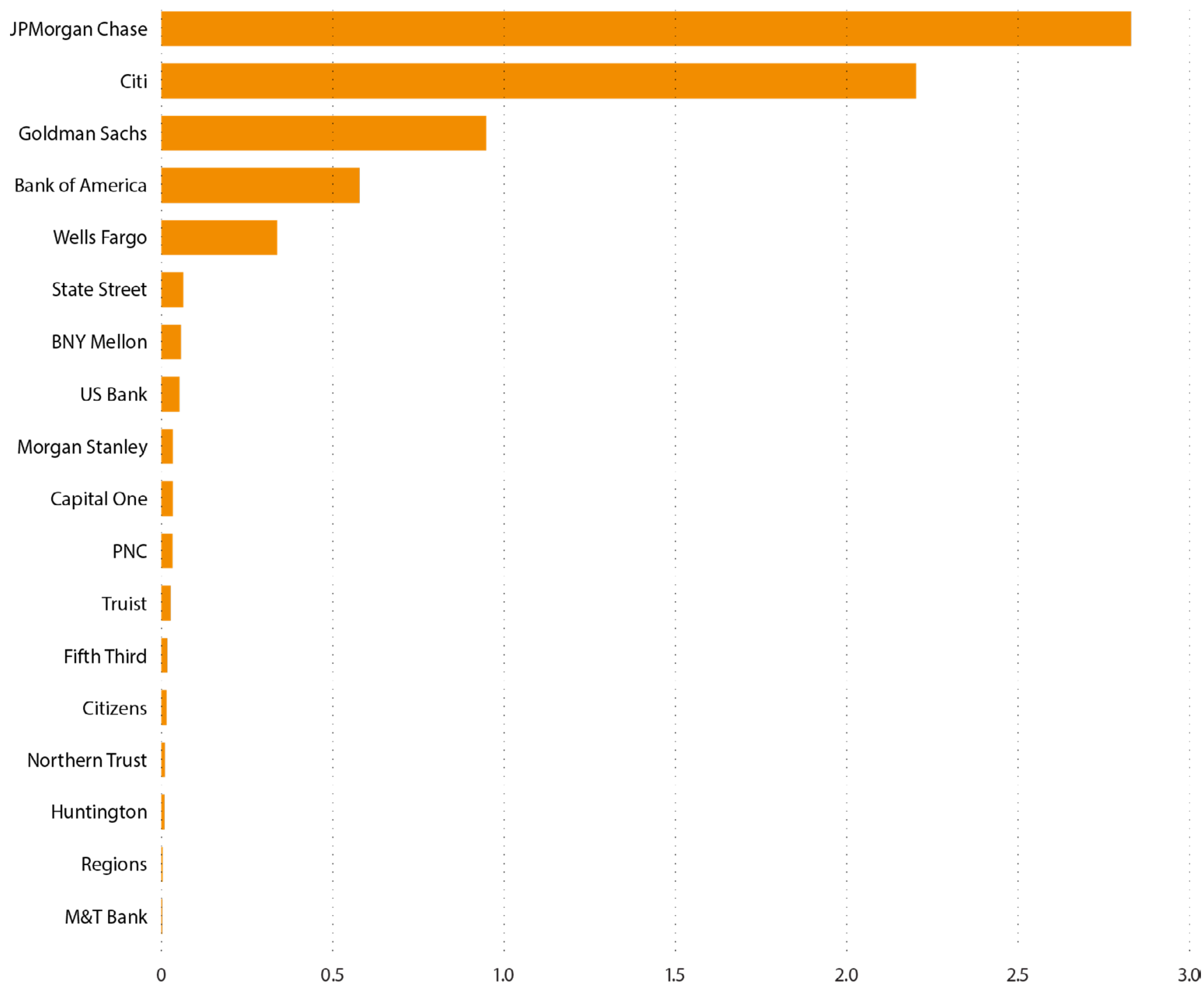


Figure 4: Change in CVA of the derivative portfolio with non-financial counterparties for a sample of top 20 U.S. banks in the NGFS disorderly transition scenario. Exposure approximated by total credit exposure. All values in billions.

Two things become clear through this analysis. First, we find that moving from the "business-as-usual" scenario to the NGFS "disorderly transition scenario" results in an increased CVA cost for the set of banks under consideration of $7.3 billion, a modest amount relative to the potential loss of leaving transition and physical climate risks unaddressed. While CVA, like a loan-loss provision, is an expected loss rather than a worst case, making this change now would help to cushion the effect of a worst-case scenario where losses could be several times higher. While acknowledging that this is a meaningful cost in absolute terms, we believe the future benefits – from both a risk mitigation and opportunity identification standpoint – will more than offset this initial "investment."

USING CLIENT SELECTION TO REDUCE CVA AND CLIMATE RISK

The results above can be broken down further to show the impact of the sectoral distribution of counterparties on CVA. These results highlight the opportunity to shift the derivative portfolio towards counterparties less exposed to transition risk. Essentially, there are CVA benefits to be earned and CVA risks to be avoided by a bank refocusing its derivatives activity from high- to low-transition risk counterparties. To illustrate this, we simulate two counterfactual disorderly transition scenarios, using the utility sector as an example:

- First, we take the percentage of utility counterparties (3.5%), across the bank syndicated loan portfolio and map that to the total derivatives exposure of non-financial counterparties (i.e., borrowers) which represents approximately 10% of all derivatives exposure.
- For utilities, this results in $3.9 billion of loan equivalent exposure in our derivatives portfolio across the 18 banks studied.
- Within that assumed "utility" subset of each bank's portfolio, we test two additional assumptions about the derivatives counterparties of each bank:
    - Scenario 1 is a "net zero" emissions scenario where all derivative utility counterparties operate only renewable plants.
    - Scenario 2 is a "high GHG" emissions scenario where all derivative utility counterparties operate only coal-fired power plants.

Figure 5 illustrates the results of this CVA scenario analysis at the bank level. The "high GHG" scenario, given the increase in climate risk versus the status quo, increases the probability of default for a fossil fuel-only utility by a very significant 39%. In terms of CVA, this leads to an increase of $1.5 billion for this scenario.

Conversely, moving from today's status quo to a "net zero" scenario results in the probability of default for a fully renewable utility decreasing by 5%. Consequently, in the "net zero" scenario the total CVA associated with the utilities sector is reduced by approximately $200 million.

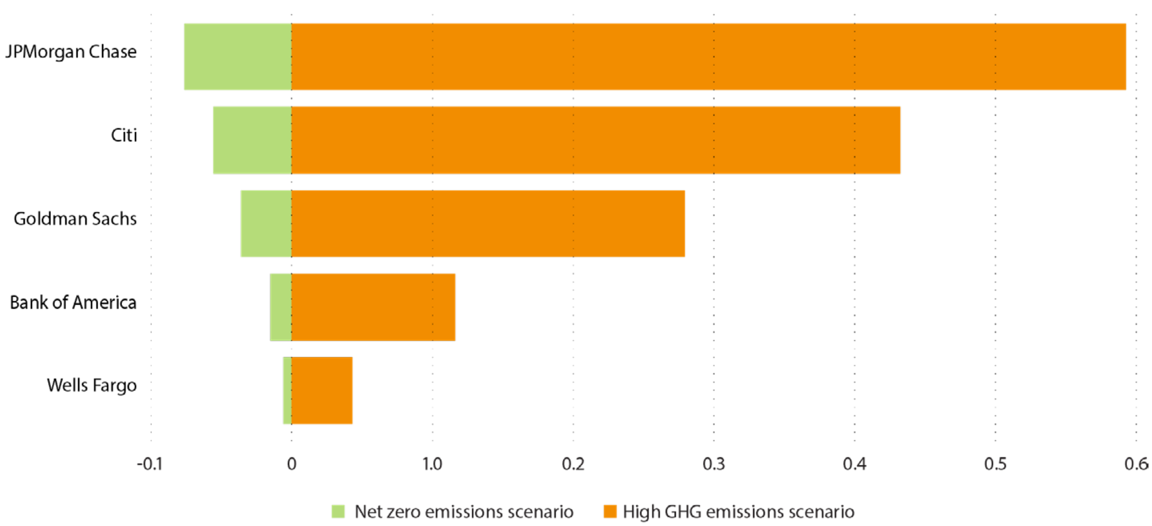


Figure 5: Change in CVA of the derivative portfolio with utility counterparties in two scenarios: the "net zero" scenario in green and the "high GHG" scenario" in orange. All values in billions.

