Learning from History: Volatility and Financial Crises

Jon Danielsson
London School of Economics

with Valenzuela and Zer

Schumpeter, Minsky, and the FCA: Exploring the links
between financial regulation, growth, and stability
10 June 2017

Introduction
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Data
○○○○○○○○○○○

Model
○○○

Results
○○○○

Nature of risk
○○○○○○○○

Macro Pru
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Conclusion
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"Learning from History: Volatility and Financial Crises"

(2017)

Jon Danielsson (London School of Economics)
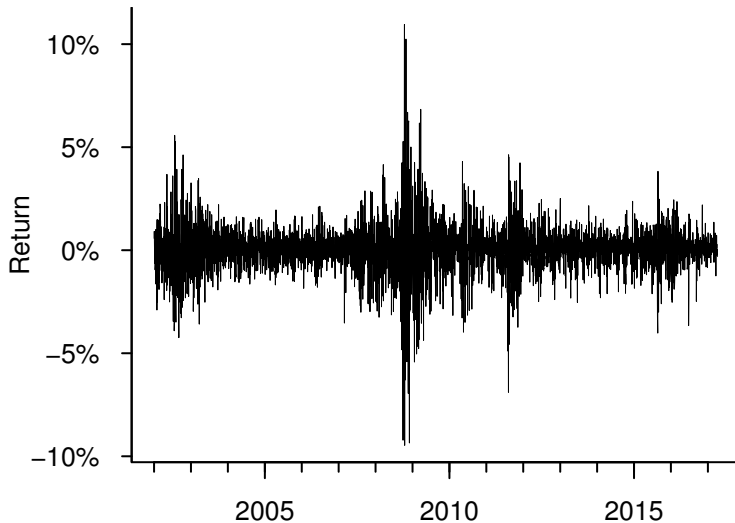Marcela Valenzuela (University of Chile)
Ilknur Zer (Federal Reserve)

"Volatility in markets is at low levels, both actual and expected, ... to the extent that low levels of volatility may induce risk-taking behavior ... is a concern to me and to the Committee."
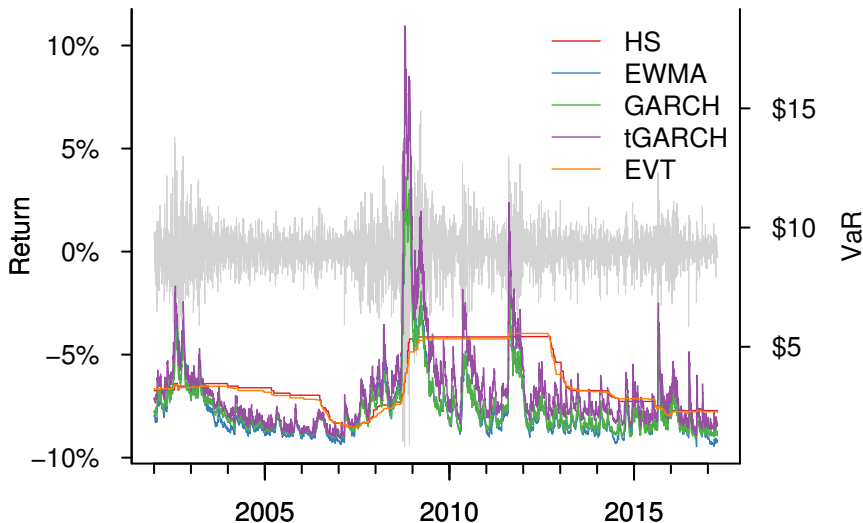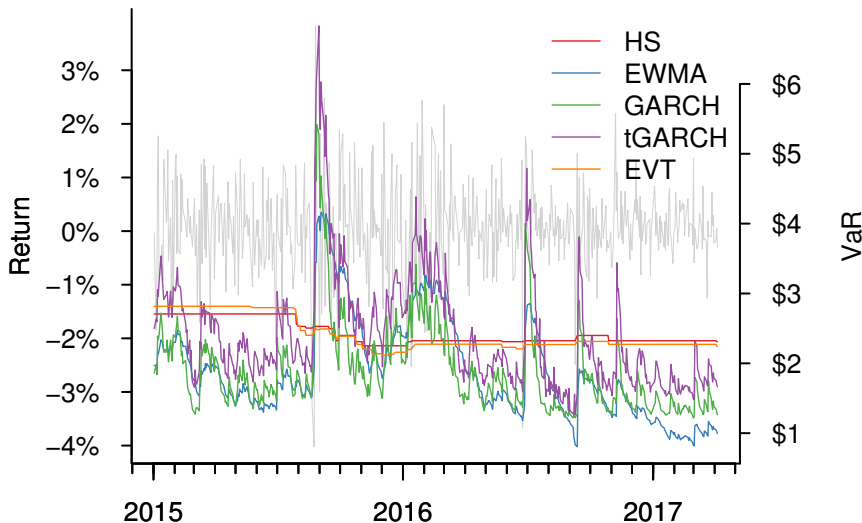
Federal Reserve Chair Janet Yellen, 2014.

S&P–500

S&P–500

from www.modelsandrisk.org

Introduction
○●○

Data
○○○○○○○○○○

Model
○○○

Results
○○○○

Nature of risk
○○○○○○○○

Macro Pru
○○○○○○○○○○○○

Conclusion
○○

S&P–500 Zoom

from www.modelsandrisk.org

The volatility — crisis cycle

volatility
    low

| $t = 1$ | $t = 2$ | $t = 3$ | $t = 4$ | |

Introduction
○○●

Data
○○○○○○○○○○

Model
○○○

Results
○○○○

Nature of risk
○○○○○○○○

Macro Pru
○○○○○○○○○○○○

Conclusion
○○

The volatility — crisis cycle

volatility
low

Appetite
for risk ↑

# The volatility — crisis cycle

volatility
  low

Credit ↑

$t = 1$ $\rangle$ $t = 2$ $\rangle$ $t = 3$ $\rangle$ $t = 4$ $\rangle$

Appetite
for risk ↑

The volatility — crisis cycle

volatility
low

Credit ↑

Defaults ↑

| $t = 1$ | $t = 2$ | $t = 3$ | $t = 4$ | |

Appetite
for risk ↑

Introduction
○○●
Data
○○○○○○○○○○
Model
○○○
Results
○○○○
Nature of risk
○○○○○○○○
Macro Pru
○○○○○○○○○○○○○
Conclusion
○○

