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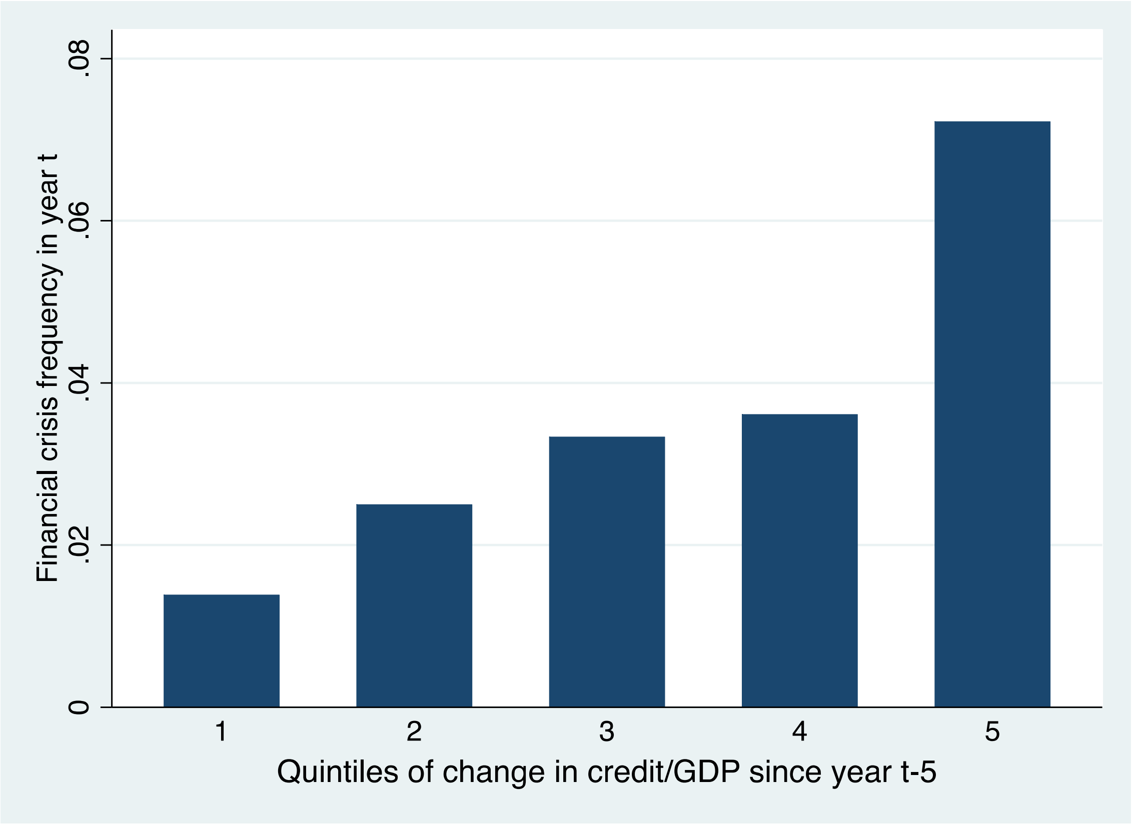
THE SWEDISH FOUNDATION FOR HUMANITIES AND SOCIAL SCIENCES

