
Predictable Financial Crises?

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H A R V A R D | B U S I N E S S | S C H O O L

How predictable are crises?

“Financial crises can’t be reliably anticipated or preempted.”

–Tim Geithner

“My strong belief is that these crises are unpredictable in terms of cause or timing or the severity when they hit.”

–Hank Paulson

“This crisis involved a 21st century electronic panic by institutions... It was an old-fashioned run in new clothes.”

–Ben Bernanke

How predictable are crises?

Recognized that crises preceded by weak economic fundamentals

Kaminsky 1990, Goldstein-Kaminsky-Reinhart 2000

But, still widely believed that crises largely unpredictable

Gorton (2012) “crises are sudden, unpredictable events”

Literature in the late 1990s and 2000s using country characteristics to forecast a currency and/or banking crisis

Emerging alternate: Crises predictable byproducts of rapid expansions of credit accompanied by asset booms (Minsky, Kindleberger)

Recent papers arguing credit expansions, growth of risky credit as share of total, tight credit spreads, predict financial fragility & worse macro outcomes

Borio-Lowe 2020, Schularick-Taylor 2012, Greenwood-Hanson 2013, Baron-Xiong 2017, Lopez-Salido-Stein-Zakrajšek 2017, Mian-Sufi-Verner 2017, Krishnamurthy-Muir 2020

Yet, precise and straightforward estimates of the probability of a crisis following credit and asset price booms remain unavailable.

Open debate about how high probability of a crisis should be permitted to climb before prompting early policy action

My goals today

Estimate probability of financial crises as a function of past credit and asset price growth

Panel of 42 countries from 1950–2016

Historical data on growth of outstanding credit to businesses and households, and data on the growth of equity and home prices.

Chronology of financial crises: Baron-Verner-Xiong (2021) use hand-collected historical data on bank stock returns to improve existing crisis chronologies.

Construct indicator variables capturing “overheated” credit markets

Overheated = **Joint occurrence** of rapid asset price growth and credit growth

Do so separately for the household and business sector

How predictable are crises?

When credit markets are overheated in this sense, $\text{Prob}(\text{Crisis with 3 years}) > 40\%$

How much lead time does a policymaker have?

A decent amount-- Predictability is much stronger at 2- and 3-year horizons than at a 1-year horizon.

What do the data say today?

Main Findings (1)

1. **Consistent with Schularick and Taylor (2012) and others, crises can be predicted using past credit growth in simple linear regressions, but predictability is modest.**
2. **Predictability rises substantially when we focus on large credit expansions that are accompanied by asset price booms.**

Prob(Crisis) is high when:

Nonfinancial business credit growth is high + stock prices have risen sharply.

Household credit growth is high and home prices have risen sharply.

“Red-Zone” = Joint occurrence of rapid asset price growth and credit growth

Natural signal of an outward shift in the supply of credit, which then sows the seeds of its own destruction

Prob(Crisis) cumulates for 3-4 years after overheating: Ample early warning

3. **Overheating in business and household credit = Separate things**

Both independently predict the arrival of future crises.

Particularly dangerous in the rare instances when they occur in tandem.

Main Findings (2)

4. **Overheating in credit markets naturally has a global component and is correlated across countries.**

Construct global business Red-zone variables: Fraction of countries in our sample that are in the Red-zone in each year.

Including global variables substantially increases predictability.

5. **How high should probability of a financial crisis be allowed to climb before prompting early action on part of policymakers?**

“Back-of-the-envelope” model

Answer turns on (1) statistical tradeoff between false negative and false positive errors and (2) costs of these two policy mistakes.

Argue that early action warranted unless costs of false negatives is very low—implausibly in our view—relative to false positives.