The volatility — crisis cycle

volatility
low

Credit ↑

Defaults ↑

Banking
crisis

$t = 1$ ⟩ $t = 2$ ⟩ $t = 3$ ⟩ $t = 4$ ⟩

Appetite
for risk ↑

Introduction
○○●

Data
○○○○○○○○○○○

Model
○○○

Results
○○○○

Nature of risk
○○○○○○○○

Macro Pru
○○○○○○○○○○○○○

Conclusion
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The volatility — crisis cycle

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Credit ↑

Defaults ↑

Banking
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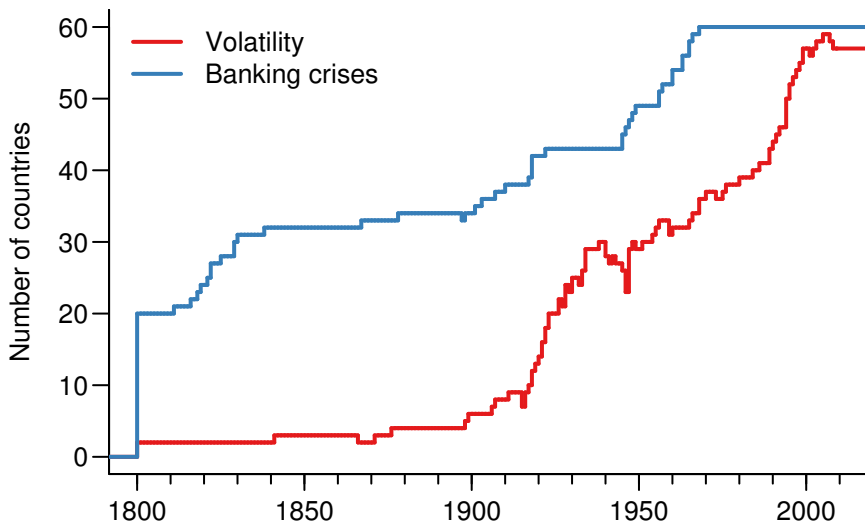
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Volatility ↑

Appetite
for risk ↑
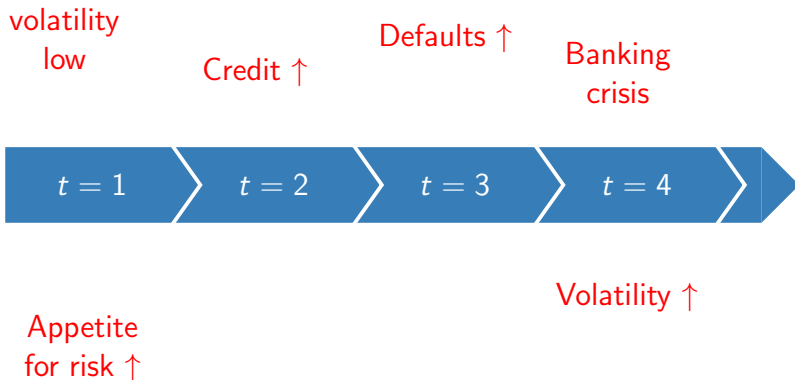
Data

- Comprehensive database on monthly returns (1800 to 2010, 60 countries)
  - Global Financial Data
  - On average 62 years of historical observations per country
- Banking crises (Reinhart and Rogoff)
  - Binary indicator of whether a *banking crisis starts* in a given year and a given country
- Risk-taking (credit-to-GDP)
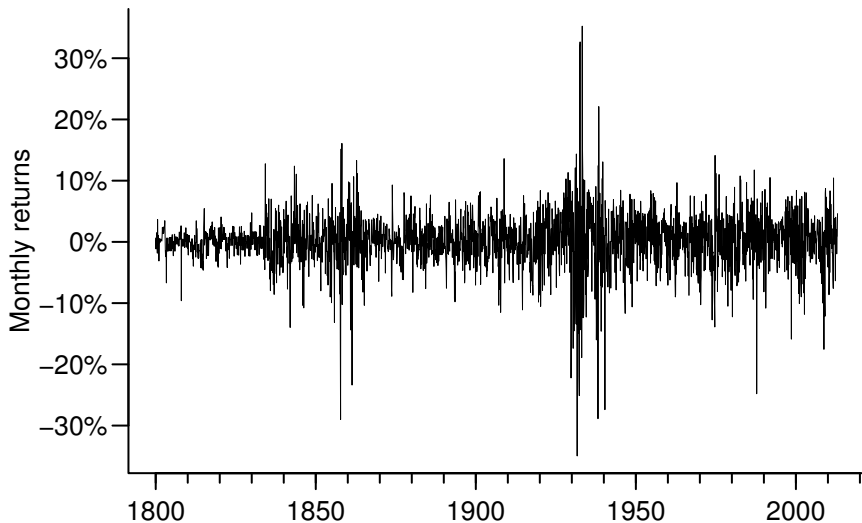- Control variables

Introduction
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Data
0●00000000

Model
000

Results
0000

Nature of risk
00000000

Macro Pru
00000000000

Conclusion
00

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Introduction
000

Data
000●0000000

Model
000

Results
0000

Nature of risk
00000000

Macro Pru
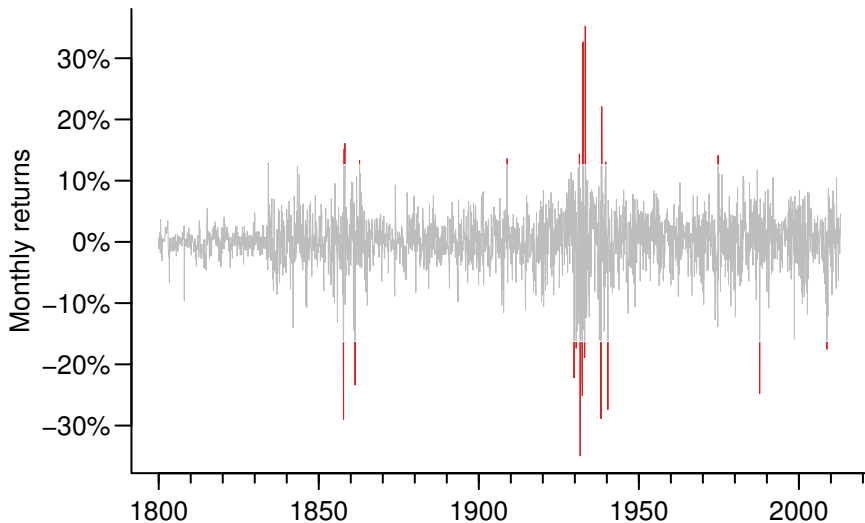000000000000

Conclusion
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Obtaining volatilities