INSTABILITY FROM BELIEFS

Pedro Bordalo, Nicola Gennaioli, and Andrei Shleifer

Credit Cycle Facts

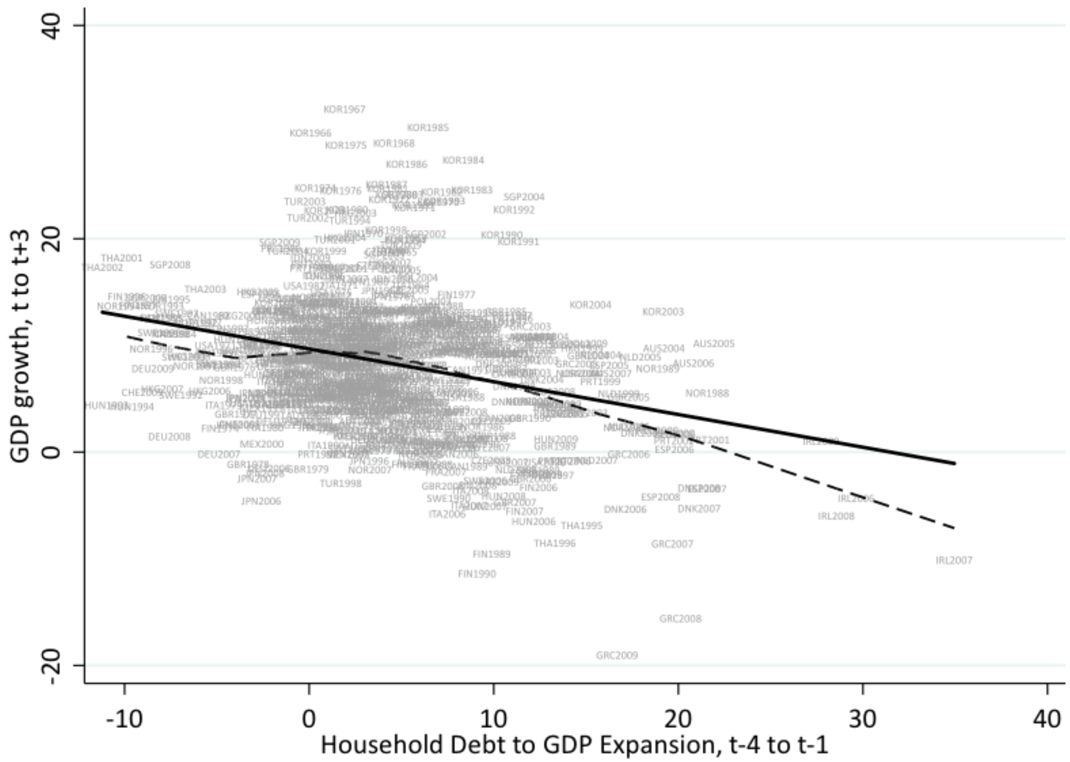
Rapid credit growth is associated with higher risk of a financial crisis.



Source: Schularick and Taylor (2012).

Credit Cycle Facts

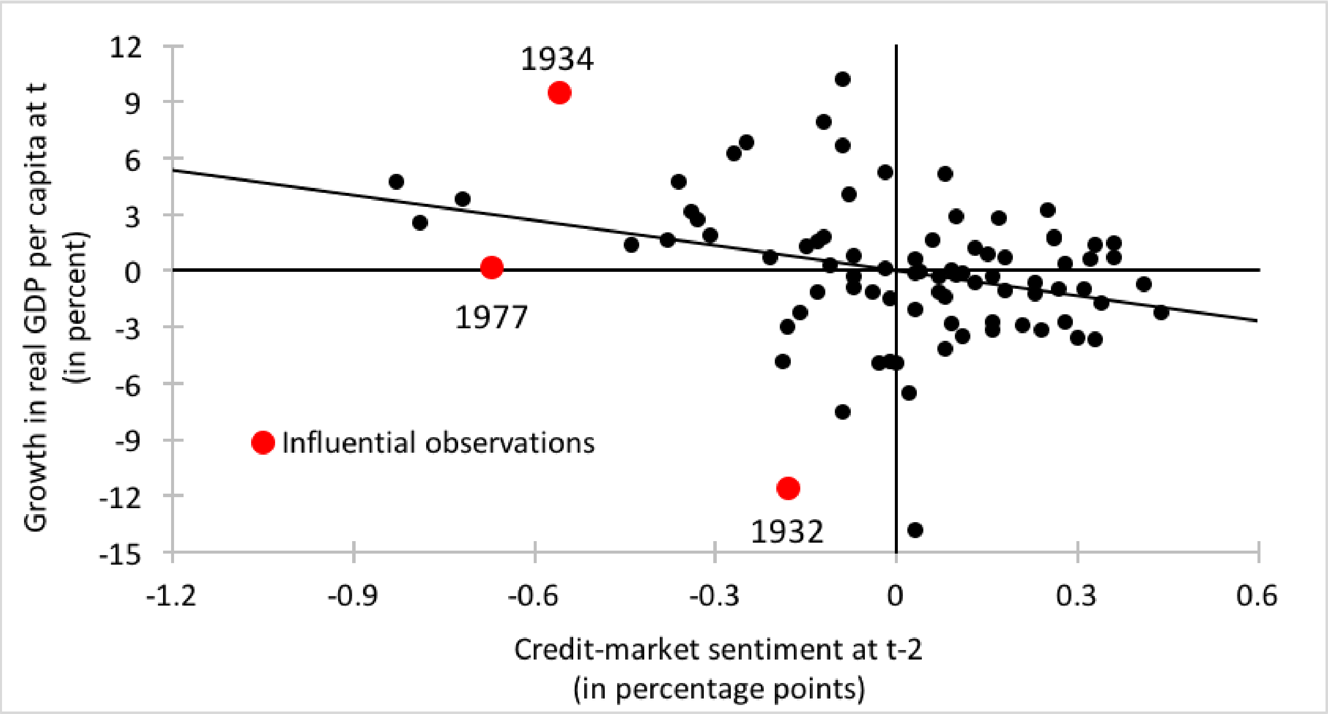
Rapid household credit growth is followed by slower economic growth.