Data

Unbalanced panel dataset covering 42 countries from 1950 to 2016

Key dependent variable = Financial crisis indicators

Baseline = Baron-Verner-Xiong (2021) indicator

Reinhart-Rogoff (2011) and Jorda-Schularick-Taylor (2017) as robustness

Independent variable #1 = Growth in business/household credit

Change in Credit-to-GDP for Businesses and Households

Focus 3-year change

Primarily drawn from IMF

Independent variable #2 = Asset price growth

Equities: 3-year real price growth from Global Financial Data

Residential Housing: 3-year real price growth from BIS

Focus on the postwar period

Forecasting Crises

Probability of Financial Crisis *onset* within 3 years

Business Debt and Equity Prices

Price Tercile	<i>Crisis Frequency</i>					<i>Diff. from Median</i>				
	Debt Quintile					Debt Quintile				
	1	2	3	4	5	1	2	3	4	5
1	4.2	4.9	4.1	7.1	19.3	-3.7	-3.1	-3.8	-0.9	11.3
2	3.5	5.3	8.0	9.5	19.4	-4.4	-2.7	0.0	1.6	11.4*
3	11.5	9.3	11.1	19.3	45.3	3.5	1.4	3.2	11.3	37.4***

Household Debt and House Prices

Price Tercile	<i>Crisis Frequency</i>					<i>Diff. from Median</i>				
	Debt Quintile					Debt Quintile				
	1	2	3	4	5	1	2	3	4	5
1	9.5	4.8	11.1	8.2	28.3	6.1**	1.5	7.8	4.9	24.9**
2	7.2	4.0	3.3	16.2	13.1	3.9	0.7	0.0	12.9**	9.8*
3	2.7	3.2	1.4	17.4	36.8	-0.6	-0.2	-1.9	14.1**	33.5***

Simple way of understanding nonlinear multivariate relationship

The Red-Zone

Define three indicator variables:

$$High-Debt-Growth_{it} = 1\{\Delta_3(Debt/GDP)_{it} > 80^{th} \text{ percentile}\}$$

$$High-Price-Growth_{it} = 1\{\Delta_3 \log(Price_{it}) > 66.7^{th} \text{ percentile}\}$$

$$R-zone_{it} = High-Debt-Growth_{it} \times High-Price-Growth_{it}$$

To assess how elevated credit and asset price growth shape Prob(Crisis), estimate Jordá-style (2005) forecasting regressions:

$$Crisis_{i,t+1 \text{ to } t+h} = \alpha_i^{(h)} + \beta^{(h)} \cdot High-Debt-Growth_{it} \\ + \delta^{(h)} \cdot High-Price-Growth_{it} + \gamma^{(h)} \cdot R-zone_{it} + \varepsilon_{i,t+1 \text{ to } t+h}$$

Results similar with or without country fixed-effects

We estimate LPMs, but marginal effects nearly identical with logit or probit

Driscoll-Kraay (1998) standard errors (panel analog of Newey-West)

Conservative *p-values* using Kiefer-Vogelsang's (2005) "fixed-b" asymptotics

Forecast with R-Zone (Business)

$$Crisis_{i,t+1 \text{ to } t+h} = \alpha_i^{(h)} + \beta^{(h)} \cdot High\text{-Debt}\text{-Growth}_{it}$$

$$+ \delta^{(h)} \cdot High\text{-Price}\text{-Growth}_{it} + \gamma^{(h)} \cdot R\text{-zone}_{it} + \varepsilon_{i,t+1 \text{ to } t+h}$$

	Crisis within 1 year				Crisis within 3 years			
	(1.1)	(1.2)	(1.3)	(1.4)	(3.1)	(3.2)	(3.3)	(3.4)
High Debt Growth ^{Bus.} ($\beta^{(h)}$)	6.9** [2.3]		5.3** [2.1]		16.8*** [3.3]		11.5** [2.7]	
High Price Growth ^{Bus.} ($\delta^{(h)}$)		0.4 [0.1]	-0.4 [-0.2]			10.5 [1.4]	7.4 [1.1]	
R-Zone ^{Bus.} ($\gamma^{(h)}$)			5.3 [0.8]	9.0 [1.1]			19.4** [2.8]	33.7*** [3.3]
Sum of coefficients ($\beta^{(h)} + \delta^{(h)} + \gamma^{(h)}$)	6.9	0.4	10.2	9.0	16.8	10.5	38.2	33.7
R^2 (within)	1.6	0.0	1.9	1.1	3.8	2.4	7.8	6.1
N	1,258	1,258	1,258	1,258	1,258	1,258	1,258	1,258

Degree of predictability rises significantly with horizon: Crises slow to develop

Additional Questions

1. How robust are these core results?
 - a) Driven by look-ahead bias?
 - b) Driven by just the 2007–2008 global financial crisis?
 - c) Hold for other crisis chronologies?
 - d) Sensitive to the specific thresholds for “high”?
2. Do overheating in the markets for business and household credit reflect a single underlying factor, or are these separate phenomena?
3. How much of the predictability is driven by global overheating in credit markets, as opposed to local, country-level credit market overheating?
4. How likely do crises need to become before warranting pre-emptive action by policymakers?

