STOR-i

excellence with impact

The Dangerous Shadow of Uncertainty

Research Topic I Talks

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Motivation

As humans, we constantly grapple with the dichotomy of **beliefs** and **uncertainty** in the process of decision-making: a canceled meeting, an earthquake, a rainy day.

In particular, a significant part of our lives is governed by money. There is uncertainty of how money and economy behave across the world. Crashes in economy disrupt lives...

Therefore, It is natural to try to anticipate **bad scenarios** and relieve their consequences.

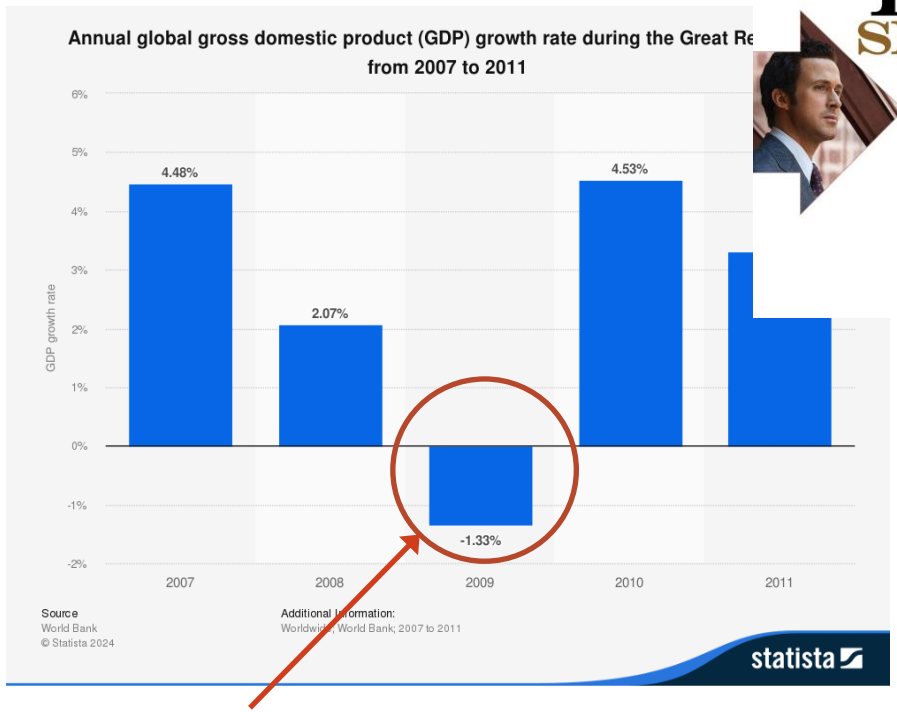
How to quantify the uncertainty?

The STOR-i: The 2008 Great Recession

To understand the importance of quantify the uncertainty or **risk** in a phenomena we exemplify how do not do that could cause catastrophic consequences.

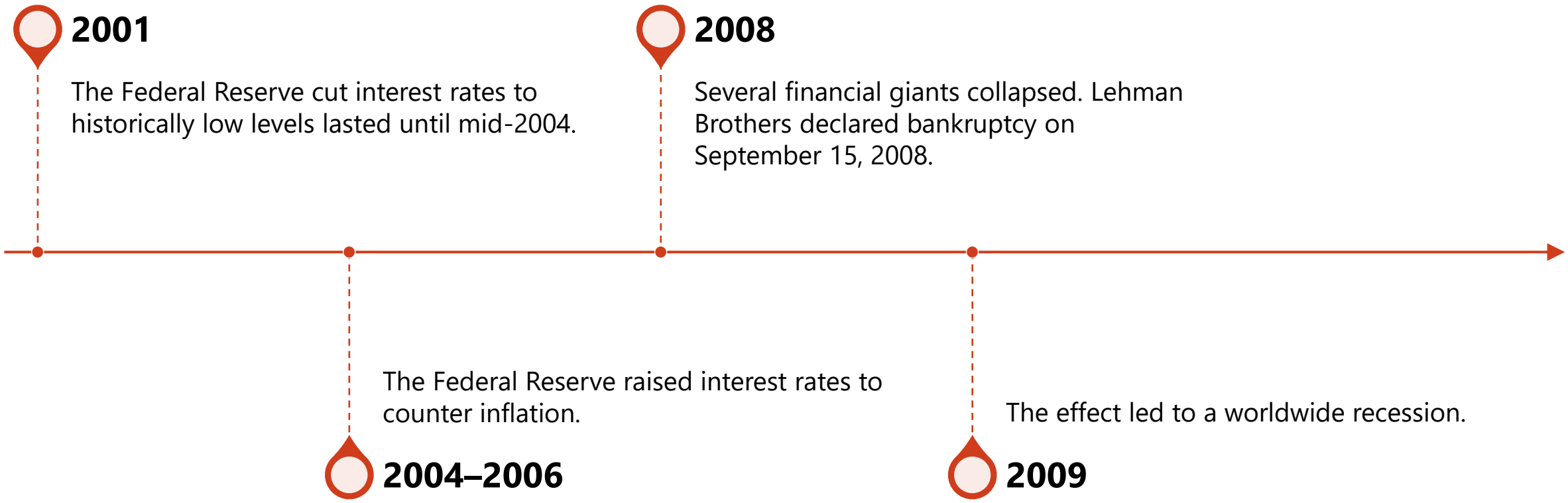
We focus on an example on finance sector where this problem raises naturally: **The 2008 Great Recession.**