Source: Mian, Sufi, and Verner (2017).

Credit Cycle Facts

Exuberant credit market sentiment is followed by slower economic growth.



Source: López-Salido, Stein, and Zakrajšek (2017).

Traditional View

1. Bad Shock
   (sunspot, bad fundamental news, spike in spreads)

2. Amplification Mechanism
   (short term debt, illiquidity, agency problems, adverse selection)

3. Recession
   (impaired intermediation)

Expectations are rational, crises amplify bad news.

See Bernanke (1983), Diamond and Dybvig (1983).

Instability from Beliefs

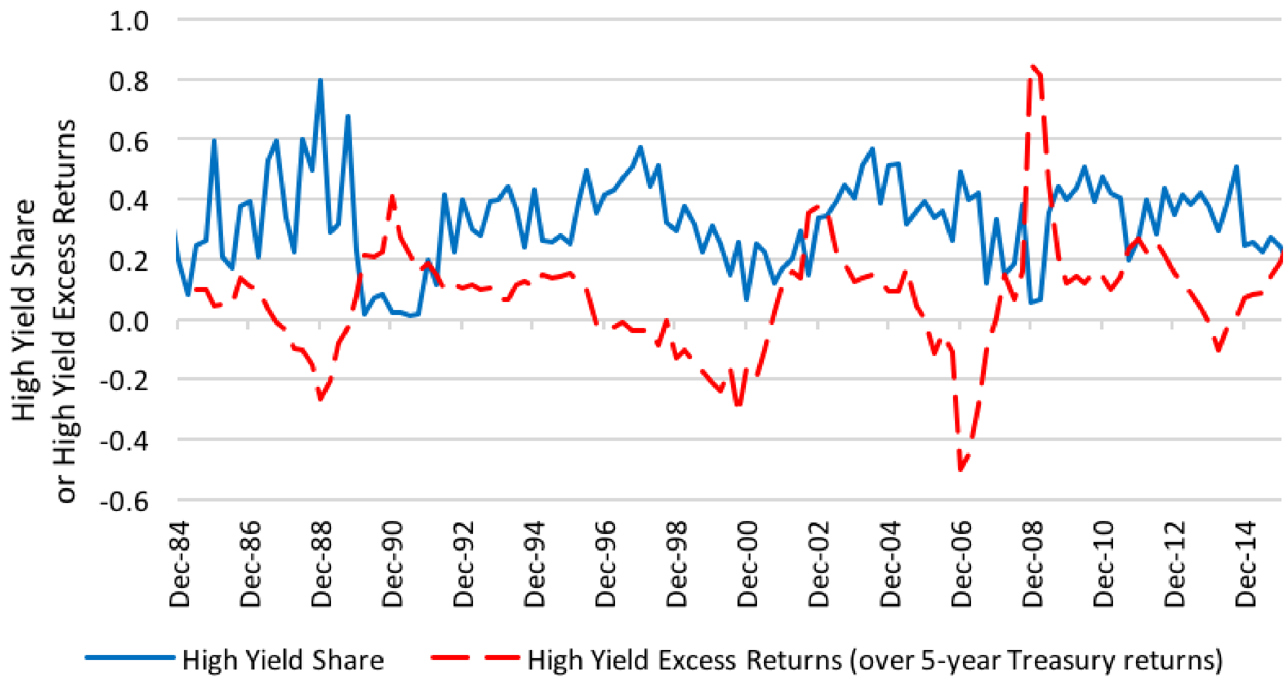
1. Excess optimism, excess lending and investment
2. Correction of expectations
   (due to bad news or waning of optimism)
3. Recession
   (impaired intermediation or excess pessimism)

Crises are due to non-rational beliefs, which may be amplified by traditional mechanisms.

See Minsky (1977), Kindleberger (1978).

