# 3 big questions related to the topic:

* **How do market participants react to a long-term risk?**
* **Is carcinogenic waste considered as long-term risk? (In**

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.

* **Among other waste, why does carcinogenic waste stand out?**

The overall national cancer-related medical care costs in the US are significant, stood at $183 billion in 2015 and are predicted to increase 34% to $246 billion by 2030 (Mariotto et al., 2020). On the individual level, this cost ranges from $5,300 to $105,000 annually, varying on different cancer phases. In addition to medical costs, cancer patients and their households have to bear the human capital burden in terms of lost years of work. Yabroff et al., (2008) estimated that the cost of cancer mortality is much higher when taking into account the loss of household duties and caregiving, in addition to regular wage-earning jobs. To put in the perspective of the credit market, these evidence show that carcinogenic exposure implicitly signals all market participants about both health risk and credit solvency of borrowers.

# Literature Review

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

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.

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

The main characteristics of such risks are that they are usually persistent in long-term rather than immediate threats. Examples are potential hurrrican damages (Hallstrom and Smith, 2005), seismic risk (), crime risk (Linden and Rockoff, 2008), and airport noise (Pope, 2008).

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

## Toxic Release Inventory background

# Data and Empirical Model

## Data

## Mortgage data

## Toxic Release Inventory data

The time range is relatively short.

However, analysing a more extended time series of TRI has its own cost, as the reporting requirements have periodically changed, making temporal comparison less reliable (Pastor et al., 2004).

## Empirical model and variables

This study aims to measure the relationship between properties’ exposure to carcinogenic waste (at the county level), and interest rate spreads. However, one empirical problem is that variation of the target variable – mortgage rate spreads - might be explained by factors other than carcinogen exposures. For example, people living near industrial facilities might

related to mortgage characteristics and borrower characteristics.

Exposure to Carcinogenic Waste

Mortgage Interest Rate Spread

Mechanism: Medical Cost from Health Risk

Borrower’s & Property’s Characteristics

Property’s Location (proximity to industrial facilities)

I have the following regression estimation:

The dependent variable {Rate Spread} is provided within the HMDA dataset, which is the difference between the covered loan’s annual percentage rate (APR) and the average prime offer rate (APOR) for a similar transaction, determined on the date when the interest rate is established. The {Carcinogens Exposure} is calculated using the total on-site carcinogenic release (in the Toxic Release Inventory dataset) divided by the county land area.

While the variable {Carcinogens Exposure} is collected at the county level, the {Rate Spread} and the set of control variables X are at the individual level. Therefore, although I try to exploit the variation of carcinogen exposure between different counties (i.e., the amount of carcinogen released), the individual-level data can provide additional variation to specify the effect of carcinogen exposure on different groups of borrowers and properties with similar characteristics.

The

### Control variables

The set of loan-level control variables, including *Jumbo Loan, Loan Purpose,*

Since the HMDA dataset does not provide the FICO score of the applicant, I include control variables to control for borrower’s risk characteristics: *Debt-to-income*, *Race, Income, Age,*

I also include property characteristics: *property value decile bins*, *property’s location (urban or rural)*

## Summary statistics

# Empirical models and Results

## Baseline results

## Robustness tests for the baseline results

### Covariates balance

I collect a random sample of 1,000,000 observations and balance the covariates.

Using propensity score matching to match loans in counties with zero carcinogenic exposure and counties with positive carcinogenic exposure based on loan characteristics.

### Using facilities density to measure carcinogens exposure.

I create a variable measuring the number of facilities with carcinogen release per 1 km squared.

### Using

# Additional Analyses

### Heterogeneity across regions

### Heterogeneity across lenders

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

Pastor, M., Sadd, J. L., & Morello-Frosch, R. (2004). Waiting to inhale: The demographics of toxic air release facilities in 21st-century California. In *Social Science Quarterly* (Vol. 85, Issue 2). https://doi.org/10.1111/j.0038-4941.2004.08502010.x

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