This same analysis could be done for other sectors. Ceres' 2020 banking report shows that a large share of U.S. bank lending is to borrowers in climate policy-relevant sectors. For example, the energy-intensive manufacturing sector (16%), the fossil fuel sector (10%), and the transportation sector (8%) could be analyzed. For reference, the utilities sector highlighted in this example comprises only 3.5% of bank portfolios.

continued next page

From this analysis, we derive three main conclusions:

- Enhancing CVA models for climate risk can provide banks with a competitive advantage in their sustainable finance efforts.
- U.S. banks should undertake similar CVA analysis across their derivatives portfolios to identify opportunities for climate risk mitigation.
- Climate risk and opportunity from derivatives should factor into client selection strategies, given the potential impact.

Additional nuance on how banks should approach enhancing CVA can be gleaned from looking at other scenarios, in addition to business-as-usual and the NGFS disorderly transition scenario. As discussed in our 2020 report, the most methodologically robust approach to pricing in climate risk is a probabilistic assessment of scenarios and the resulting economic outcomes.

For the purposes of this analysis, CLIMAFIN looked at a total of five scenarios developed by the scientific community and disseminated by individual central banks and central bank coalitions, such as the NGFS:

- The NGFS orderly transition scenario, which corresponds to an early, ambitious pivot to a net zero carbon emissions economy.
- The NGFS disorderly transition scenario, which corresponds to climate action that is late, disruptive, sudden, or unanticipated.
- The core impact scenario of **Ceres' 2020 report**, which is a worst-case version of a disorderly transition scenario in the fossil-fuel and utility sectors only.
- The wide impact scenario from the same 2020 Ceres report, which is a worst-case version of a disorderly transition scenario for all non-financial, climate-relevant sectors (including energy-intensive manufacturing, buildings, transportation, and agriculture).
- The Bank of England scenario, where sectoral losses are inferred from the Bank of England 2019 stress-testing scenario. This scenario was also used in the Ceres 2020 report.

The impact on bank CVA (looking at the entire derivatives book) for each of these scenarios can be seen in Figure 6. While Ceres recommends that banks use a basket of credible scenarios when incorporating climate risk into any analysis, the specific scenarios used can vary bank to bank (although it should certainly include any scenarios used in the bank's current climate scenario analysis exercise and target setting, if applicable)

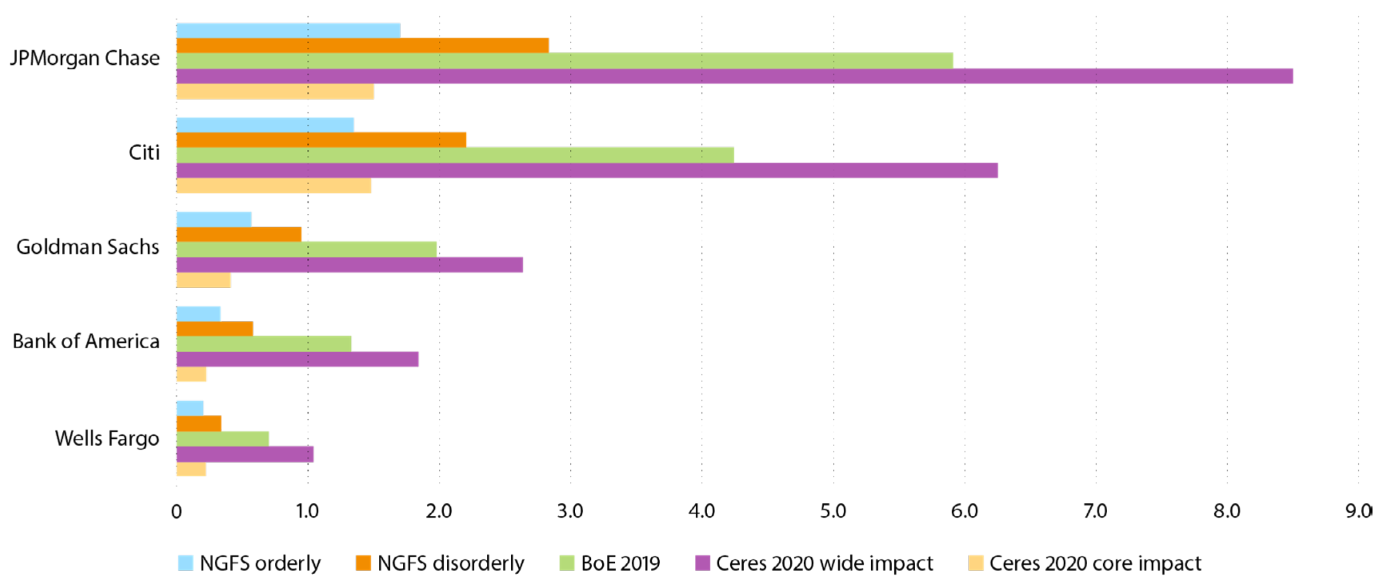


Figure 6: Change in CVA of the derivative portfolio with non-financial counterparties for a sample of U.S. banks for a range of climate scenarios. All values in billions.

Physical and Transition Risk Drivers of Market Risk

As described above, market risk from derivative transactions is the risk caused by changes in the value of the underlying market. For U.S. dollar interest rate swaps, this would be driven by changes in the underlying U.S. Treasury bond market, among other factors. Climate-related financial risk can translate into market risk insofar as it impacts the price (and other key market characteristics) of these underlying markets.

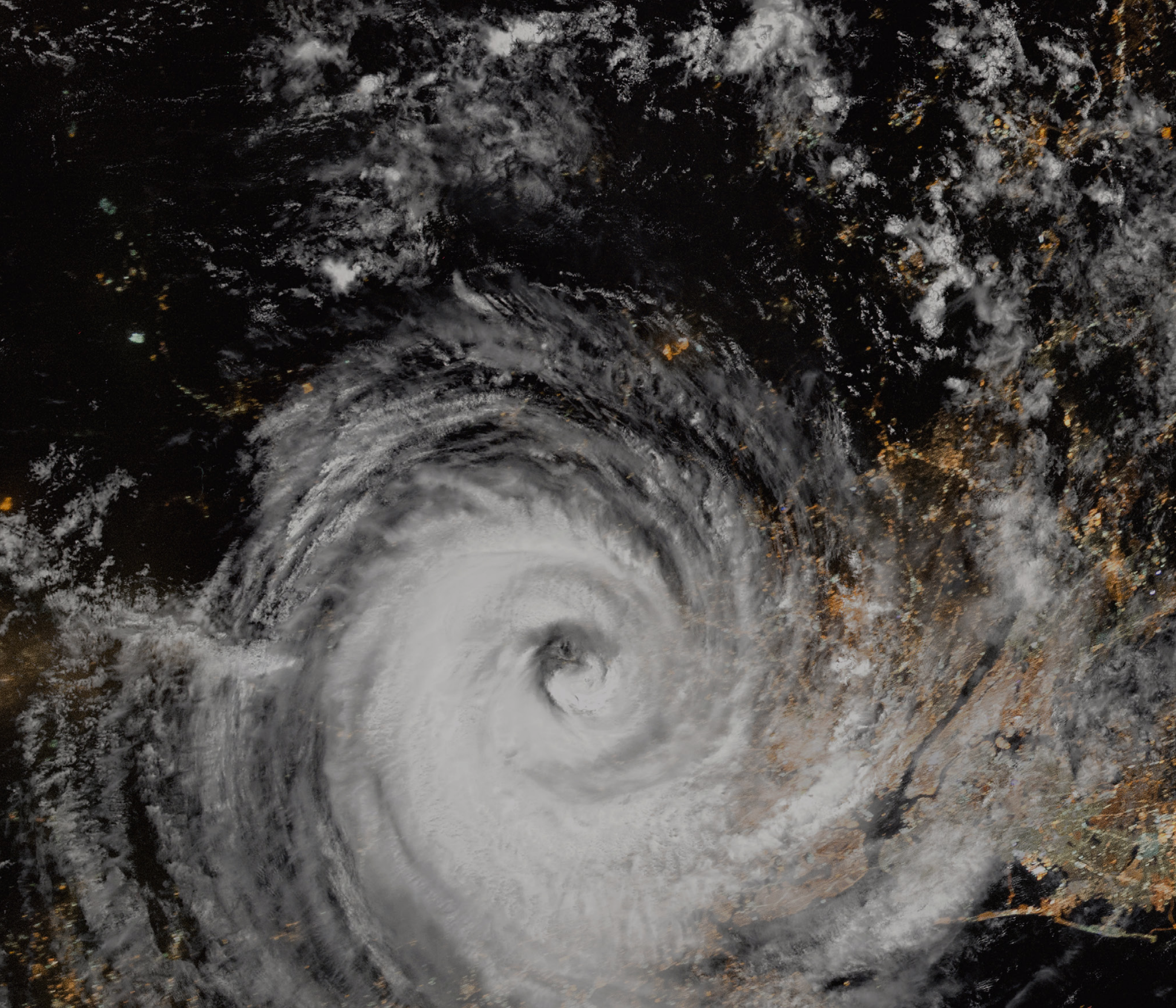
For example, recent research by MSCI shows that transition risk could negatively impact the sovereign bond yields of highly industrialized economies such as the U.S., Germany, Japan, the U.K., and China, due in part to decarbonization-related inflation (e.g., "greenflation") and GDP impacts. Transition risk is also extremely relevant for derivatives activity with certain emerging markets sovereigns, such as those that depend on the economic performance of the fossil fuel industry (or any other climate policy relevant sector) for a substantial share of its GDP or tax revenues.