Some Intriguing Evidence-1

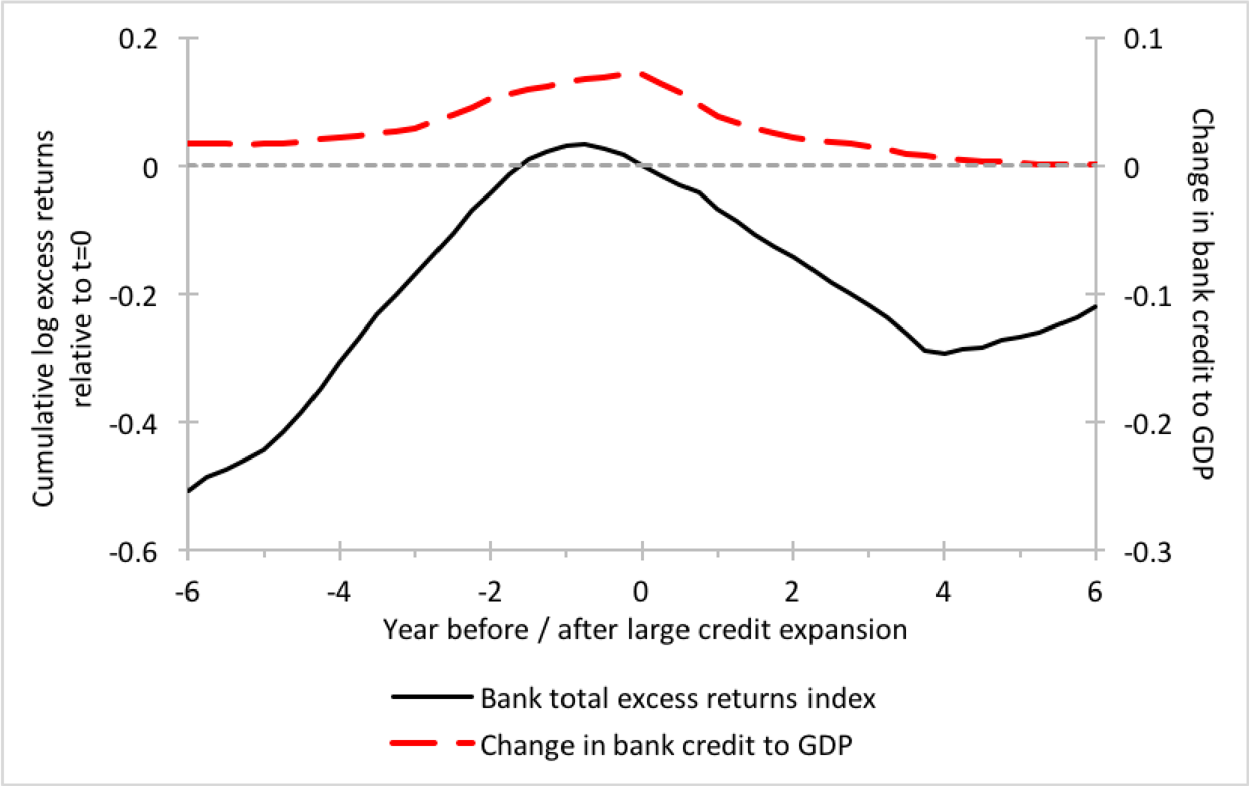
When the share of risky corporate debt in total is high, corporate bonds have low excess returns moving forward.



Source: Greenwood and Hanson (2013).

Some Intriguing Evidence-2

Bank equity prices rally leading up to the peak of a credit boom and decline afterward.



Source: Baron and Xiong (2017).

Instability from Beliefs: A Program

Measure and analyze expectations

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Develop psychologically founded, portable models of beliefs

↓

Incorporate them in standard macro/finance settings

Measure and Analyze Expectations

- How to measure beliefs?
  - Surveys
  - Techniques for inferring beliefs from asset prices
- Are survey measures reliable or just noise?
- Are measured beliefs rational? If not, how?
  - Study the predictability of forecast errors
- Heterogeneity of beliefs may be important – see Geanakoplos (2010).

Survey Data are Informative

- Greenwood and Shleifer (2014):
  - Measured expectations of stock returns strongly correlate:
    i) across six different surveys
    ii) with mutual fund flows

- Gennaioli, Ma, and Shleifer (2015):
  - Measured CFO expectations of their firms' earnings growth strongly positively correlated with:
    i) analyst expectations
    ii) firm level and aggregate investment

- Armona, Fuster, and Zafar (2016):
  - Household expectations of home prices correlated with intended home buying decisions.

