# Introduction

The aggregate expenses for cancer-related medical care in the United States are considerable. They amounted to $183 billion in 2015 and are projected to surge by 34% to reach $246 billion by 2030 (Mariotto et al., 2020). On an individual scale, these expenses fluctuate between $5,300 and $105,000 annually, varying according to the different phases of cancer. Beyond the direct medical costs, people suffering from cancer and their families must endure the intangible costs in terms of years of work lost. In their estimation, Yabroff et al., (2008) found that the cost of cancer mortality is notably higher when accounting for the loss of household duties and caregiving, in addition to the standard wage-earning jobs.

In a context related to the financial market, these pieces of evidence illustrate that exposure to carcinogens implicitly communicates with all participants in the market, imparting information about both health risks and the creditworthiness of borrowers.

Lenders may charge higher interest rates for borrowers with higher health risks. Health conditions that could potentially lead to increased medical expenses or reduced income-generating capacity might cause lenders to view the borrower as riskier. To compensate for this perceived risk, lenders might raise the interest rate on the loan.

# Background

How market participants behave towards long-term risks is a broad question. Significant heterogeneity exists in the type of assets, including the type of assets involved, the specific risks being considered, and whether the perspective is from the lender-side or borrower-side.

It should be noted that there is a distinction between scientifically assessed risk and perceived risk, with the public often having different beliefs about environmental risk compared to experts.

## How do mortgage lenders (financial institutions) make decisions towards borrowers’ long-term risk?

## How do mortgage borrowers (household) make decisions towards long-term risk?

Research has looked into the effect of borrowers’ long-term risks, which are taken into consideration by lenders when they make credit decisions.

* In certain situations where environmental emergencies or contaminations happen, lenders might even find some parts of the current environmental legal framework unfavourable. For example, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) does not specify the time period when a foreclosing lender can sell the property to be exempted from direct environmental liabilities. This introduces uncertainties for lenders if they want to secure both the liability exemption and the optimal timing to sell the properties. (Xu & Xu, 2020)

The question is, how do lenders make decisions towards a loan associated with long-term risks?

Nguyen et al., (2022) find that lenders tend to charge higher mortgages’ interest rates for properties that have a higher risk of sea level rise, although this interest premium is modest and varies among lenders.

## Toxic Release Inventory and Environmental Inequality

The Toxic Release Inventory is a result of the Emergency Planning and Community Right-to-Know Act (EPCRA), a legislation passed by the U.S. Congress in response to the raising public awareness about toxic chemicals in industrial activities after the Union Carbide disaster in Bhopal, India.

EPA defined carcinogenic or cancer risks (CR) as "the incremental probability of an individual to develop cancer, over a lifetime, as a result of exposure to a potential carcinogen"

All the chemicals classified as “carcinogenic” in the TRI database follows the reporting requirements of Occupational Safety and Health Administration (OSHA), in which chemicals are only required to report if they exceed “de minimis” concentrations in a mixture.

# Hypothesis Development

Consider the following scenario involving two main actors: the mortgage Lender, and the mortgage Borrower. Suppose the mortgage Borrower wants to acquire a property exposed to carcinogenic waste, which has complete disclosure information on the Toxic Release Inventory dataset. The Borrower goes to the mortgage Lender to apply for a loan.

From the standpoint of the Borrower, the potential health hazards associated with the property prompt certain expectations on the mortgage’s cost of credit. Specifically, the Borrower might predict a possible reduction in the property's market price compared to the housing market; therefore, expect a corresponding discount in the applicable mortgage interest rate. This perspective is empirically supported by Mastromonaco (2015), which indicated a noticeable decline in property values due to exposure to toxic waste, with evidence from the Toxic Release Inventory dataset.

On the other side, the mortgage Lender holds a contrary expectation. The Lender interprets that the property's exposure to carcinogens might make the potential tenants (the Borrower) more vulnerable to cancer, which in turn can lead to impending financial problems. Mariotto et al. (2020) and Yabroff et al. (2008) show a significant linkage between carcinogenic issues and financial hardship, due to the considerable medical expenses often associated with cancer and the potential reduction in the individual's capacity to work. As a response, the mortgage Lender might consider the introduction of a premium on the mortgage interest rate. This marginal cost is akin to a form of risk insurance, as it would compensate for the elevated risk exposure and uncertainty associated with the Borrowers’ increased health risk.

The main hypothesis is as follows: The occurrence of carcinogen exposure leads to a corresponding rise in the mortgage rate spread. This hypothesis assumes that lenders possess more bargaining power and better access to information compared to borrowers. This assumption shapes the proposed relationship between carcinogen exposure and the adjustment of mortgage rate spreads.

Mariotto, A. B., Enewold, L., Zhao, J., Zeruto, C. A., & Robin Yabroff, K. (2020). Medical care costs associated with cancer survivorship in the United States. In *Cancer Epidemiology Biomarkers and Prevention* (Vol. 29, Issue 7). https://doi.org/10.1158/1055-9965.EPI-19-1534

Mastromonaco, R. (2015). Do environmental right-to-know laws affect markets? Capitalization of information in the toxic release inventory. *Journal of Environmental Economics and Management*, *71*. https://doi.org/10.1016/j.jeem.2015.02.004

Nguyen, D. D., Ongena, S., Qi, S., & Sila, V. (2022). Climate Change Risk and the Cost of Mortgage Credit. *Review of Finance*, *26*(6). https://doi.org/10.1093/rof/rfac013

Xu, M., & Xu, Y. (2020). Environmental Hazards and Mortgage Credit Risk: Evidence from Texas Pipeline Incidents. *Real Estate Economics*, *48*(4). https://doi.org/10.1111/1540-6229.12213

Yabroff, Bradley, & Hutchinson, F. (2008). Economic cost of cancer mortality is high in U.S., regardless of how cost is measured. In *Journal of the National Cancer Institute* (Vol. 100, Issue 24). https://doi.org/10.1093/jnci/djn488