The activities described above (in the section on credit risk mitigation) will also have effects on market risk. However, further exploration of this topic is beyond the scope of this report.

CLIMATE TRANSITION RISK FOR PHYSICALLY-SETTLED DERIVATIVES

For the sake of accessibility and to keep the focus squarely on climate risk management, we have limited the scope of this report to OTC derivatives that are financially settled (i.e., all contracts are settled with cash payments based on movements in the underlying assets - there is no option for receiving the actual underlying itself as settlement). However, it is worth noting that certain types of bank-provided derivative instruments can be physically settled. For example, an energy commodity derivative based on crude oil (or natural gas), where the bank borrower could actually receive delivery of the physical energy commodity from the bank upon settlement of the contract (i.e., the bank delivers crude oil or natural gas to the borrower for industrial usage).

Although detailed discussion of the implications of physically-settled derivatives is outside of the scope of this report, when the underlying transaction involves high-GHG emitting commodities, this business line will result in a higher level of transition risk and may require different financed emissions calculations than described elsewhere in this report. For example, LERs for these kinds of transactions can be as high as 100%. Physically settled derivatives may also need to be accounted for differently in scope 3 emissions calculations, as they may be part of category 3 (fuel- and energy-related activities not included in scope 1 or scope 2) or category 11 (use of sold products) rather than category 15 (investments), depending on the details of the transaction.



CHAPTER THREE

Mitigating Climate Risk in Derivatives Portfolios

KEY
Takeaway

Derivatives could serve as an amplifier of climate risk at a systemic level, given that bank counterparties across lending and derivatives often significantly overlap. In the case of a "climate shock" where assets are rapidly revalued, losses from loans, derivatives, and other asset classes could be highly correlated, resulting in potentially increased systemic risk, as well as risk to individual banks.

The global derivatives market is extremely large and systemically important. OTC derivatives dominate the market. The notional amount of global OTC derivatives outstanding at the end of December 2021 amounts to $600 trillion. Exchange traded derivatives accounted for an additional $79 trillion.

For U.S. banks, a review of derivatives exposure is performed quarterly by the Office of the Comptroller of the Currency (OCC). Key figures for Q1 2022 are reported in Figure 7 below. Based on this most recent data, the total derivative notional outstanding for U.S. banks is close to $200 trillion. In terms of relative importance, the interest rate segment is, and continues to be, the dominant contract-type (See Figure 7). Overall, interest rate swaps account for over 70% of the notional amount of derivative contracts transacted by U.S. banks. Around 60% of the exposure is short term (less than a year), 26% is mid term (between one and five years) and 14% is long term (more than five years). So, although the majority of the exposure is short term, there is still significant mid- and long-term exposure as well. This mid- and long-term exposure is particularly susceptible to the risks associated with climate change.

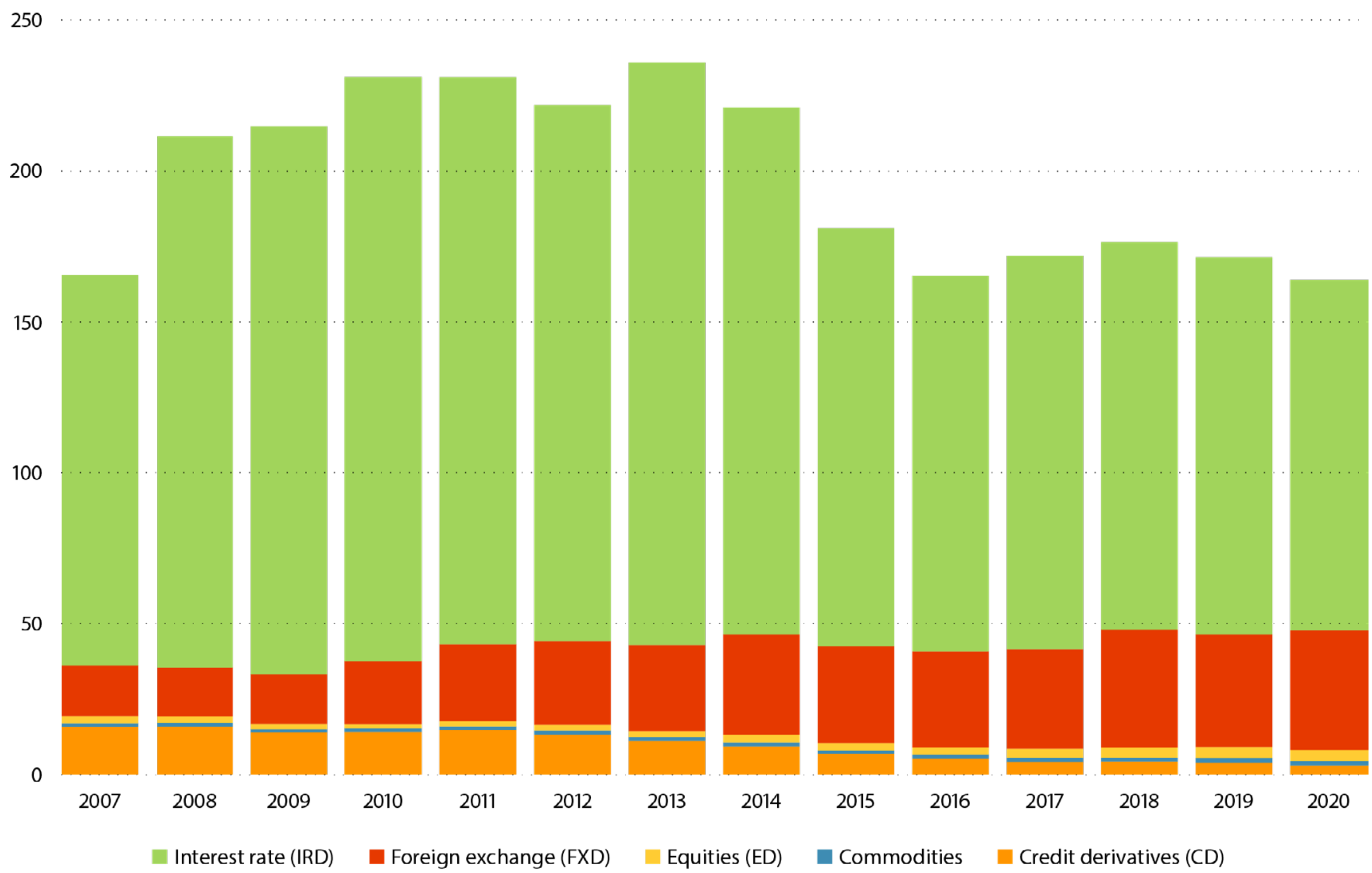


Figure 7: OCC Quarterly Report on Bank Trading and Derivatives Activities, First Quarter 2022, figure 9, page 33.

This market is also highly concentrated in terms of bank providers. Although many U.S. banks provide derivative risk management products to their borrowers, based on OCC data from the first quarter of 2022, the top 25 U.S. banks command over 99% of the marketplace. And it should be noted that the concentration increases considerably as you approach the top market makers. For example, the top five U.S. derivative banks hold about 95% of the OTC notional amount and the top three U.S. derivative banks have a lock on over 75% of the market.

