Identifying and Managing Credit Risk in Climate Risk

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Abstract: Credit risk default resulting from climate risk can be triggered by not only physical disasters, but also policy changes designed to mitigate such disasters. Thus, regulations should be enacted cautiously to avoid large-scale mortgage credit default, as seen in the subprime mortgage crisis. The probability of credit default can be reduced by fully integrating climate risk into regular credit risk practices.

1. Risk Identification

Between 1980 and 2018, greenhouse gas (GHG) emissions have contributed to rapid global temperature increase, and subsequent extreme weather conditions that have led to a total loss of $5.2 trillion.[11] It is projected that global temperature will increase by 1ºC in the next 20 years and ~4ºC by the end of this century.[2] Climate risk is therefore of paramount importance to risk assessment and must be incorporated into standard credit risk models. Climate risk is comprised of two risk types: physical risk and transition risk; in addition, to thoroughly secure their assets, risk managers in financial organizations must be adept at identifying and managing the inherent and residual risks that accompany climate risk.

Inherent risk scores of physical and transition risks are based on geographical anchors and carbon-dependent industry anchors, which lead to both market and credit risks.[3] Physical risks resulting from extreme climate conditions such as hurricanes, sea level rise, flooding, droughts, and extreme wildfires, yield catastrophic disasters that threaten people's lives and assets. The devastating 2005 hurricane Katrina, for example, resulted in over 1,800 casualties, and destruction responsible for $125 billion in losses.[4] Transition risk scores are assessed based on an organization's relationship to external environmental factors, such as fossil fuel reliance or environmentally destructive activities. In addition to organization-led mitigation tactics, public policies and regulations aimed at reducing the threat of physical risks, such as implementing a low-carbon green economy, in turn threaten investments in traditional carbon-based "dirty" industries. A sharp policy change could lead to a "Minsky moment": a sudden collapse of the market and/or zeroing of an asset that may ultimately lead to an economic recession.[2] Both physical risks and transition risks can constrain supply chains, increase borrower costs, and subsequently increase market risks. Physical and transition risks may also generate credit risks when lost asset values from natural disasters or suppression of "dirty" industries cripple previously thriving industries and thus result in credit defaults. Once inherent physical and transition risk scores have been analyzed, and mitigation strategies are developed in response to assessments, residual risks remain and should be scored and combined with inherent risks to create a comprehensive risk analysis. Furthermore, these residual risks may suggest operational risks, including costly changes to an organization's technology, strategy, policy, and reputation.[5]

Several methods can be used to mitigate these risks. First, an in-depth risk analysis in risk management must be performed. Second, risk can be reduced by decreasing investments in natural disaster-prone locations and in "dirty" industry sectors. Third, risk can be transferred to third parties via the purchase of insurance for liable assets. Fourth, rather than mitigate risk, a high-risk strategy to charge borrowers higher interest in natural disaster-prone areas provides an opportunity to capture significantly higher returns, in comparison to more conservative strategies.

Recently, to reduce physical risk and transition risk, environmental risk measurements have been introduced into mortgage credit reports by many European banks.[6.] Banks such as HSBC, Wells Fargo, and BOA, have set net-zero objectives in an effort to reduce global emissions by means reduction and/or offsets. In a pioneering effort, Amalgamated Bank announced it will meet its net-zero goal by 2045, with

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plans to achieve this goal by decreasing traditional mortgage financing by 47% by 2030 and by increasing investments in solar energy and energy efficient programs.[7]

2. Lessons Learned from the Subprime Mortgage Crisis

The Great recession of 2007-2009 was triggered by catastrophic mortgage credit defaults. In the early 2000s, the global economy was experiencing unprecedented growth fueled by cash flow from international markets, specifically the new Asian market, flowing into the T-bill market and real estate market within the U.S. This booming market, combined with low interest and loose regulation emboldened overly optimistic investors to drastically underestimate risks to a devastating degree. In an attempt to capitalize on this, they recklessly invested in higher-risk assets with higher returns, most notably poorly vetted subprime loans that offered higher leverage and interest than that of prime loans. At its height, the subprime loan industry totaled $600 billion and accounted for 20% of new mortgages in 2005–2006. By 2008, a mass credit default of subprime borrowers burst the U.S. housing bubble, taking with it wealthier borrowers, causing a worldwide recession.[8]

Much like the subprime mortgage crisis, the inherent risk of climate change includes a mortgage credit default risk that, on top of natural disasters and sudden disruptive policy remediation, will only deepen economic instability. To manage the credit risk within climate risk, there are several lessons to be learned from the great recession:

1. The risk of global temperature increase must be confronted head-on. The global scientific community argues that a 2 ^{o}C increase from pre-industrial climate will lead to mass, global catastrophic disasters. Though global leaders have announced in the 2015 Paris Agreement to reduce GHG emissions, no clear aim was established.[9] In November 2021, international leaders failed again to make a constructive agreement to control GHG emissions in a UN climate change conference held in Glasgow, UK.[10] Investors thus must be prepared for a +4 ^{o}C increase, or even worse, by the end of the 21st century. The resultant natural disasters and policy changes will likely lead to large-scale mortgage credit defaults.
2. Sound risk management practices must be developed and rigorously adhered to. Eligibility of borrowers must be evaluated with close scrutiny, under well-established rating systems, such as the FICO credit score. Loan amounts should be based on these verified borrower ratings, not by simple trust or reputation. Likewise, rating hazard zones under climate risk should be standardized and integrated with regular risk management procedures.
3. Do not put all of your eggs into one basket: Diversified portfolio investments will reduce unsystematic risk. Rather than to focus on real estate, treasuries and traditional mortgage investors should diversify into a wide range of real, rather than intangible, industries such as the manufacturing industry. Even today's green mortgage investments may tomorrow become environmentally unfriendly, due to the exponential growth rate of technology and unpredictable government policies
4. Lastly, always maintain enough capital to absorb unexpected loss in the case of disaster.

3. Integrating Climate Risk into Risk Management

With its vast uncertainties the probability of climate risk is difficult to assess and must therefore be approached from outside well-established models. However, it is feasible to confine climate risk within the framework of a credit report. For example, some banks integrate environmental risk into standard risk management procedures.[6] Likewise, mortgage credit risk may be combined into the five step credit risk management practice that includes 1) rating, 2) costing, 3) pricing, 4) monitoring, and 5) work-out.

Herein, we use the flood risk of 33 London boroughs in our dashboard to include climate risk management with financial factors in the balance sheet and other environmental factors within each step.[11]

The purpose of rating risk is to explore the probability of borrowers' credit risk default (PD). Climate risk can be evaluated by using different indicators based on a rating of 1-10 of the degree of hazards in different zones. For instance, a Special Flood Hazard Area (SFHA) is classified into different zones based on the flooding probabilities. A flood return period of 100 years (1% annual chance) is marked as the base level.[12] Flood indicators may include water depth, flow peak and/or increased storm surge frequency due to GHG emissions. However, we cannot accurately predict the rate of global temperature increase by using any existing models that ascribe to the complexity of human activities, such as international military engagements or failures to enact global consensus on policy change. It should be noted that as floods become more frequent, borrowers are classified as overrated, based on historical flood volatility. In our dashboard, we assumed three 100-year flood scenarios with 2ºC under GHG control, 4ºC under current GHG emission rate, and an extremely unlikely 7.11 ºC (H++) increase by 2080 following Sayer's report.[13] Lastly, we may integrate this flood risk evaluation with the financial rating to form a final rating system.

During costing analysis , the expected loss in climate risk is estimated through costing based on the equation.

Expected Loss = Expected Annual Damage (EAD) X Probability of Default (PD) X Loss Given Default (LGD).

An estimated EAD is obtained through data modeling of historical flood damage. An estimation of LGD is reached by forecasting damage severity based on a scale of low-to-high year return flood history. In our dashboard example, Extreme Value Analysis (EVA) was based on the assumption that a 100-year return flood event would result in total destruction.[14] Thus, LGD is assumed as 1. The mortgage loan total was assumed as EAD in the dashboard. Coefficients at different scenarios (2 ºC, 4 ºC and H++) were introduced to calculate the expected loss by the year 2080, assuming imminent global temperature increase. [13]

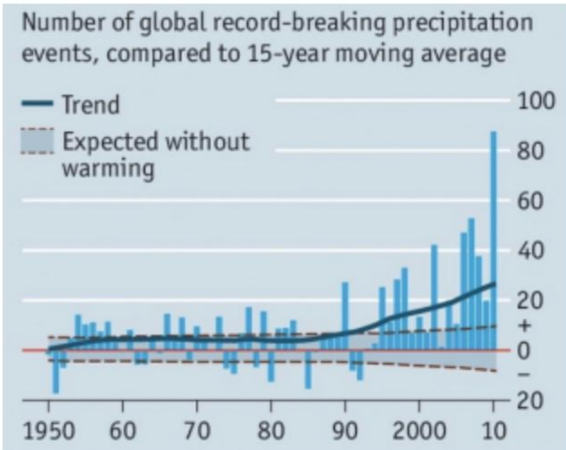
Based on the above costing analysis, lenders can charge borrowers a premium fee in the pricing phase, especially for long-term, unsecured, committed, and subordinated mortgage loan exposure in high risk flood zones. It is advisable that a conditional interest rate be offered in order to mitigate credit risk. Upon delivery of the loan to the borrower, the lender is exposed to credit risk.

Mortgage credit default probability must be monitored closely by tracking all pertinent parameters, including climate factors. If global temperature rises faster than expected, along with increased loss expectancy, floating interest may require a higher adjustment. Upon destructive climate events, including floods, if borrower credit deteriorates, it may lead to credit non-payment.