What were the main causes of this financial crisis?



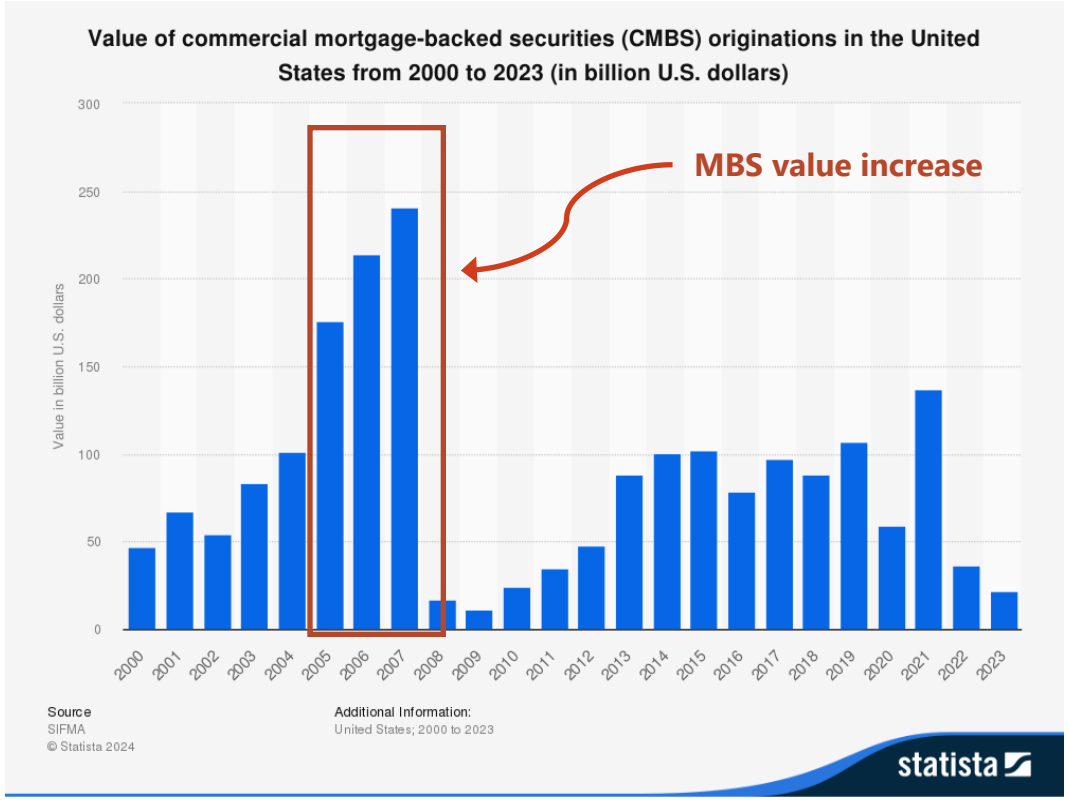
Recession

Timeline of the crisis



Causes

- Low interest rates and government politics let to a dramatic expansion of mortgage debt.
- Financial institutions aggressively bought, sold and securitized mortgages though an instrument called **Mortgage-Backed Securities (MBS)**.
- Underestimation of the risk.
- Lack of **diversification** by the financial institutions.
- Change of the conditions in 2004-2006 lead to **massive decrease** of the MBS price.



Overview of Risk Theory

Mathematically, the way to understand the **risk** is by assessing the volatility. In Probability and Statistics, we do through the **variance.**

In finance, this idea was introduced by Harry Markowitz in 1952.