- GARCH? No
- *Realized volatility* (standard deviation of 12 past monthly real returns)
- Wars and hyperinflations result in extremes. We know that realized (and GARCH) volatilities are not robust in presence of extremes, and so
- *Winsorized* — ($+/_-$ 0.5% of tails)

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Introduction
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Data
0000●000000

Model
000

Results
0000

Nature of risk
00000000

Macro Pru
00000000000

Conclusion
00

SP-500

with winsorization

Volatility decomposition

- We could use the annual volatility ($\sigma_{i,t}$) as a crisis predictor, or
- Volatility decomposed into *trend* and *deviation from trend*

  - Different countries have different volatility levels
  - High volatility for a country and time could be low or typical in another period or country
  - Deviation from the prevailing volatility regime

- *High volatility:* volatility that is *above* the trend
- *Low volatility:* volatility that is *below* the trend
- One could use Markov switching, but that is a bad idea, instead:

Hodrick and Prescott (HP) filter

- Smoothing parameter, $\lambda = 5000$, which quantifies the degree to which volatility deviates from its trend

- Two sided (run recursively, past data used for current trend)

$$\min_{\{\tau_t(\lambda)\}_{t=1}^{T}} \sum_{t=1}^{T} [\sigma_t - \tau_t(\lambda)]^2 +$$

$$\lambda \sum_{t=2}^{T-1} \{[\tau_{t+1}(\lambda) - \tau_t(\lambda)]$$

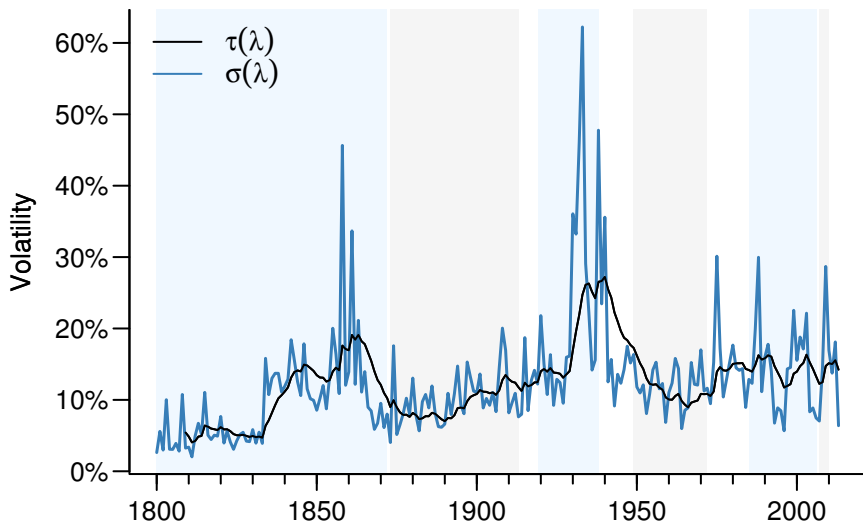$$- [\tau_t(\lambda) - \tau_{t-1}(\lambda)]\}^2$$

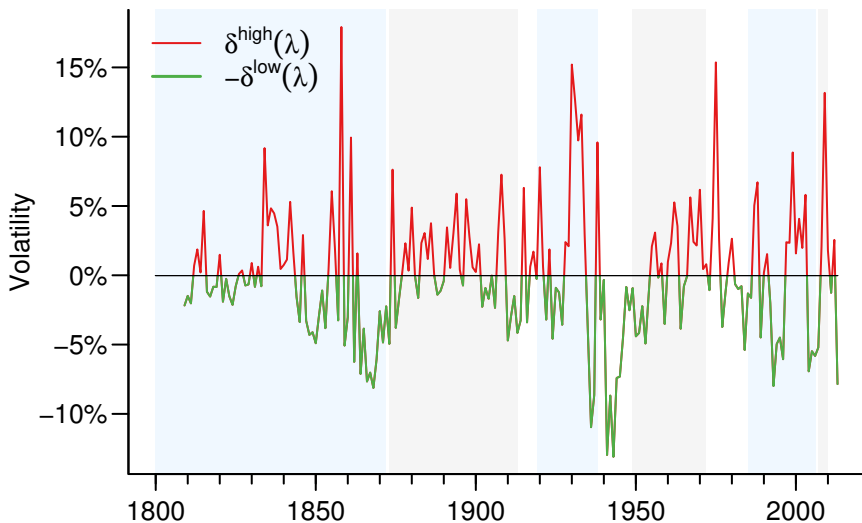$$\sigma_t = \tau_t + \delta_t$$

- Low and high volatilities

$$\delta_t^{\text{high}} = \begin{cases} \sigma_t - \tau_t & \text{if} \qquad \sigma_t \geq \tau_t \\ 0 & \text{otherwise,} \end{cases}$$

$$\delta_t^{\text{low}} = \begin{cases} |\sigma_t - \tau_t| & \text{if} \qquad \sigma_t < \tau_t \\ 0 & \text{otherwise.} \end{cases}$$

SP-500

Introduction
ooo

Data
ooooooooo•o

Model
ooo

Results
oooo

Nature of risk
ooooooooo

Macro Pru
oooooooooooo

Conclusion
oo

SP-500

Introduction
000

Data
000000000●

Model
000

Results
0000

Nature of risk
00000000

Macro Pru
00000000000

Conclusion
00

Control variables — $X_{t,i}$

- Lags of the crisis dummy
- log *GDP*: GDP per capita to control for the economic development of a country
- *INFLATION*: annual CPI inflation rate
- $\Delta PD/GDP$: change in public-debt to GDP ratio
- *POLCOMP*: the degree of political competition as a proxy for institutional quality
- Time series and cross sectional fixed effects

Econometric Model

- The dependent variable is the *start* of a crisis,

$$C_{i,t}$$

  i country index
  t starting year of a crisis

- Moving average variables

$$\overline{z}_{i,t-1 \text{ to } t-L} = \frac{1}{L} \sum_{j=1}^{L} z_{i,t-j}, \quad z = C, \delta, X$$

- L_1, L_2 are the first and last lags, respectively
- Baseline: $L_1 = t - 1$, $L_2 = t - 5$

Panel-logit regressions

$$C_{i,t} = \beta_1 \overline{C}_{i,L_1\_L_2}$$
$$+ \beta_2 \overline{\delta^{\text{high}}}_{i,L_1\_L_2}$$
$$+ \beta_3 \overline{\delta^{\text{low}}}_{i,L_1\_L_2}$$
$$+ \beta_4 \overline{X}_{i,L_1\_L_2}$$
$$+ \varepsilon_{i,t}$$