Bank	Total Derivatives Notional	Total Percentage Share
JPMorgan Chase	$60.3T	30.08%
Goldman Sachs	$49.8T	24.83%
Citi	$45.7T	22.83%
Bank of America	$22.5T	11.22%
Wells Fargo	$11.8T	5.90%
Total	**$190.1T**	**94.86%**

Top 25 Banks	$199.3T
Top 5 Share	94.86%
Top 3 Share	77.74%

Figure 8: OCC Quarterly Report on Bank Trading and Derivatives Activities, First Quarter 2022, table 13, page 18.

From the perspective of systemic risk, the combination of the size of the derivatives market and the concentration of exposure in a very few large banks makes this business line quite different from lending, which is highly fragmented and spread across many financial institutions.

- Loans and other bank services are areas of fierce competition between banks and sophisticated actors known as non-bank financial intermediaries, or NBFIs. (Non-bank financial intermediaries, sometimes referred to as "shadow banks," include credit hedge funds, reinsurance companies, and sovereign wealth funds.)

- However, NBFIs do not typically provide derivatives to corporate borrowers, meaning that efforts by banks to address climate risk in their derivatives portfolios are less likely to simply shift the risk to less-regulated parts of the financial system, such as NBFIs. This is one factor that makes the climate risk of derivatives easier to address than that of loans or capital markets activity.

Nonetheless, because they take place in a large and highly concentrated market composed of very complex products that have valuations that can be highly correlated with each other, with other bank revenue, and with the value of assets in the real-economy, derivative transactions could inadvertently increase climate-related transition risk within the financial system—as they have with market risks during previous financial crises.

In fact, derivatives played a key role in the emergence and the propagation of the 2008 financial crisis. As Professor Michael Greenberger, the former Director of Trading and Markets at the Commodities Futures Trading Commission (CFTC), explained in his testimony in 2010 to the Financial Crisis Inquiry Commission, which examined the causes of the 2008 financial crisis:

> *"It is now almost universally accepted that the unregulated multi-trillion dollar OTC CDS [Credit Default Swap, a type of derivative contract] market helped foment a mortgage crisis, then a credit crisis, and finally a once-in-a-century systemic financial crisis that, but for huge U.S. taxpayer interventions, would have in the fall of 2008 led the world economy into a devastating Depression."*

In concert with high systemic concentrations of risk, the increased systemic interconnectedness, partly brought about from significant derivatives usage, put several systemically important U.S. financial institutions at high risk of insolvency. The resolution of this crisis in an "orderly" manner was only possible through massive injections of public money into the financial system. In response to this, these institutions now carry the regulatory designation of "global systemically important banks" (or G-SIBs) and this highly complex problem of financial interconnectedness is commonly referred to as being "too big to fail."

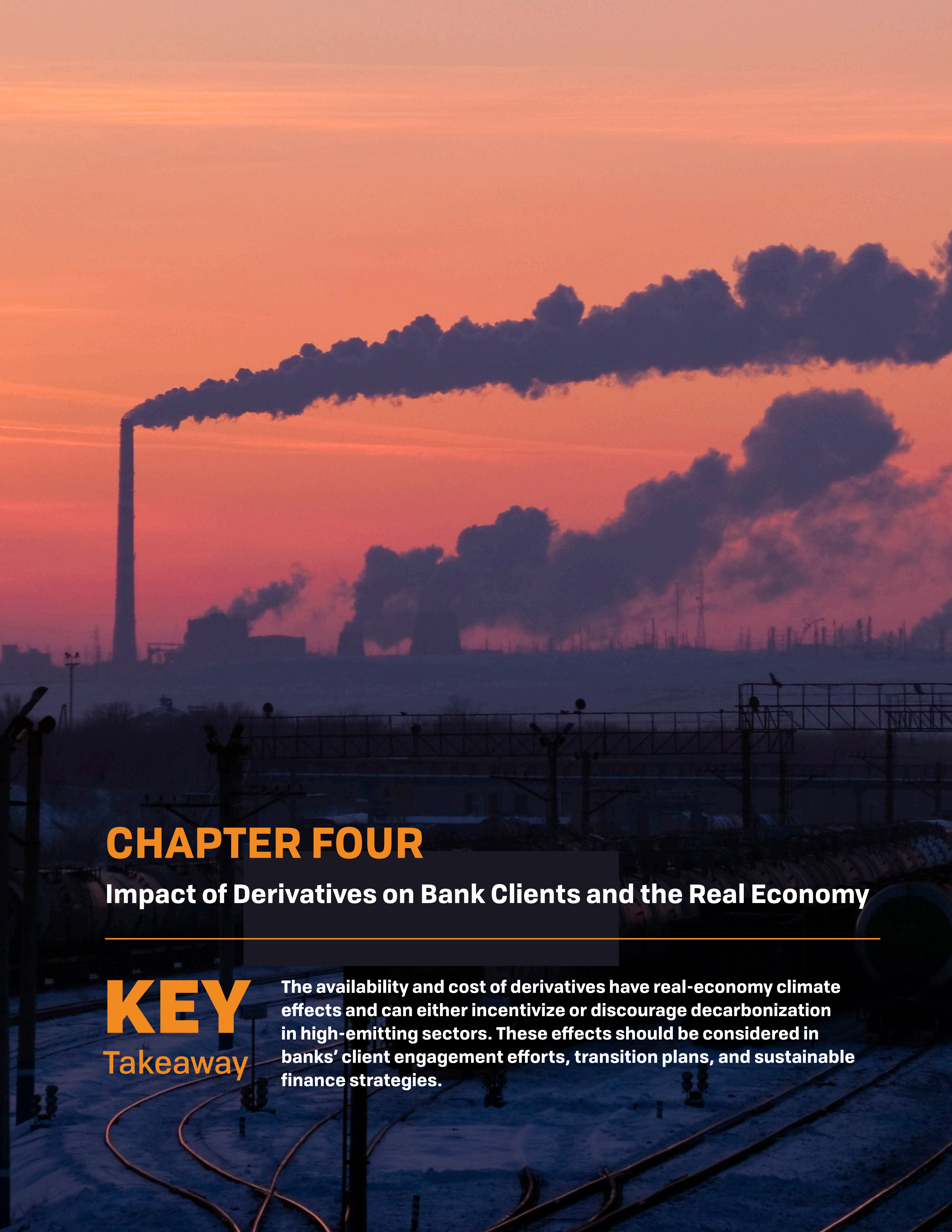
Given the systemic importance of the global OTC derivative markets, regulations were strengthened in the wake of the 2008 financial crisis. In the U.S., the Dodd-Frank Act requires increased reporting and registration for derivatives activity. Similarly, the E.U. Markets in Financial Instruments Directive (MiFID) strengthened derivatives regulation across a number of dimensions: reporting and recordkeeping of derivative transactions, margin requirements, risk-capital requirements, position limits, and mandatory clearing.

This increased regulation means that derivatives are unlikely to be the primary cause of a climate-related financial crisis. However, they could exacerbate a crisis that starts elsewhere, especially given the overlapping nature of banks' derivatives portfolios with their loan books. Ceres' 2020 report found that a sudden change in investor expectations on climate could trigger a systemic shock where assets are rapidly revalued due to changes in default probabilities across banks' loan books. In such a scenario, the initial revaluation of high-carbon assets in the real economy spreads throughout the financial system by means of "secondary shocks." This is because most financial transactions are between financial institutions, rather than between a financial firm and a non-financial company. Changes in default probabilities of bank clients could change the probability that a bank itself could default, affecting the value of all deals which that bank is a counterparty to, including derivatives transactions.

While a disorderly transition spiraling out of control in this way is a worst-case scenario, it could be made more likely if the risk in banks' loan books is compounded by credit risk in the derivatives portfolio. The worst-case scenario in our 2020 report saw double-digit percentage losses in banks' loan portfolios compounded by secondary shocks that added several additional percentage points of losses. Loans alone have the potential to cause a crisis that looks disturbingly like 2008 in such a scenario, but any additional asset classes that are large and correlated to the loan book (like derivatives) could increase the probability of such a scenario. While loans should be the first focus for banks when it comes to systemic risk, derivatives should be a strong second focus, given the correlated nature of the risks.

The current U.S. regulatory framework does not directly address climate risk for derivatives, nor does it provide a "hedge" against the strongly correlated shocks on market valuations that could occur in the context of a disorderly transition to a net zero emissions economy. Although state and federal financial regulators require banks to identify and mitigate material risks, currently no U.S. prudential regulator requires the use of climate scenario analysis to properly measure such exposures. To correct this, **banks should proactively advocate for smart financial regulations and policy actions in support of enhanced climate risk management of their derivatives activities**.