Crisis prediction & financial stability

While Red-zone indicator has substantial predictive power for arrival of a crisis, still fails to signal some crises and also generates false alarms.

How strong must the predictability be to warrant taking early policy actions to either avert or mitigate the severity of financial crises?

Different ways of defining R-zone events are associated with a natural statistical tradeoff between false negative errors and false positive errors

For instance, many of the crises not preceded by a R-zone event are “near misses” in the sense that credit and asset price growth fall just short of our assignment thresholds

So, they are preceded by a Yellow-zone or “Y-zone” in which credit and asset price growth are elevated, but not as high as in the R-zone.

So, Y-zone has fewer false negatives, but generates more false alarms than R-zone.

Use our data to construct a “policy possibility frontier,” which provides a more formal summary of the statistical tradeoff faced by policymakers.

Develop a simple framework to quantify how a policymaker tasked with promoting financial stability should trade off false positive and false negative errors—e.g., when setting her threshold for acting to “lean against the wind” of credit-market overheating.

Crisis prediction & financial stability

Contingency table: A simple representation of the predictive efficacy of the Business R-zone indicator

	Crisis within 3 years $Crisis_{i,t+1 \text{ to } t+3} = 1$	No crisis within 3- years: $Crisis_{i,t+1 \text{ to } t+3} = 0$
R-zone: $R\text{-zone}_{it} = 1$	True Positives (34)	False Positives (41)
No R-zone: $R\text{-zone}_{it} = 0$	False Negatives (117)	True Negatives (1,066)

Looking at rows:

Positive Predictive Value: $PPV = 34 / (34 + 41) = 45.3\%$

Negative Predictive Value: $NPV = 1,066 / (1,066 + 117) = 90.1\%$



$TPR = 32/50 = 64\%$ of crises preceded by Red-zone (either Bus or HH)

$TPR = 41/50 = 81\%$ of crises preceded by Yellow-zone (either Bus or HH)

7/9 crises not preceded by Yellow-zone are “double-dips”