Volatility and risk-taking

$C_{i,t}$	I	II	III	IV
$\sigma_{i,t-1 \text{ to } t-5}$	0.07**	-0.01		
$\delta^{\text{high}}_{i,t-1 \text{ to } t-5}$			0.26**	0.20
$\delta^{\text{low}}_{i,t-1 \text{ to } t-5}$			0.30***	0.31***
Control variables	No	Yes	No	Yes

So

- Volatility predicts crises *but not* when control variables are included
- High volatility predicts crises *but not* when control variables are included
- Low volatility predicts crises *including* when control variables are included
- A 1% decrease in volatility below its trend translates into a 1.01% increase in the probability of a crisis
- Economic importance increases monotonically and reaches a maximum at $L = 5$ and decreases then after dies out after $L = 10$

Volatility and risk-taking

- We use credit-to-GDP ratio gap (the difference between the credit-to-GDP ratio and its long-run trend) (and credit growth) as a proxy for risk-taking

$$R_{i,t} = \beta_1 \overline{\delta}_{i,L_1 \_ L_2}^{\text{high}} + \beta_2 \overline{\delta}_{i,L_1 \_ L_2}^{\text{low}} + \beta_3 \overline{X}_{i,L_1 \_ L_2} + \varepsilon_{i,t}$$

	$CR\_GAP_{i,t}^{\text{BIS}}$	$\Delta logCR_{i,t}^{\text{BIS}}$	$CR\_GAP_{i,t}^{\text{ST}}$	$\Delta logCR_{i,t}^{\text{ST}}$
$\delta_{i,t-1\ \text{to}\ t-L}^{\text{high}}$	-1.66	0.02	-0.01***	-0.91
$\delta_{i,t-1\ \text{to}\ t-L}^{\text{low}}$	4.53***	0.97***	0.01**	1.32**

- Low levels of financial volatility are followed by credit booms

What drives risk?

- 2008 happened because of decisions made years earlier
- In 2003 all the signs pointed to risk being low
- The authorities and the private sector thought we were safe
- And so it was perfectly OK to take extra risk
- But
- "*Stability is destabilizing*" (Minsky)

The unknown unknowns

- The US stock market goes down by $200 billion in one day and nobody cares
- Potential subprime losses of less than $200 billion, and OMG, its the end of civilization
- The risk we know we prepare for — *known unknowns*
- The risk we don't know is the dangerous type
- The *unknown unknowns* are most damaging

Risk is endogenous

Danielsson–Shin (2002)

- Risk is *exogenous* or *endogenous*

  exogenous Shocks to the financial system arrive from outside the system, like with an asteroid

  endogenous Financial risk is created by the interaction of market participants

"The received wisdom is that risk increases in recessions and falls in booms. In contrast, it may be more helpful to think of risk as increasing during upswings, as financial imbalances build up, and materialising in recessions."
Andrew Crockett, then head of the BIS, 2000

- Market participants are guided by a myriad of models and rules, many dictate myopia
- Prices don't follow random walks in adverse states of nature
- Because that is when the constraints bind
- Endogenous risk is created by the interaction of human beings
- All with their own objectives, abilities, resources, biases
- *All large market outcomes are endogenous*

Risk models underestimate risk during calm times and overestimate risk during crisis — they get it wrong in all states of the world

Two faces of risk

- When individuals observe *and* react — affecting their operating environment
- Financial system is not invariant under observation
- We cycle between virtuous and vicious feedbacks
  - *perceived risk* — as reported by risk models
  - *actual risk* — hidden but ever present

Endogenous bubble

Introduction
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Data
ooooooooooo

Model
ooo

Results
oooo

Nature of risk
ooooo●oo

Macro Pru
ooooooooooooo

Conclusion
oo

Endogenous bubble

Introduction
ooo
Data
ooooooooo
Model
ooo
Results
oooo
Nature of risk
oooooo●oo
Macro Pru
oooooooooooo
Conclusion
oo
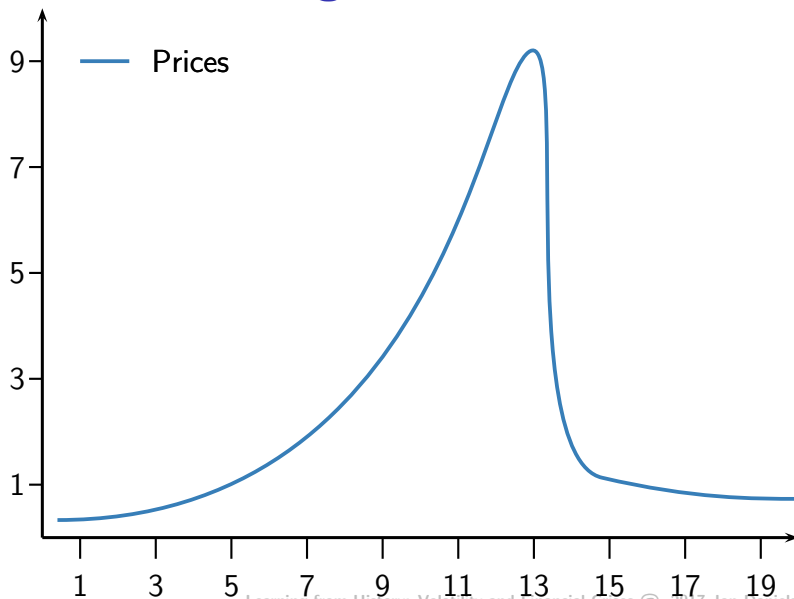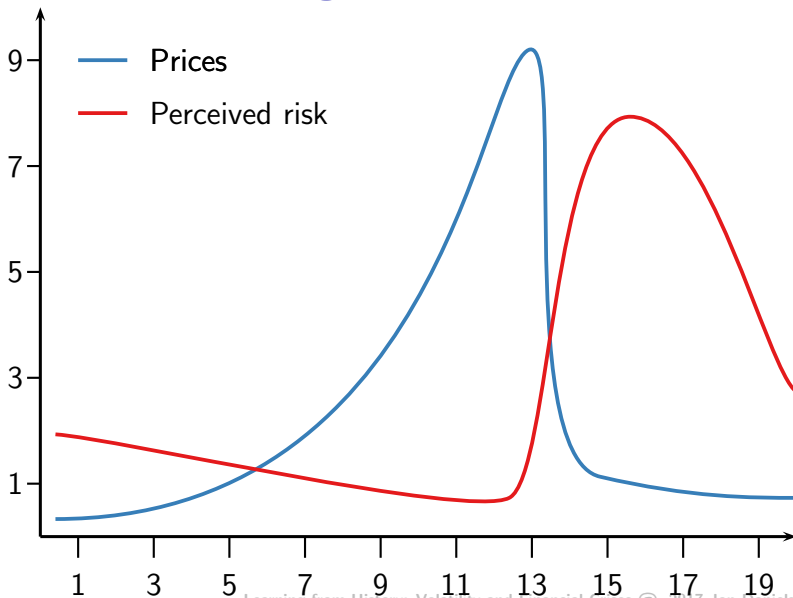
Endogenous bubble
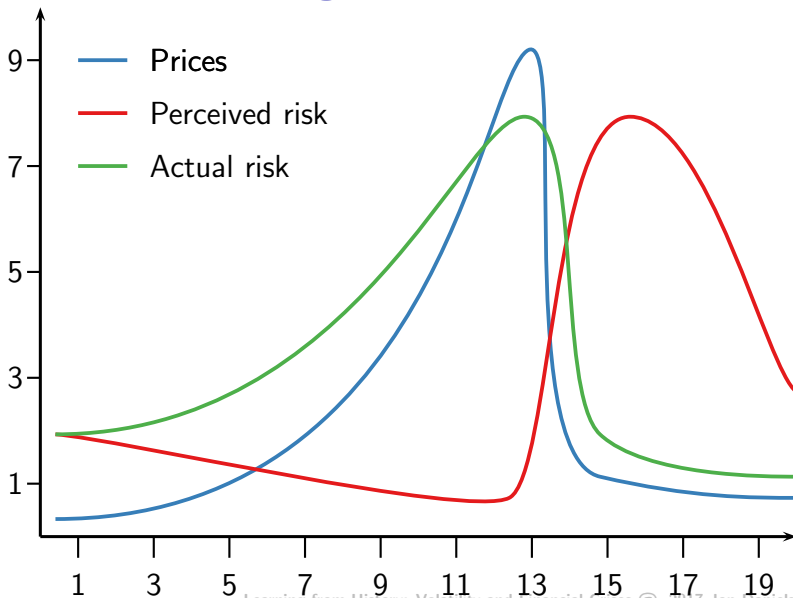
How often do systemic crises happen?