This action is especially important given the strong signals the marketplace is receiving from federal bank regulators. In a September 2022 speech, the newly installed Vice Chair of the Federal Reserve Michael Barr explained the Fed's updated climate plan, saying that "next year we plan to launch a pilot micro-prudential scenario analysis exercise to better assess the long-term, climate-related financial risks facing the largest institutions." Additionally, the OCC and FDIC have identified the importance of climate scenario analysis (as mentioned in the OCC's Principles for Climate-Related Financial Risk Management for Large Banks and the FDIC's Principles for Climate-Related Financial Risk Management for Large Financial Institutions which Ceres has submitted comments on). However, to date, regulators have been silent on whether derivatives will be included as part of this analysis, creating an opportunity for banks to advocate proactively for their inclusion in a way that makes sense for their stakeholders.



CHAPTER FOUR

Impact of Derivatives on Bank Clients and the Real Economy

KEY
Takeaway

The availability and cost of derivatives have real-economy climate effects and can either incentivize or discourage decarbonization in high-emitting sectors. These effects should be considered in banks' client engagement efforts, transition plans, and sustainable finance strategies.

Deloitte estimates that the cost of inaction on climate change could reach as high as $178 trillion over the next 50 years. Without immediate action, the extreme weather, from the record-breaking heat waves to nearly nonstop wildfire seasons that we are now witnessing will be a preview of a business-as-usual future. With this in mind, banks must double down on leading the changes needed for real-economy decarbonization in order to protect their stakeholders – including investors, borrowers, and employees – as well as the global financial system itself.

To understand how the risks outlined in this report could manifest in the real economy, it is important to understand how derivative contracts are typically used. Banks regularly enter into derivative contracts with their lending clients to mitigate a borrower's exposure to market risk - from interest rates, credit market, equity market, and even energy market risks. These bespoke contracts are employed by borrowers to reduce the financial risks associated with their operations and financing strategies.

Like loans, derivative transactions can contribute to the financing of high-GHG emitting corporations by de-risking the underlying financing activity. For example, in our earlier hypothetical example (see page 10: Overview of an Interest Rate Swap Derivative), without access to an interest rate swap as a risk management tool for the underlying loan, our borrower might not have been able to secure this financing (at all or at the same cost). That makes derivatives a key part of a bank financing package and another potential source of climate risk. This is the main channel through which derivatives impact the real economy.

And, while the focus of this report is on risk, the broader concept of climate alignment should be considered when evaluating the impact of derivatives on the real economy. Ceres partner RMI describes climate alignment "as actively pursuing climate objectives by bringing a firm's portfolio emissions in line with 1.5°C temperature targets, which requires retiring high-carbon assets and scaling up low-carbon assets." Thinking in terms of alignment and not just risk allows banks to think about the opportunity side of the climate equation, along with the need for holistic sectoral transition plans that can be used to guide clients through the transition and increase the likelihood of positive climate outcomes for broader society.

On the opportunity side, banks can support sustainability projects and capitalize on new revenue generation opportunities by de-risking energy transition and climate adaptation investments. The market for these investments is massive: it reached $755 billion in 2021 and must increase three- to five-fold in order to keep pace with climate objectives. However, Ceres interviews indicate that many banks perceive a lack of investable opportunities in the sustainable finance market, particularly in developed countries. Much of the investment required to transition the economy to a low-carbon pathway will be made by companies that are currently involved in high-carbon sectors, rather than by new firms using only sustainable technologies. This has led to a major emphasis in recent months on banks developing sector- and client-specific transition plans in cooperation with the relevant firms. The Climate Safe Lending Network has published the leading research on what these transition plans should look like, and GFANZ is currently working on additional guidance that could be helpful to banks.

In terms of transition plans, derivatives can be leveraged in the same way loans can. As risk transfer mechanisms, derivatives can help encourage (or discourage) types of economic activity that affect the pace and scale of the energy transition. In fact, some banks are already developing sustainability-linked derivatives that pay out differently as sustainability KPIs are achieved. As banks work with their clients to develop transition plans, they should consider how ISDA agreements (and other documentation, such as loan covenants related to derivative transactions) could be used to support bank sustainability goals and real-economy decarbonization.

Another possible role for derivatives in transition plans is in helping to de-risk sustainable projects in developing countries, where the vast majority of investable opportunities currently lie. Many of these projects are not pursued due to various emerging market risks that increase the cost of capital to a point where the project is no longer economically viable. Once bank CVA risk models are enhanced to include climate factors, opportunities could be identified where U.S. banks could provide derivative products that otherwise would not be available in these markets on top of loans that could be provided by local lenders. This could help provide cash flow certainty to those sustainable finance projects and increase the likelihood of them being built.

Overall, banks need to build derivatives into transition plans by applying the same client selection process to derivatives clients as they would to borrowers. In Ceres' 2021 research on transition planning, we proposed that banks move through a three-stage process of climate risk evaluation and client engagement leading up to 2030.

1. In the first phase, the bank would assess the climate risk (and financed emissions) of each sector / client and evaluate any transition strategy currently in place. The analog for derivatives is building climate risk into CVA (as described in Chapter 2) and ensuring that derivatives are appropriately accounted for in financed emissions calculations (see Chapter 5).

2. In the second phase, banks engage with clients who don't yet have transition plans and determine their willingness to work with the bank to develop such a plan. It is at this stage that the bank provides incentives to the client to facilitate a faster transition. The link to derivatives at this stage is through the sustainability-linked derivative products described above. Client costs would begin to increase (or decrease) depending on the lender's climate targets and sectoral KPIs.

3. In the final stage, banks assess any clients who are unable or unwilling to transition and evaluate whether a divestment strategy is appropriate. A similar approach would be needed for the derivatives business, as it would not make sense (philosophically or practically) for a bank to continue providing derivatives to a client while moving away from bank debt financing for the same firm.

It is very possible that there are additional strategies banks could employ that would leverage their derivatives businesses to accelerate decarbonization in the real economy, and the firms that proactively develop those strategies have the potential to capture significant opportunity. At a minimum, however, banks should consider how existing derivatives business impacts the pace and scale of decarbonization in the real economy and their own climate alignment, and take that into account when developing sectoral transition strategies.

CHAPTER FIVE

Derivatives, Target Setting, and Portfolio Alignment

KEY Takeaway

Derivatives should be incorporated into banks' climate target setting. Actionable and practical reporting solutions for derivatives already exist. Whether banks are setting targets to reduce financed emissions or using the forward-looking portfolio alignment tools recommended by TCFD and GFANZ, derivatives belong in the conversation. Targets and transition plans which do not include derivatives would be missing a material source of transition risk.

While climate alignment is fundamentally about how bank activities affect the real economy, banks' target setting and mitigation efforts should focus on the elements of alignment that banks can control. These elements include:

1. The financial activities the bank is involved in.
2. The clients the bank chooses to work with.
3. The pricing and incentives built into bank financing activities.
4. The purpose of the financing activity (generally profit, but also can include economic development, community investment, financial inclusion and/or the managed phase-out of high-emitting assets).

Since the release of the TCFD disclosure guidelines in 2017, there has been a tremendous amount of work done on measuring the alignment of financial activities with climate goals. While no single measure captures the complexity of what it means for a financial institution to be climate aligned, in aggregate these measures have developed to the point where they are meaningful performance indicators. Investors and other stakeholders use these measures as proxies for transition risk (in the absence of publicly disclosed value-at-risk measures or other direct indicators of risk) and banks' transition plans are typically built around one or more portfolio alignment goals.

GFANZ highlights four types of portfolio alignment metrics which can generally be calculated via two types of data that banks are already gathering: backward-looking data (e.g., carbon accounting using PCAF) and forward-looking information (e.g., clients' emissions targets). While forward-looking information is generally preferred for portfolio alignment calculations, it is by nature less accurate, so both kinds of data are regularly used. The most common portfolio alignment metric used by banks today is the comparison of banks' financed emissions to a scenario-based benchmark, a type of "benchmark-divergence" metric. The Science Based Targets initiative also has methodologies for banks to use binary metrics on the percentage of the portfolio covered by verified emissions reduction targets and an Implied Temperature Rise metric, although very few banks have chosen to use these metrics so far. To provide an effective basis for comparison and a comprehensive measure of alignment, both forward- and backward-looking alignment data must account for all the products and services that are material to the bank.