However, using variance could be too conservative. This motivates the development of more refined **risk measures.**

Risk Measures

Let Z the random variable that represents the loss of the **log-returns** and F_Z its distribution

Downside Risk Measures

- Semi Variance

$$\text{SemiVar}(Z) = \mathbb{E}\left[|Z - \mathbb{E}[Z]|_+^2\right]$$

- Mean Regret

$$\text{MeanRegret}_\tau(Z) = \mathbb{E}\left[|Z - \tau|_+\right]$$

Tail Risk Measures

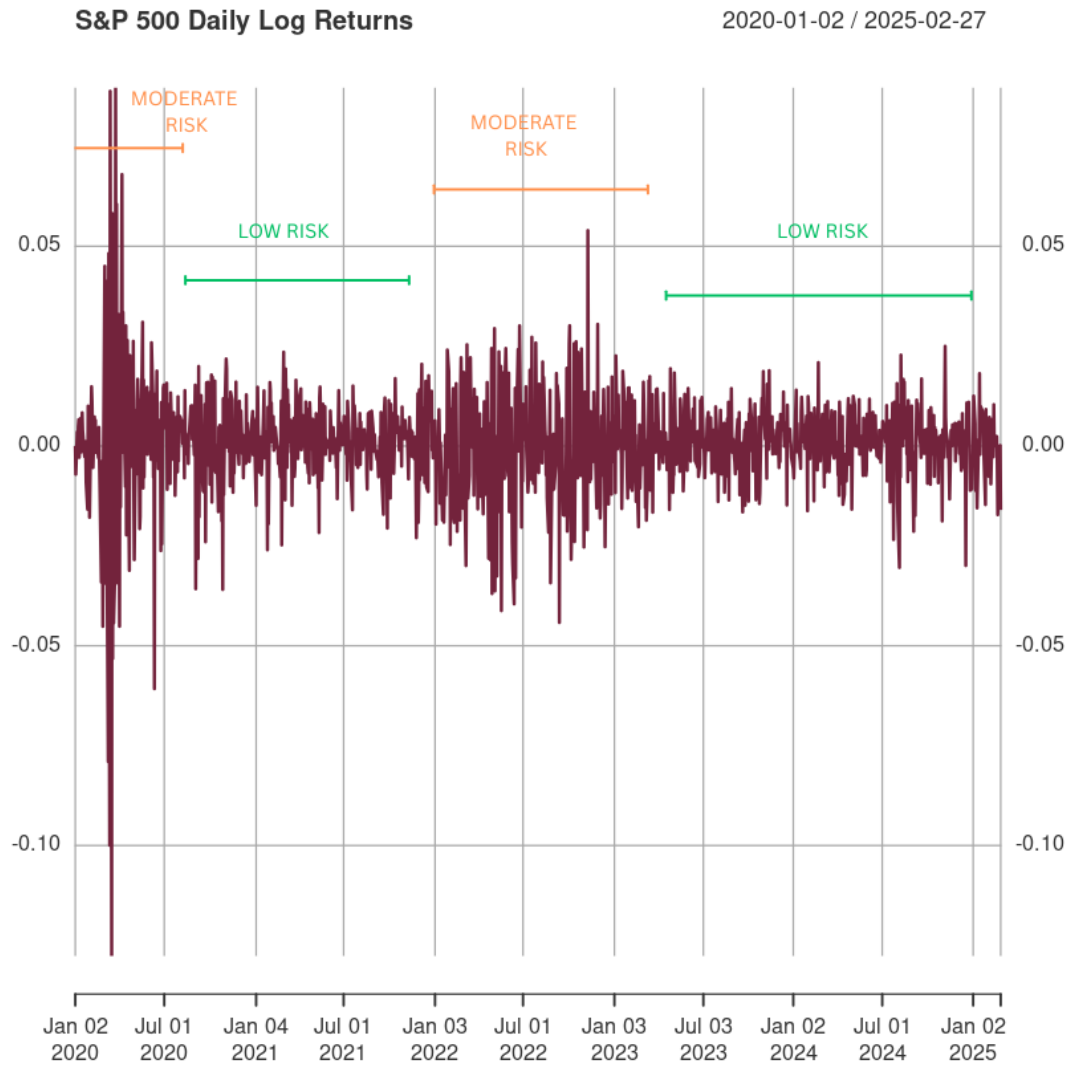
- Value-at-Risk (VaR) (J.P. Morgan, 1996)