- Ask the IMF–WB systemic crises database (only OECD)
- Every 43 years (17 for UK)
- Best indication of the target probability for policymakers
- However, most indicators focus on much more frequent events
- Typically every month to every five months

The 43 year cycle of systemic risk
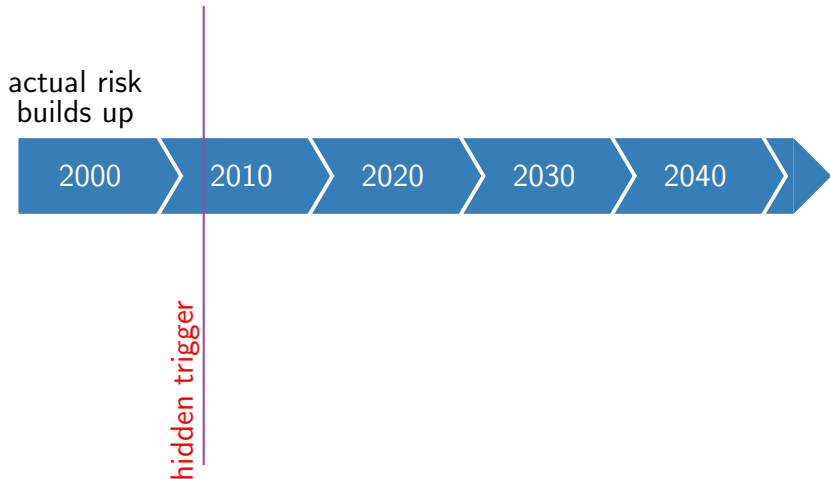
actual risk
builds up