While the current initial focus of portfolio alignment metrics is rightly on commercial lending, derivatives should be a key priority for the largest banks once their lending books are well understood. Broadly speaking, when banks lend to corporate borrowers, they:

1. Act as principals
2. Lend their own capital
3. Retain the credit risk arising from exposure to the borrower under the loan

In addition to creating risk for banks, these characteristics create relationship leverage with the borrower, as the bank loans are financing the business-as-usual activity that produces real-economy GHG emissions. The same is true for derivatives. **Because banks act as principals in derivative transactions with corporate borrowers** (**i.e., they use their own capital and retain the credit risk associated with the borrower**), **we recommend that derivatives be included in portfolio alignment metrics and financed emissions.** And while we understand that most derivatives do not provide a borrower with financing in the conventional sense, certain types of derivatives, such as interest rate swaps, can generate initial funding benefits for the counterparty receiving the fixed-rate (which is eventually repaid over time) and other types of derivatives, such as pre-paid commodity forwards, do generate actual upfront financing.

This is in stark contrast to other non-lending activities that have received much greater attention when it comes to climate. For instance, banks can also help finance companies through the public capital markets. Here they act as arrangers, working with institutional investors to raise capital for borrowers in the form of bond market debt or equity (for example, via an IPO or secondary stock sale in the public equity markets). Unlike principal lending however, in these capital markets transactions, the banks do not lend their own money or retain any of the credit risk. The value the banks provide is via the professional service of advising and arranging the financing by bringing the borrower (or "issuer") together with interested investors. Banks are only facilitating these transactions and not actually providing the financing themselves. Thus they have much less leverage over the use of proceeds, and limited ability to control pricing or incentives. **Therefore, while portfolio alignment efforts should prioritize lending, derivatives should be prioritized for inclusion ahead of activities where a bank acts only as a facilitator.**

As mentioned earlier, unlike investment banking and other capital markets activities, there already exists an actionable and practical solution to include derivatives activity in portfolio alignment calculations in the form of a bank's own loan equivalent risk (LER) metric.

In addition to being a useful measure of risk that allows banks to aggregate both loan and derivative exposures at the client portfolio level, the LER calculation outlined in Chapter 1 can be used to integrate banks' derivatives activity into portfolio alignment metrics. While LER is certainly not the only option (historical average mark-to-market (MTM) credit exposure over the past year is even simpler to calculate), Ceres believes LER is a useful metric for the following reasons:

- Generally speaking, investors are using portfolio alignment metrics as a proxy for transition risk, which is better reflected by the forward-looking LER metric than by historical measures, such as observed mark-to-market exposure.
- The methodology for calculating LER is similar across banks.
- Since it represents a "worst case mark-to-market exposure" (usually to within two standard deviations of confidence), using LER is similar to reporting a loan's committed amount. This is in contrast to using a historical MTM figure, which is more akin to reporting a loan's drawn amount (and which, of course, can fluctuate over time).
- In cases where a bank's net derivatives exposure to a particular borrower is negative (i.e., the bank owes the borrower on a mark-to-market basis), using an historical MTM approach could lead to the creation of "negative derivative-based offsets." This outcome is avoided via use of LER.
- Using LER will enhance transparency and consistency, since a bank's reported metrics will not be as impacted by movements in the markets underlying a derivative. By contrast, using historical MTM would cause a bank's metrics to fluctuate as the associated MTM increased or decreased – independent of any real-economy banking activity.

An example shows how LER could be used to calculate "loan equivalent" exposures from derivatives. As opposed to a loan, which intuitively has an LER of 100%, the LER for a derivative is usually only a fraction of the notional amount. This is because it is only the difference in interest rate amounts on the notional that is owed and not the full principal amount itself (as is the case under a loan). For example, a bank might calculate the LER of a five-year pay-fixed U.S. dollar interest rate swap (used to hedge the floating interest rate risk of a loan) as 1%. In practical terms, this means the exposure under the derivative is equivalent to only 1% of the principal exposure of the associated loan.

Continuing with this example for the calculation of "loan equivalent" exposure, the following basic formula can be used to calculate the total amount of financing that would be included in portfolio alignment calculations:

Derivatives Financing = Loan Equivalent Risk x Notional Principal Amount of Derivative

So, if the bank provided its borrower with a five-year floating rate loan and a five-year interest rate swap (to hedge the loan into a fixed rate), calculating the associated LER at 1%, the total exposure from financing would be calculated as:

Derivatives Financing = 1% x Notional Principal Amount of Derivative (100%)

+

Loan Financing = 100%

Total Exposure from Financing = 101%

Target Setting

The inclusion of derivatives in portfolio alignment metrics should flow through into the climate targets that the largest banks are in the process of setting. Targets and transition plans which do not include derivatives are missing a material piece of the puzzle. Since most bank targets are currently set based on financed emissions, Ceres recommends banks work with PCAF to develop a methodology to include them in those calculations (see box beginning on page 34). As banks begin to publish targets based on forward-looking metrics, derivatives should be included there as well.

Investors also expect derivatives to be included in target setting. Ceres partner IIGCC has recently published the first comprehensive benchmarking framework for global banks, which consolidates investor expectations for the sector. Investors in the Ceres and IIGCC networks represent tens of trillions of dollars of assets under management and the IIGCC expectations are very clear that all material asset classes must be included in banks' target setting, which for the largest U.S. banks unquestionably includes derivatives.

The NZBA target-setting guidance, which most banks are currently using, does not mention derivatives directly. Ceres recommends that banks involved with NZBA endeavor to include derivatives in the next iteration of NZBA's target-setting guidance. Regardless of whether a bank uses NZBA guidance to set its targets, most target-setting methodologies can be readily adapted to include LER-adjusted derivative amounts in the baseline. Adding derivatives, while keeping the stringency of the targets the same, would not necessarily have a major strategic impact. But it could affect the relative importance of certain sectors and geographies. Within sectors it could put even greater emphasis on the banks' relationships with their largest clients (since those clients are more likely to have derivatives in place with that bank).

Ceres' analysis suggests that the role of derivatives in bank-client relationships and in the financial system broadly makes it even more important that banks' unit of analysis for its climate targets is the client relationship, rather than an individual deal or financial instrument. Part of this enhanced target-setting effort will require additional capacity building and internal education for the front-office markets division staff responsible for marketing, trading, and structuring derivative transactions with bank borrowers. Likewise, communicating to borrowers that going-forward client engagement will include derivatives activity as an in-scope activity is also important. Finally, from a governance perspective, banks should include the climate impact from derivatives activity (positive or negative) as a key performance indicator that flows through to their management and board compensation plans. Only through a comprehensive revision to target setting and client engagement can effective transition plans be developed that will help banks achieve their targets and maximize the pace of real-economy emissions reductions.

DERIVATIVES AND BANK FINANCED EMISSIONS

Financial institutions are an important example of an industry where scope 3 emissions (the emissions linked to the value chain of a company's products or services as a whole) dominate relative to other emission types. Typically, **banks have comparatively few scope 1 and 2 emissions** (the direct emissions from operations and indirect emissions generated by the company that provides energy to a company).

However, GHG emissions associated with bank lending are more than **700 times** higher than a financial institution's direct emissions. This is because banks are financing all sectors of the economy, and since that economic activity is dependent on the availability of financing, a portion of emissions from every sector are attributable to banks.

Through the use of carbon accounting frameworks (such as **PCAF**) and standards (such as the **GHG Protocol**), banks can calculate the GHG emissions that result from their financial activity, called financed emissions. While many banks have not yet published financed emissions numbers, the PCAF methodology allows them to be estimated using publicly available emissions factors. What these preliminary calculations find is that bank financed emissions are among the **largest contributors** to climate change (see Figure 7 next page). Fortunately, it also means that bank action on climate can reverberate throughout all sectors of the economy, potentially accelerating decarbonization across almost every sector.