The policy tradeoff

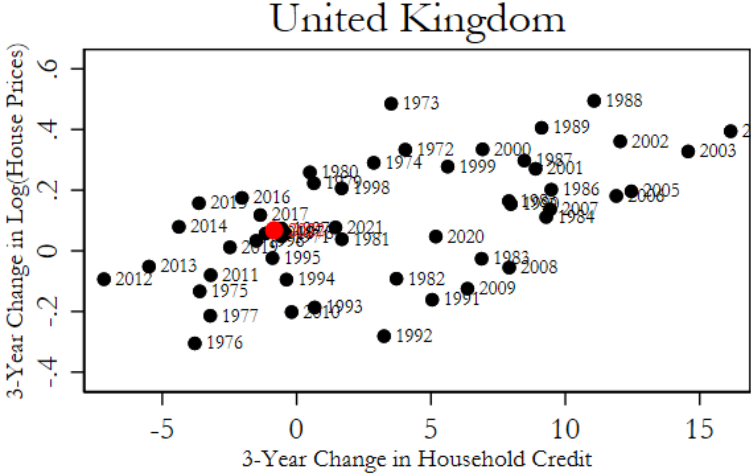
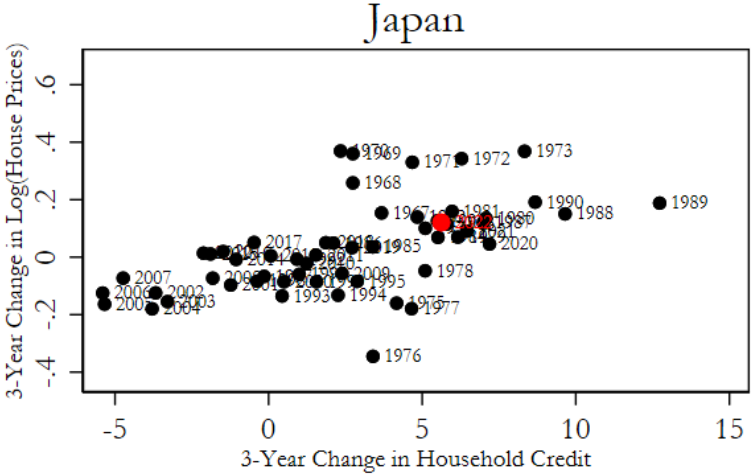
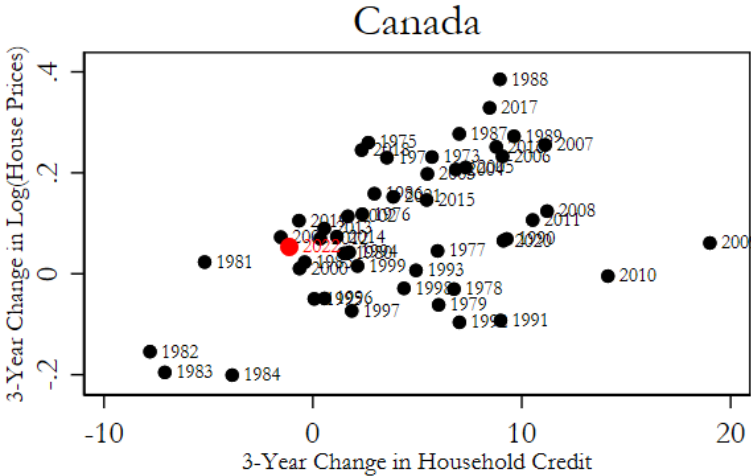
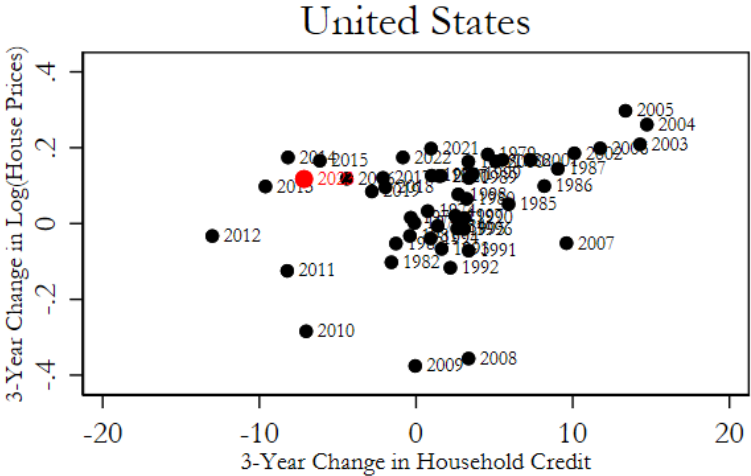
- What point on the policy possibility frontier should a policymaker choose?
 - Given the statistical tradeoff between false positives and false negatives, what should a policymaker concerned with financial stability do?
 - How high of a threshold should set for taking early actions.
- Tradeoff:
 - Taking steps to avert crises, the policymaker runs the risk of leaning against the wind based on false alarms.
 - But, if they set too high of a threshold they will fail to act.
- Optimal threshold for taking early action depends on the cost of acting based on a false alarm, compared to the cost of failing to act when the risk of a crisis is truly elevated.

Crude back-of-the-envelope

- Predictability we observe is sufficiently strong that policymakers should only adopt a “do nothing” strategy if they hold fairly extreme views about costs of failing to respond to financial stability threats vs. costs of false alarms
 - Policymaker would need to believe a leaning-against-the-wind policy, which would reduce GDP by 1 percentage point for two years if there is no crisis, would only reduce the expected severity of an incipient crisis by 2.2%.