2000 〉 2010 〉 2020 〉 2030 〉 2040 〉

The 43 year cycle of systemic risk

actual risk
builds up

| 2000 | 2010 | 2020 | 2030 | 2040 |

hidden trigger

The 43 year cycle of systemic risk

perceived risk
indicators flash

actual risk
builds up

2000 2010 2020 2030 2040

hidden trigger

The 43 year cycle of systemic risk

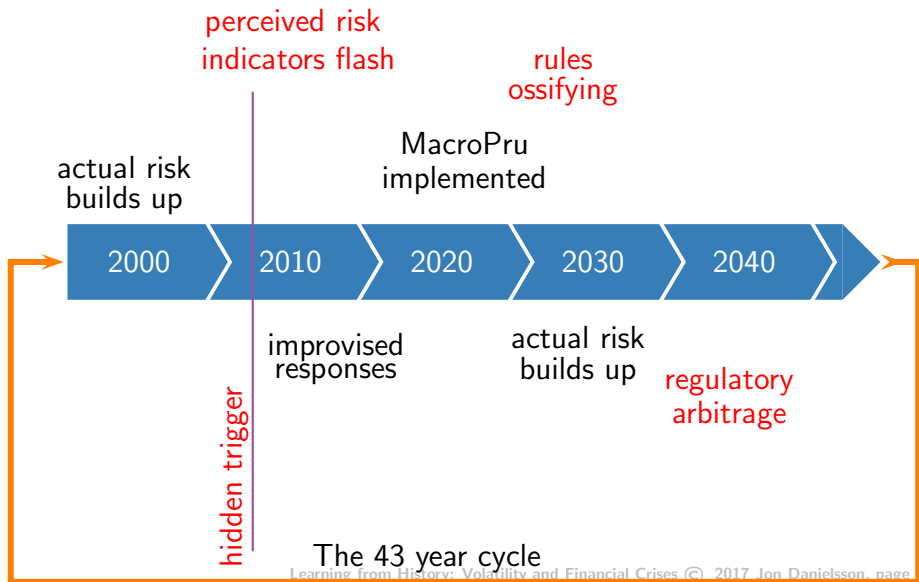# The 43 year cycle of systemic risk

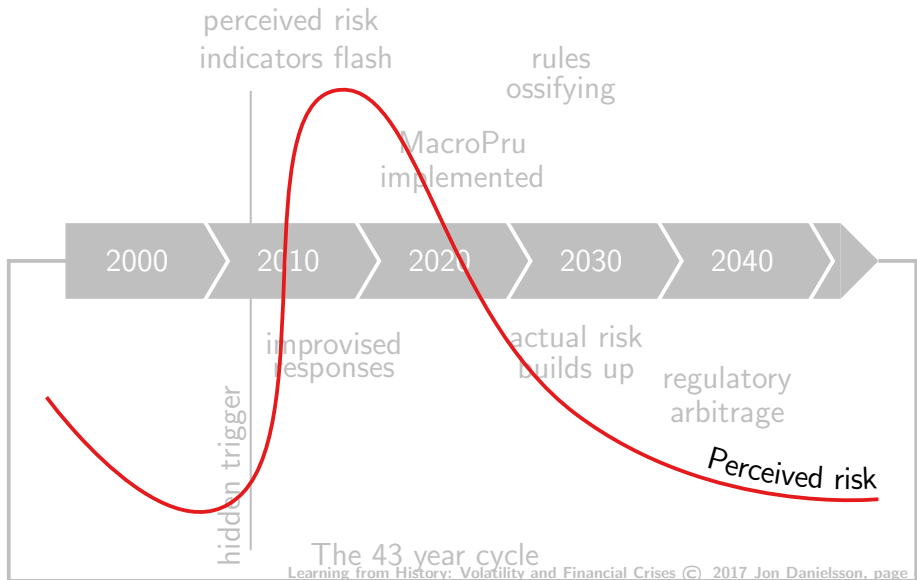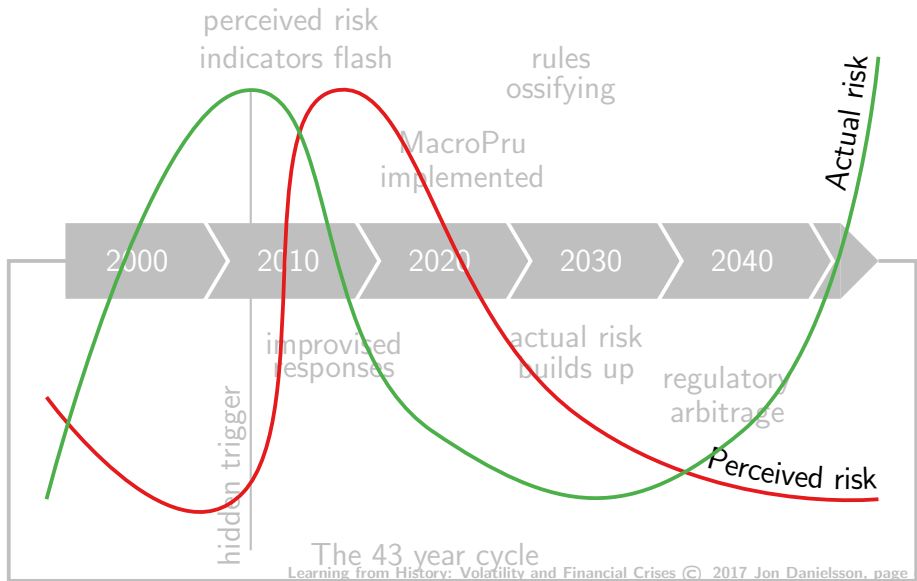# The 43 year cycle of systemic risk

Introduction
○○○
Data
○○○○○○○○○○
Model
○○○
Results
○○○○
Nature of risk
○○○○○○○●
Macro Pru
○○○○○○○○○○○○
Conclusion
○○
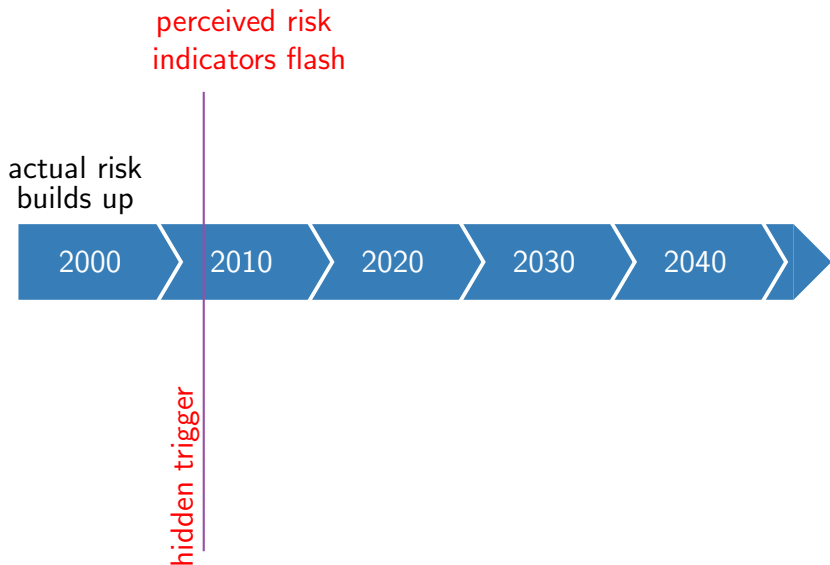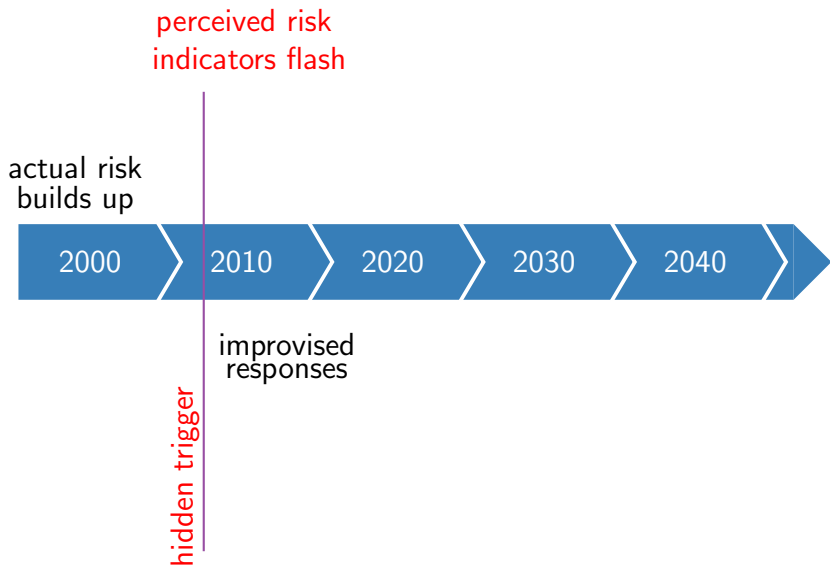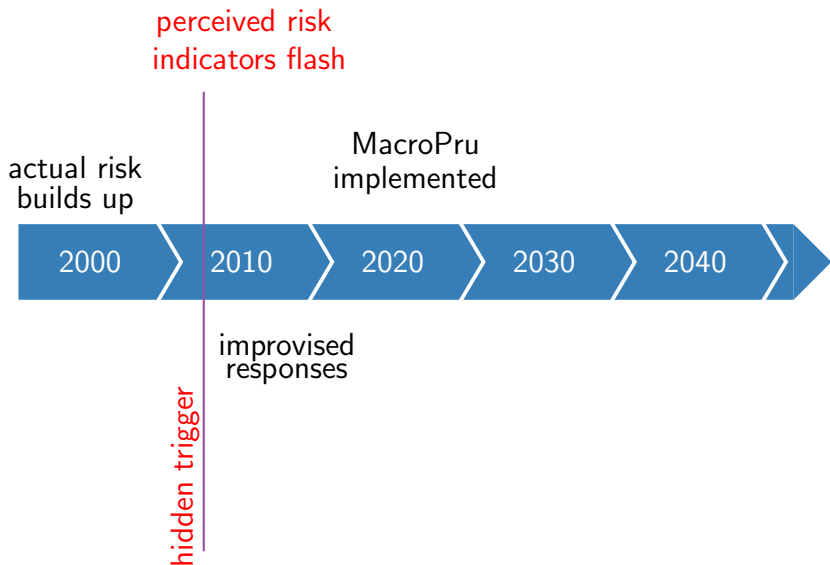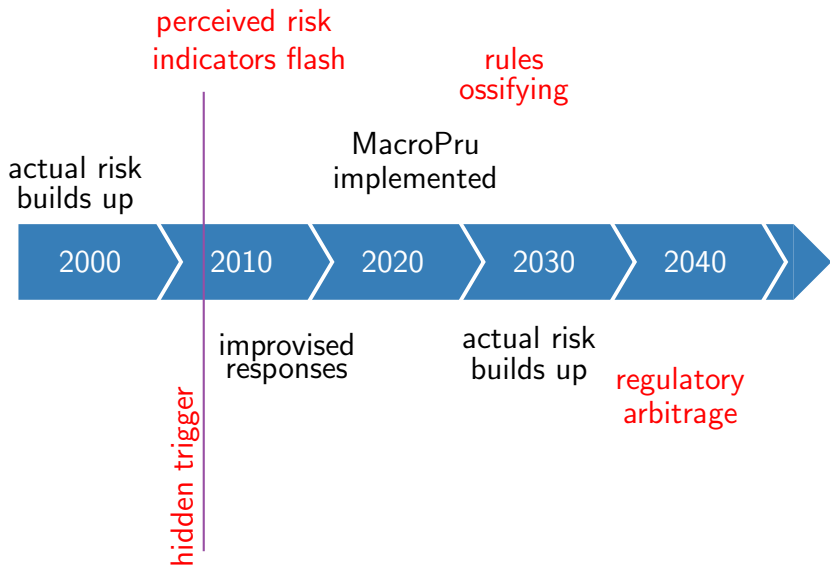
The 43 year cycle of systemic risk