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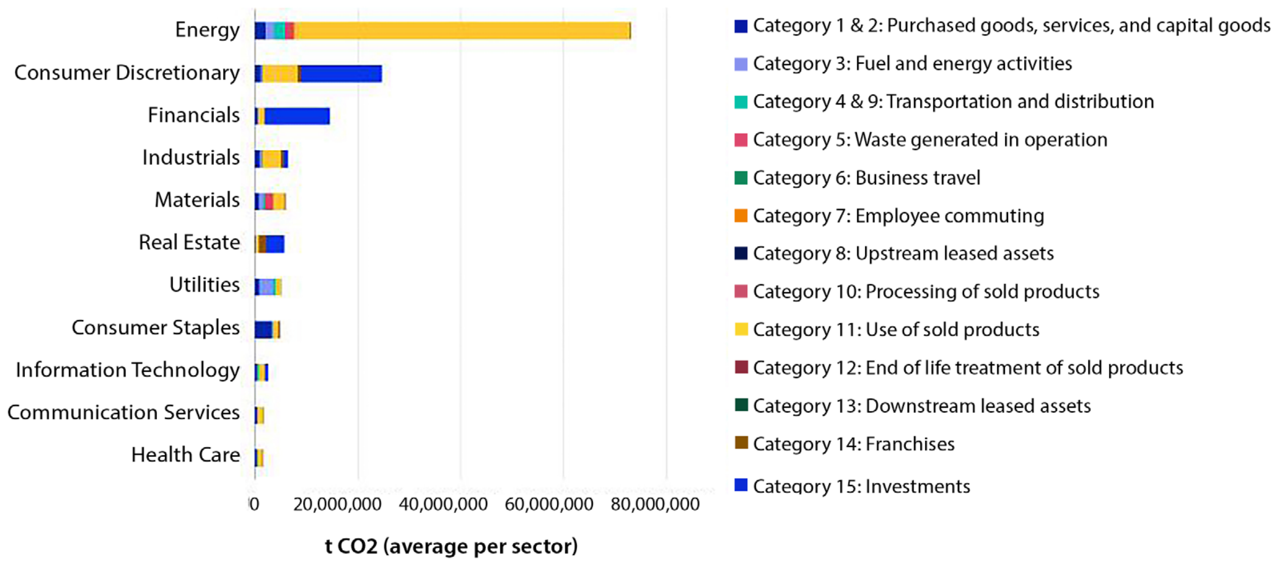

Figure 9: Financial institutions rank third for scope 3 emissions. Source: MSCI ESG Research LLC.

Currently, derivatives activity is not covered in the PCAF financed emissions **methodology**. Nor is it a focus in the newly created category of "facilitated emissions," according to a recent PCAF **white paper**. Given the findings in this report about how derivatives contribute to bank climate risk and impact emissions reduction efforts in the real economy, Ceres recommends that PCAF consider developing a methodology to account for derivatives as financed emissions in the immediate future. PCAF is the recognized standard for carbon accounting by financial institutions and banks need to converge around a common approach to this issue, which PCAF is best positioned to develop. Sector-specific reporting frameworks should also be updated to include derivatives.

While current financed emissions efforts by banks are appropriately focused on lending, PCAF and its participating banks should begin to set the groundwork for the inclusion of derivatives in financed emissions over the next few years. Since almost all existing bank targets are based on financed emissions, it is critical that a methodology to include derivatives in financed emissions is developed as soon as possible so banks can begin to align with investor expectations such as the IIGCC benchmark.

One complexity that arises from treating derivatives as financed emissions comes from the fact that under the principles of carbon accounting, financed emissions of non-financial firms are attributed to financial institutions based on the share of financing that the financial institution provides to each non-financial company. In the PCAF standard, the share of financing is typically calculated by apportioning the enterprise value of the firm (total equity plus total debt). One way to add derivatives to this picture would be to adjust this methodology to treat derivatives as an additional source of debt financing (using LER or a backward-looking metric of some kind). Real-economy emissions would then be attributed based on debt, synthetic debt from derivatives, and equity exposures, ensuring that no additional double counting of emissions occurs. IIGCC has also **proposed** methodological alternatives as part of its work with investors.

Including derivatives in the attribution of financed emissions would tend to increase the financed emissions of the largest banks and decrease the financed emissions of all other financial institutions. While this does add some complexity, it appropriately reflects the centrality of the global systemically important banks to the energy transition and gives additional weight to their unique ability to influence the energy transition through their financing and risk management activities.

CHAPTER SIX

Recommendations

On the basis of our analysis, we have developed a series of recommendations for the integration of derivatives in the climate risk management framework of U.S. and international banks.

Recommendations for U.S. and International Banks

1 RECOMMENDATION

Banks should analyze and disclose the contributions of their derivatives portfolios to their overall climate risk and opportunity.

The TCFD recommendations ask companies to disclose their material climate-related risks, their process for managing those risks, and the resilience of the organization's strategy to various climate scenarios. Ceres' analysis suggests that for the largest banks, derivatives may need to be part of this disclosure, as they are significantly affecting overall climate risk for banks, as well as their scope 3 emissions. While specific risk metrics are likely to be proprietary, banks should provide investors with enough information to understand how derivatives might change the climate risk picture and how the bank is planning to use derivatives to capture additional transition-related opportunities.

2 RECOMMENDATION

Default probabilities in bank credit valuation adjustment (CVA) calculations should be updated to incorporate climate risk factors.

To the degree that climate risk from derivatives is not accounted for, portfolio credit risk for the largest U.S. banks will be underestimated, possibly by a significant amount. CVA is one of the most important tools banks possess to help mitigate this risk, by reducing the losses they could face in a crisis situation. Although extremely fine-tuned and sophisticated, most bank CVA models currently do not utilize climate risk factors to adjust the probability of default for derivatives counterparties. Moreover, apart from simply being a risk management exercise, incorporating climate risk factors into CVA could also allow banks to better access and evaluate sustainable finance opportunities. Integrating climate risk into a bank's current CVA model will provide that bank with the ability to calculate higher returns (i.e., positive CVA) for transactions that not only reduce credit and market risk, but also for those deals that reduce a bank's scope 3 GHG emissions or advance other real-economy decarbonization and sustainability goals. In that way, adopting a climate risk-adjusted CVA model is not only a sound risk management practice but good for promoting sustainable finance and the bottom line.

3 RECOMMENDATION

Banks should proactively advocate for smart financial regulations and policy actions in support of enhanced climate risk management of their derivatives activities.

As described in our 2021 report, Financing a Net Zero Economy: The Consequences of Physical Climate Risk for Banks, as part of seizing on adaptation finance as a significant and revenue-generating opportunity for bank lending, banks should also capitalize on the opportunities for adaptation finance-related risk management via derivatives hedging. Without smart policy, however, the scope and scale of the opportunity could be reduced. Banks have a financial interest in promoting regulatory and policy change that ensures the U.S. regulatory framework supports the proper management of the climate risk embedded within their derivative business, while incentivizing the development of new sustainable financing risk management products and services. Doing so will not only reduce the risk for banks and their borrowers, but through the remediation of industrial pollution, will also benefit disadvantaged communities and society more broadly.

4 RECOMMENDATION

Banks should deepen engagement with their borrowers to help them develop transition plans, and should start including derivatives activity in these engagement initiatives.

As mentioned in our previous reports, client engagement only reduces climate risk if it leads to the creation of credible transition plans, target setting, and, ultimately, emissions reductions in support of real-economy decarbonization. Given the significant role that derivatives play in derisking corporate financings, and thus facilitating high-emitting business-as-usual activity, we encourage all banks to begin engaging their clients regarding their OTC derivatives activity immediately. Remember, client engagement should first focus on the most material drivers of financed emissions.

5 RECOMMENDATION

Banks should account for derivative transactions as additional sources of financed emissions and include these in their disclosure of firm-wide total financed emissions.

When used to de-risk a borrower's underlying loan activity, derivatives become both a key part of the bank financing package and a potential additional source of scope 3 emissions, especially when dealing with high-GHG emitting counterparties. Our analysis shows that a bank's derivatives business can be a material source of financed emissions - potentially increasing total financed emissions by as much as two to three times for the largest bank derivatives providers. Furthermore, there already exists a calculation methodology for converting derivative- and loan-based financed emissions into an "apples to apples" comparison for disclosure purposes.

6 RECOMMENDATION

Banks should update their 2030 and 2050 net zero targets to include derivatives exposure.

Bank net zero commitments should incorporate the latest science, use credible climate scenarios, and disclose decarbonization progress on a sector-by-sector basis. To ensure that banks meet their published firm-wide net zero and sectoral decarbonization targets by championing real-economy decarbonization and not through excessive or inadvertent usage of financial engineering, we recommend that banks include their derivatives activities in their net zero goals and interim targets over time (both baseline and progress measurements). This level of transparency is necessary to provide investors, regulators, clients, employees, and other bank stakeholders with an accurate picture of a financial institution's decarbonization progress.