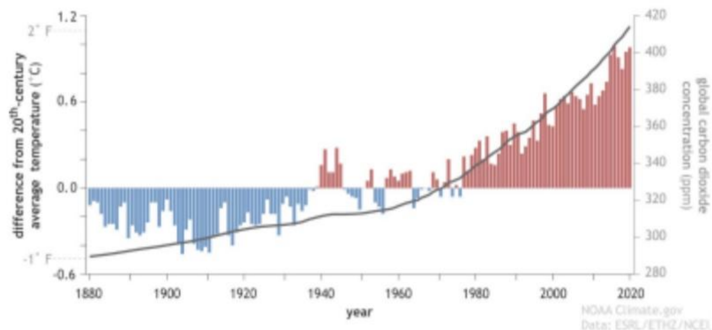
In the work-out phase, the lender must look for solutions to reduce increased default probability. To lower the flood damage liability for mortgage default, lenders can work with borrowers to retrofit their homes to better withstand the effects of climate change. If assets are damaged by floods, the lender can render a bailout to borrowers to recover from default. In any case, enough capital should be reserved for worst case scenarios. In our dashboard, in the event of an H++ scenario, London should set aside £2.5 billion. If a work-out cannot be achieved, the lender can still walk out.

In summary, we have reviewed why climate risk management should be holistically integrated into a financial credit report through the five step process. A shortcoming of many lenders is to merely combine climate risk into the rating phase: while perhaps more economical in the short term, a partial integration would be both an inefficient and ineffective method of risk management. On top of this, the effort put into the climate rating would be voided if there is not a full climate risk practice implemented as laid out in this examination.

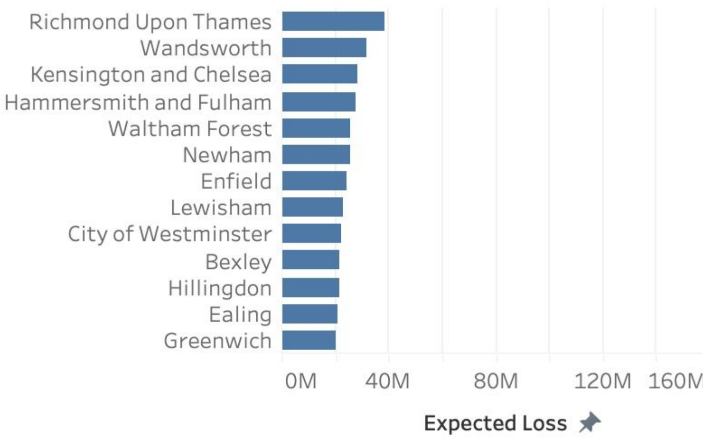
Increased precipitation events under global warming



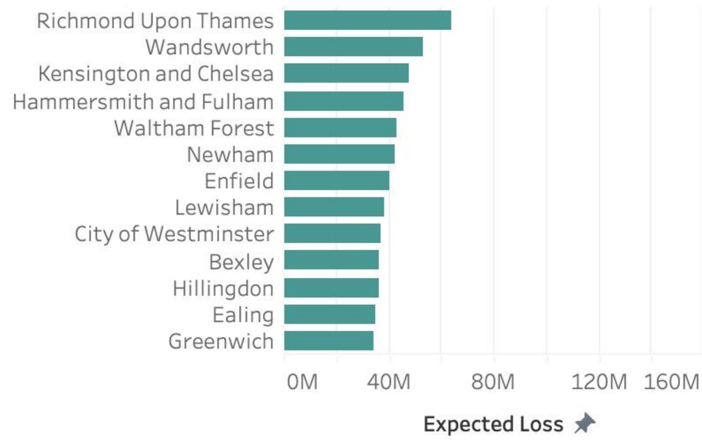
Global atmospheric carbon dioxide & surface temperature (1880-2020)



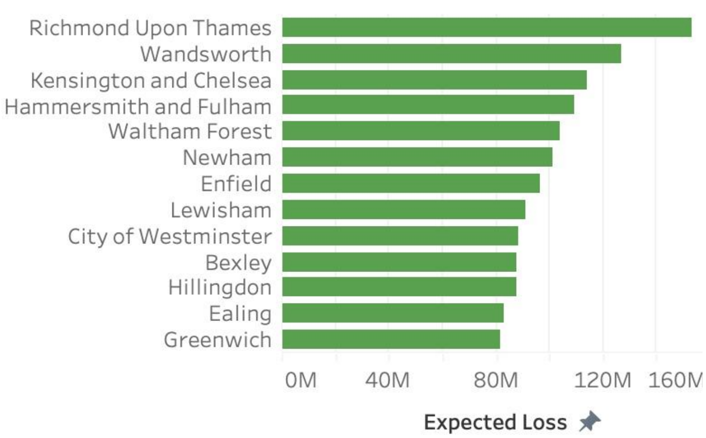
Expected Loss by 2°C increase in London Boroughs



Expected Loss by 4°C increase in London Boroughs



Expected Loss by 7.11°C increase (H++) in London Boroughs



We assumed three 100-year flood scenarios with 2°C under GHG control, 4°C under current GHG emission rate, and an extremely unlikely 7.11°C (H++) increase by 2080 following Sayer's report.

In the event of an H++ scenario, London should set aside £2.5 billion. If a work-out can not be achieved, the lender can still walk out.

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