The 43 year cycle of systemic risk

The 43 year cycle of systemic risk

MacroPru objectives

a. Prevent excessive risk accumulating

b. Contain financial crises when they happen

c. Ensure the financial system contributes to growth

Effective MacroPru authorities need

VoxEU.org (2016) Jon Danielsson and Robert Macrae

- **a.** Estimates of systemic risk (and its impact on the real economy)
  - from the early signs of a build-up of stress to
  - the post-crisis economic and financial resolution
- **b.** Tools to implement effective policy remedies
- **c.** Legitimacy, a reputation for impartiality, and political support

MacroPru directions

- *Passive*
    - crisis resolution and fixed rules that hold through the financial cycle
- *Ambitious* — lean against the wind in a discretionary manner
    - Discretion to deviate from rules
    - Tighten capital and liquidity requirements during upswings and relax the same rules during and after a crisis
    - Cut through the amplifying feedback loops
- Discretionary macropru policies aim to be countercyclical
- If successful, of considerable benefit to the wider economy
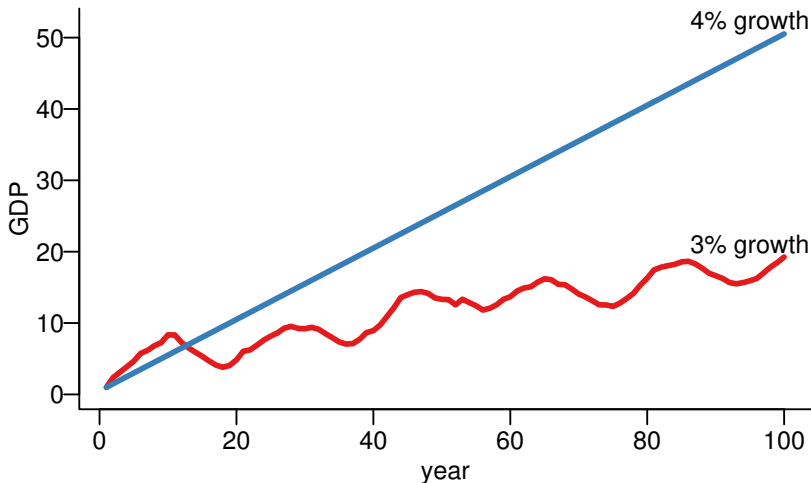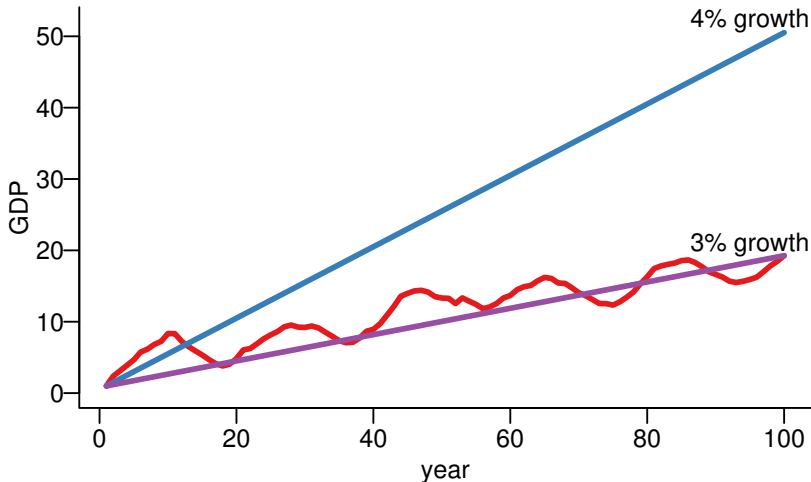
Which is the most likely?
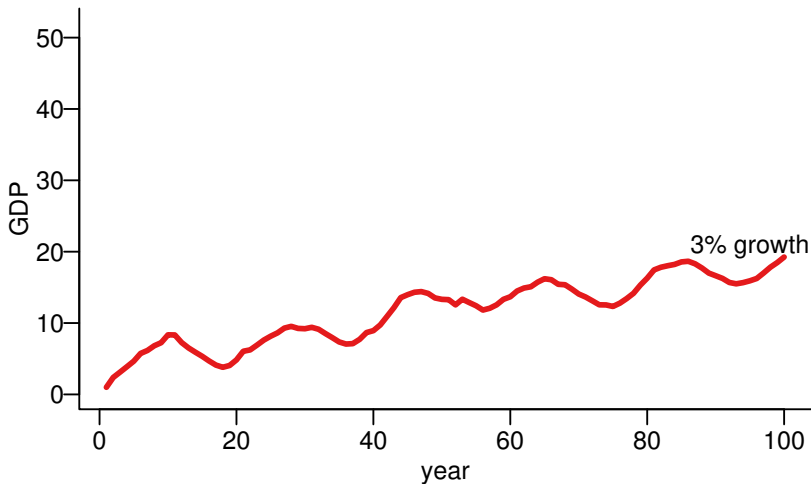
GDP over a century