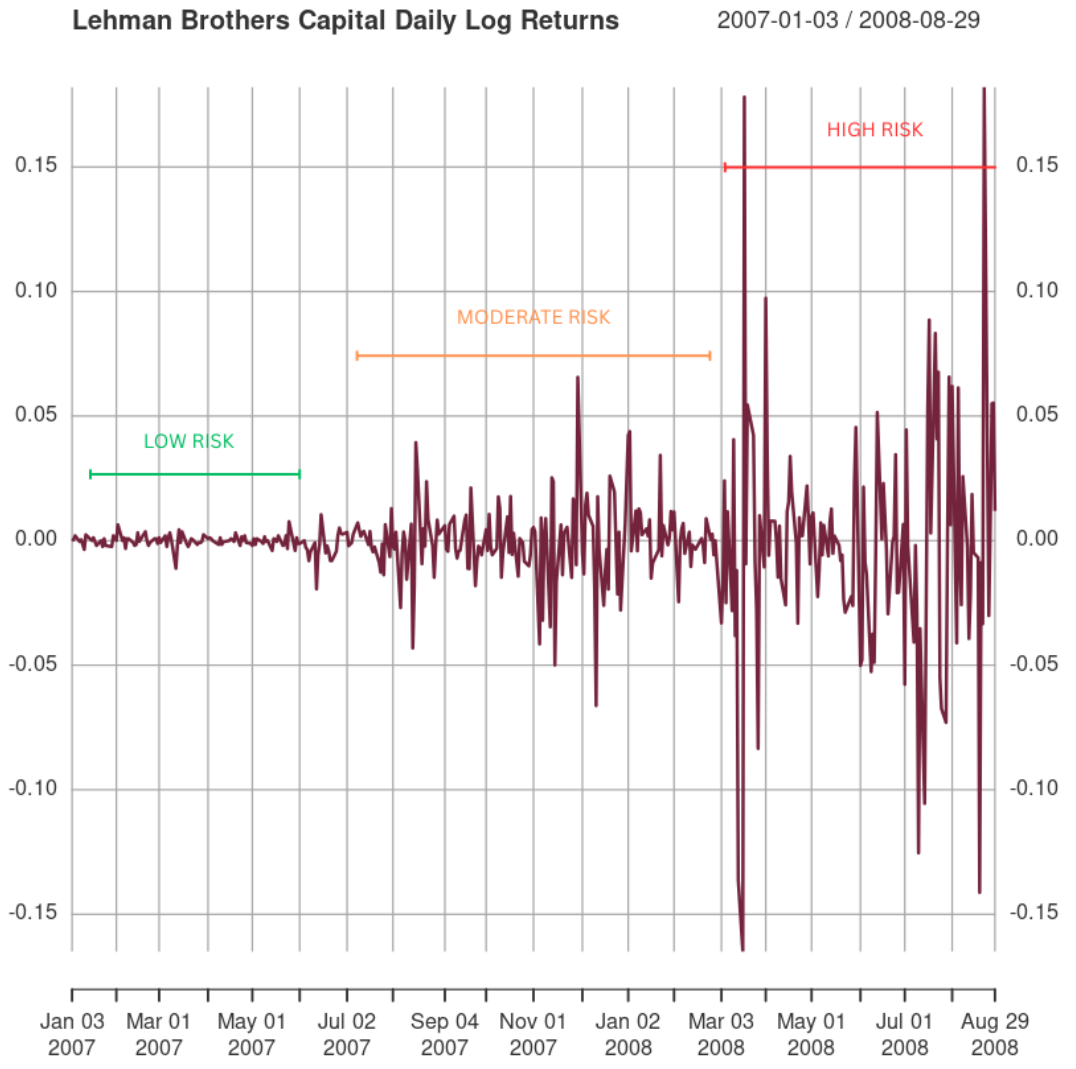
$$\beta\text{-VaR}(Z) = F_Z^{-1}(\beta)$$

- Conditional Value-at-Risk (CVaR) (Rockafellar et al., 2000)

$$\beta\text{-CVaR}(Z) = \mathbb{E}\left[Z \,|\, Z \geqslant \beta\text{-VaR}\right]$$

Analysis


S&P 500 Daily Log Returns
2020-01-02 / 2025-02-27
MODERATE RISK
MODERATE RISK
LOW RISK
LOW RISK
0.05
0.00
-0.05
-0.10
Jan 02 2020
Jul 01 2020
Jan 04 2021
Jul 01 2021
Jan 03 2022
Jul 01 2022
Jan 03 2023
Jul 03 2023
Jan 02 2024
Jul 01 2024
Jan 02 2025


Lehman Brothers Capital Daily Log Returns
2007-01-03 / 2008-08-29
HIGH RISK
MODERATE RISK
LOW RISK
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
Jan 03 2007
Mar 01 2007
May 01 2007
Jul 02 2007
Sep 04 2007
Nov 01 2007
Jan 02 2008
Mar 03 2008
May 01 2008
Jul 01 2008
Aug 29 2008

Risk Measures Results

	S&P 500	Lehman Brothers
Volatility	0.01337	0.02833
VaR	-0.01867	-0.03855
CVaR	-0.03264	-0.07294
Mean Regret	-0.00900	-0.01506
Semi Var	0.00021	0.00080

- Each risk measure has a different interpretation.
- There is more or less difference between the two stocks depending on the risk measure used.
- In particular, the CVaR captures better the distance in risk between the two markets.

''La Morajela''

- Risk measures serve as thermometers to anticipating a crash.
- The choice depends on the specific situation at hand.
- These are tools for decision-making as alarms to investigate the underlying causes.

Risk measures are the light to banish the shadow of uncertainty

References

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