CONCLUSION

Every day, dedicated risk management professionals at U.S. and international banks prudently use derivative hedging products to de-risk the real economy from the naturally occurring foreign exchange, interest rate, credit, equity, and commodity market risks inherent in their borrower's commercial operations. However these very same products can expose banks to additional climate-related financial risk – and, in some cases, can also help perpetuate investment in business-as-usual high-emitting companies and projects.

We hope that the findings of this report will spur banks and their regulators to conduct further internal analysis to understand how derivatives portfolios should fit into net zero plans and other disclosures. While this is complex work and may not proceed quickly, it is critical that it be started as soon as possible. Successfully measuring all bank financed emissions is a first step towards securing a net zero emissions future for all of us.

APPENDIX

CLIMAFIN Methodology Details

The CLIMAFIN methodology provides a transparent and science-based approach to quantitatively assessing and pricing forward-looking climate risks and their characteristics (i.e., deep-uncertainty, non-linearity and endogeneity) in the value of individual financial contracts and investors' portfolios. More specifically, it can embed scenarios of forward-looking climate transition risks provided by climate science and climate economic models in:

- Probabilities of defaults of contracts and securities (i.e., embedding climate risks in financial pricing models for equity holdings, corporate and sovereign bonds);
- Quantitative metrics of financial risks (e.g., Climate VaR, Climate Spread);
- A full-fledged climate stress test rooted in financial network models.

This methodology can answer two questions:

1. How can banks carry out a quantitative assessment of climate transition risks at the individual and systemic financial levels that makes best use of the available scientific knowledge?

2. How to price climate risk characteristics (deep uncertainty, non-linearity, endogeneity) in the probability of default of financial contracts and banks' portfolios, considering counterparty risks?

The major challenges in addressing these questions are related to the nature of climate risks that renders standard finance approaches to risk pricing and valuation inadequate. The CLIMAFIN framework is a quantitative assessment arranged in a workflow of four modules.

Figure 10 shows the interplay of the four modules in the CLIMAFIN workflow.

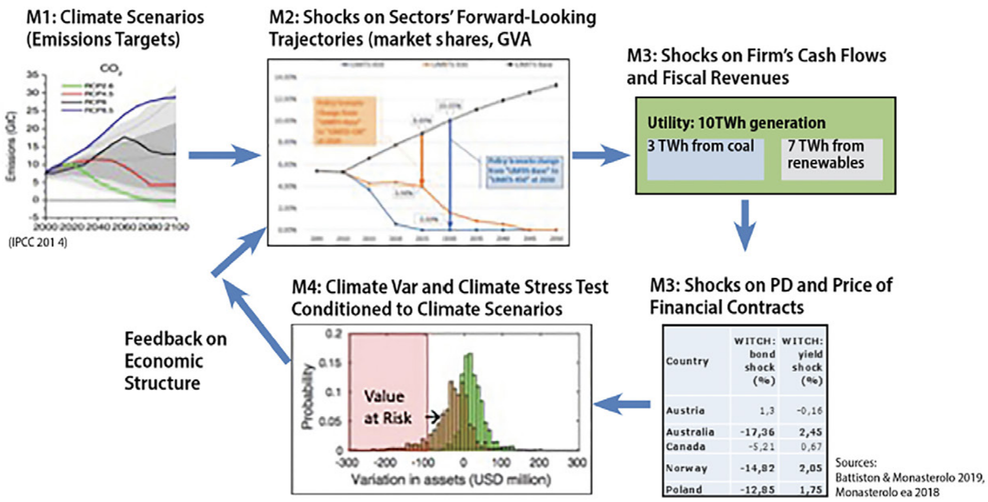

Figure 10: CLIMAFIN climate-financial risk assessment workflow. Module 1 provides the information set combining science-based knowledge and market data to be used in the analysis. Module 2 provides information on the economic shocks (positive and negative) associated with the climate transition scenarios, at the level of economic activity. Modules 3 and 4 provide metrics and methods to measure financial risks and support investment and policy decision making in the transition to a net-zero-carbon economy.

Module 1 gathers and consolidates a database of climate science scenarios and climate transition scenarios, e.g., those provided by the IPCC.

Module 2 uses the information from Module 1 to derive impacts of economic shocks (market share, gross value added) in particular climate scenarios by region and sector of economic activity. Integrated assessment models (IAMs) are used to do this. The core of the feedback mechanism is the following:

1. The forward-looking climate transition scenarios imply a shock on the low-carbon and carbon-intensive economic activities (respectively positive and negative) based on their energy technology (i.e., renewable energy or fossil fuels based).

2. The shock affects the economic activities' output and contribution to gross value added.

It is important to note impacts are measured as differences in sectoral output between the business-as-usual and the climate scenario-conditioned economic trajectories for the same IAM. In particular, the disorderly transition is intended as a temporary out-of-equilibrium shift of the economy between two separate equilibrium trajectories based on the energy technology that drives the transition. This formulation makes the exercise familiar to economists because they are consistent with traditional economic models' rationale. Multiple models and scenarios are used to construct a probability distribution that feeds Module 3.

Module 3 defines the information set of a risk-averse investor or bank who aims to minimize the largest climate-related losses to her portfolio. It defines an information set that can accommodate incomplete information and deep uncertainty and can cover a time-horizon that is relevant both for investment strategies and for the low-carbon transition (from 2020 to 2050). The model carries out a valuation adjustment and a risk adjustment of individual financial contracts, i.e., in their default probability based on the scenarios of economic shocks (by activity and its energy technology) obtained from Module 2. First, the model computes the adjustment on the default probability conditioned to the climate policy shock on firms and individual financial contracts (e.g., equity holdings, corporate and sovereign bonds, loans). Then, it computes the adjustment to key financial risk metrics (e.g., the Climate VaR) for gains and losses at the portfolio level, which represents the worst-case loss for a chosen confidence level, conditional to forward-looking climate policy shock scenario. The Climate Spread is then defined as the change in the spread of a corporate or sovereign bond contract conditional to a given climate policy shock scenario, thus introducing future climate risks in the assessment of firms or countries' financial solvency. Overall, Module 3 takes the outcome of the economic shock on each economic activity and asset, and prices it into the default probability and value of the financial contracts (loans, equity holdings, corporate and sovereign bonds) associated with that activity.

Therefore, conditional on a scenario and on the timing of the shock, losses on a portfolio of loans can be computed using the CLIMAFIN methodology. The methodology provides a linear approximation of the impact of a sectoral economic shock on the default probability of an entity within the sector (see Battiston et al. 2019 for more technical details). The value of a (zero-coupon) loan with nominal value **X** and maturity **T** given a climate policy scenario **s** and a date **t** for the shock is then given by $X_{s,t}$ such that:

$$X_{s,t} = (1 - Q - P_{s,t})\, e^{-rT} X + (1 - LGD)(Q + P_{s,t}) e^{-rT} X$$

where $\boldsymbol{Q}$ is the idiosyncratic (non-climate related) default probability $\boldsymbol{P_{s,t}}$, the climate-induced change in default probability, ***LGD*** the loss-given-default and $\boldsymbol{r}$ the risk-free interest-rate.

In a stress-testing context, worst-case assumptions are made about the timing of the shock and the loss-given-default. Thus, the most prudent/ambiguity averse valuation of the loans is used, i.e., consider $\boldsymbol{X}$ is valued at $min_t\, X_{s,t}$, and assume a loss-given-default ratio of 1. The latter assumption about the loss-given default ratio means that there is zero recovery of debts from clients that default (at least in the short-term). For this to happen, the transition would have to lead to a systemic financial crisis in which financial actors repeatedly and substantially reevaluate the book value of their assets.

In **Module 4**, the information on the repricing of the contracts is used to run the climate stress test. This is rooted in financial valuation in network models and allows assessment of the losses for individual portfolios conditioned to climate scenarios, considering risk amplification and reverberation driven by financial interconnectedness and the implications on systemic financial risks. The financial risk part of the climate stress test consists in translating the macroeconomic shock into shocks on the value of the securities and loans that financial institutions have invested in. The transmission channel works as follows:

1. During a disorderly transition, the firms in the energy sector that have not adapted their business to the climate targets face unanticipated costs and reduced revenues.

2. In contrast, firms that have invested in low-carbon technologies face unanticipated profits via changes in production costs, prices and revenues.

3. Accordingly, the positive/negative shocks on the energy firms are reflected in shocks on the value of the associated financial contracts. The relation between changes in economic output and changes in values of financial investments depends on the type of asset class considered (e.g., equity, sovereign bond, corporate bond, loan), and the valuation approach used.