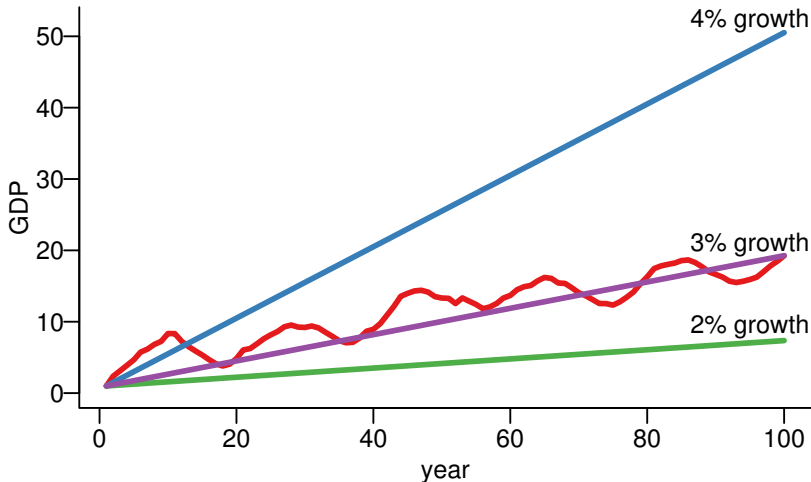# Which is the most likely?

GDP over a century

Which is the most likely?

GDP over a century

Which is the most likely?

GDP over a century

Central banks and monetary policy

- The powers given to central banks are *extraordinary* for a democratic society
- Who is more powerful, Janet Yellen or the chairman of the Joint Chiefs of Staff?
- Justified by the importance of politicians not manipulating monetary policy for short-term gains
- But it is relatively straightforward
    - **a.** One measurement (inflation)
    - **b.** Two tools (price and quantity of money)
- *Clear objective, target and tools*

By contrast

- Macropru is complex and ill-defined
- Indicators are imprecise and conflicting
- Surgical tools are ineffective
- Powerful tools too blunt
- Identifies clear winners and losers (lobbying and politics)

Major financial stress events

- Very few stress events arise purely from excessive risk (I can only think of one)
- Most are strongly influenced by politics
  a. Wars
  b. Venezuela
  c. Transition between political systems
  d. Populism and anti-globalism
  e. Government policies promoting home ownership
- The macropru event is only a consequence of something bigger

The dilemma of political risk

- Can a nonpolitical entity legitimately implement macroprudential policies that affect democratic outcomes?

- Recall Bank of England and Brexit

- Does the mandate given by the political leadership to the regulator extend to the behavior of the political leadership?

- If the macropru authorities are not able to incorporate political risk in their analytic frameworks, how effective can they be?

- And how legitimate?

Ability to execute macropru

The potential for procyclical macropru

VoxEU.org (2016) Jon Danielsson, Robert Macrae, Dimitri Tsomocos, Jean-Pierre Zigrand

- Minsky — stability is destabilizing
- Homogenization of the financial system
- Measurement
  - Most current indicators of systemic risk only identify perceived risk
  - Reacting with lag to indicators measured with a lag
  - Out of cycle response
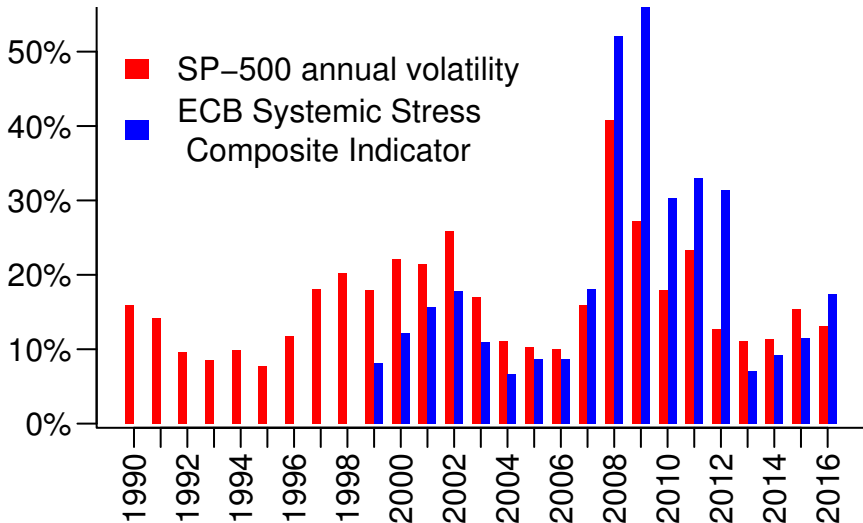
- Transparency
  - When macropru policy is known to the market, banks will schedule risk-taking around indicators, stress tests and expected policy reaction
- Symmetry
  - The authorities should be willing to *reduce* aggregate risk-taking and leverage during booms and *increase* it in times of stress
  - Post 2008 response

Conclusion

Summary

1. Volatility and high volatility weakly predict crises

2. Low volatilities strongly predict crises 5 to 10 year into the future

3. Prolonged periods of low volatility lead to excessive risk taking

4. Empirical support of Minsky's financial instability hypothesis

⇒ *"Stability is destabilizing", Minsky (1992)*