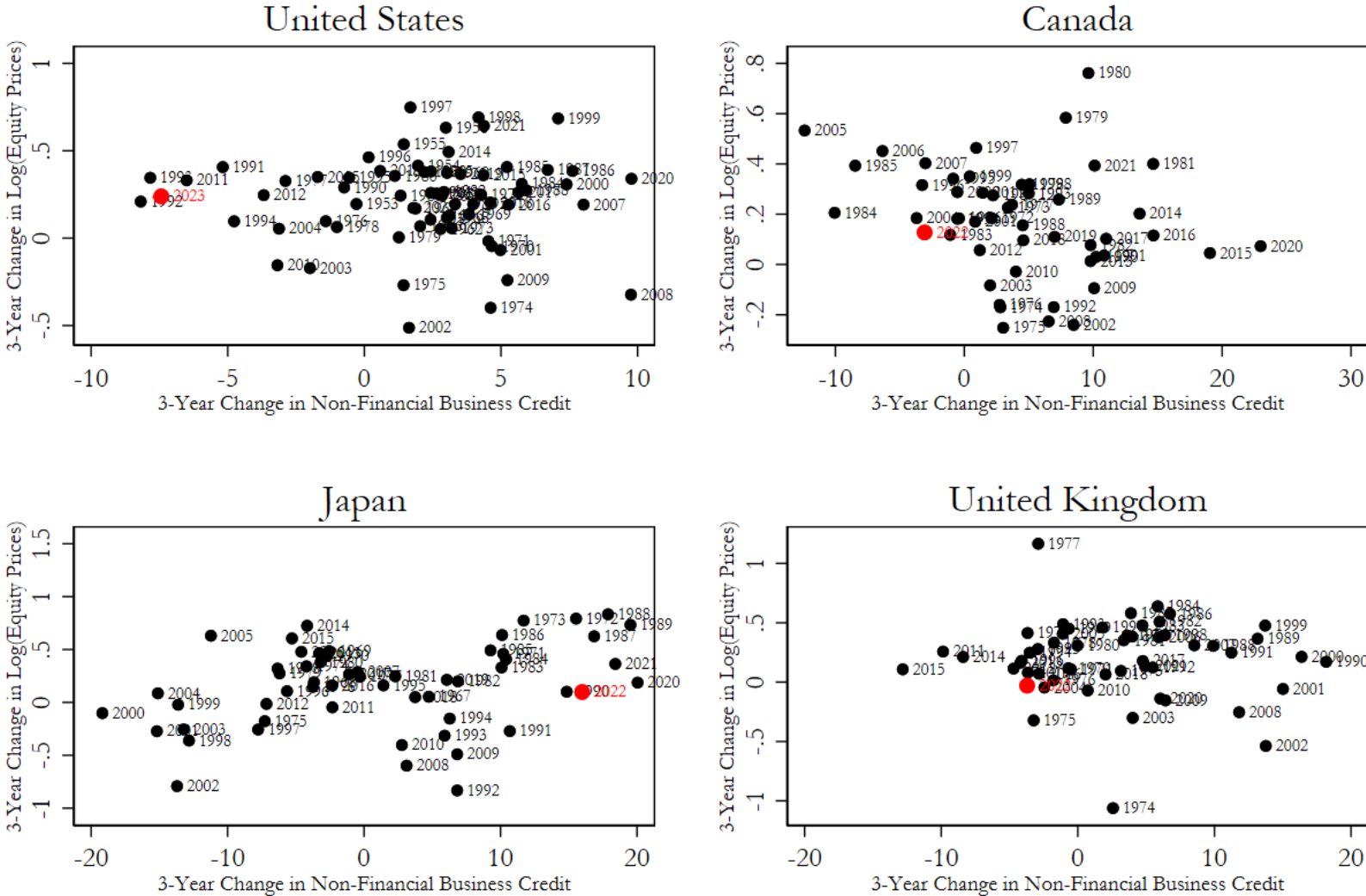
Predicting Financial Crises (Top right=Frothy Credit)

Households



Predicting Financial Crises (Top right=Frothy Credit)

Businesses



Open Issues

- These findings abstract away from policy that (presumably) tries to avoid crises.
 - Higher capital ratios
 - Countercyclical policy
- To the extent that these are successful, they make it less likely that we find predictability in the data
- But, raises question of whether awareness of these issues, combined with higher capital requirements for levered players, helps today
- Another issue is the nonbank financial sector
 - Some recent evidence by Chernenko and Scharfstein that private credit is handled by less leveraged players

Thank you!