Survey Data are Informative

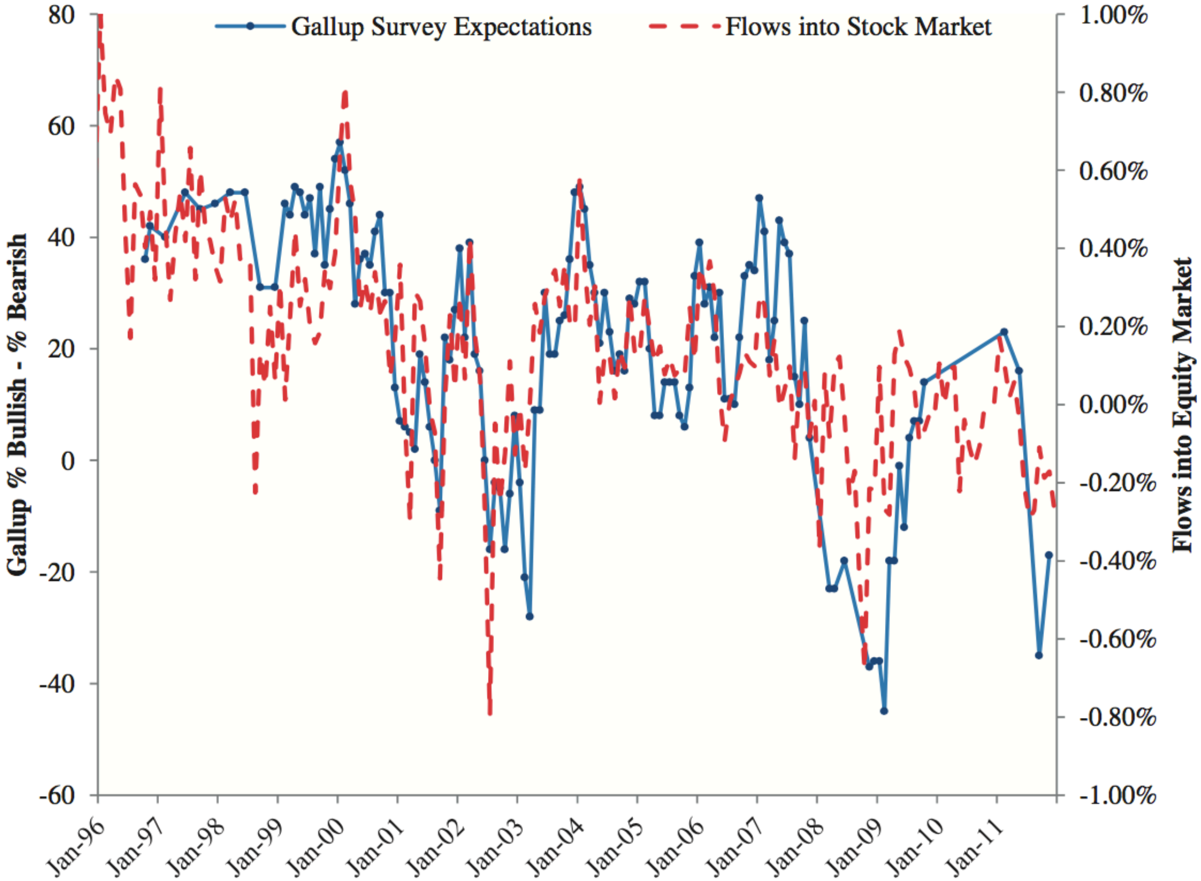
Survey expectations are not noise - market participants of different degrees of sophistication have highly correlated expectations about future returns.

	Gallup (N = 135)	Graham-Harvey (N = 42)	American Association (N = 294)	Investor Intelligence (N = 588)	Shiller (N = 132)	Michigan (N = 22)	Expectations Index (N = 294)
Graham-Harvey	0.77						
	[0.000]						
American Association	0.64	0.56					
	[0.000]	[0.000]					
Investor Intelligence	0.60	0.64	0.55				
	[0.000]	[0.000]	[0.000]				
Shiller	0.39	0.66	0.51	0.43			
	[0.000]	[0.000]	[0.000]	[0.000]			
Michigan	0.61	-0.12	0.60	0.19	-0.55		
	[0.003]	[0.922]	[0.003]	[0.395]	[0.020]		
Expectations Index	0.87	0.58	0.87	0.81	0.52	0.55	
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.008]	
Fund flow	0.69	0.71	0.42	0.20	0.51	0.40	0.45
	[0.000]	[0.000]	[0.000]	[0.002]	[0.001]	[0.068]	[0.000]

Source: Greenwood and Shleifer (2014).

Survey Data are Informative

Comparing the Gallup survey with flows into equity mutual funds.



Source: Greenwood and Shleifer (2014).

Extrapolative Beliefs

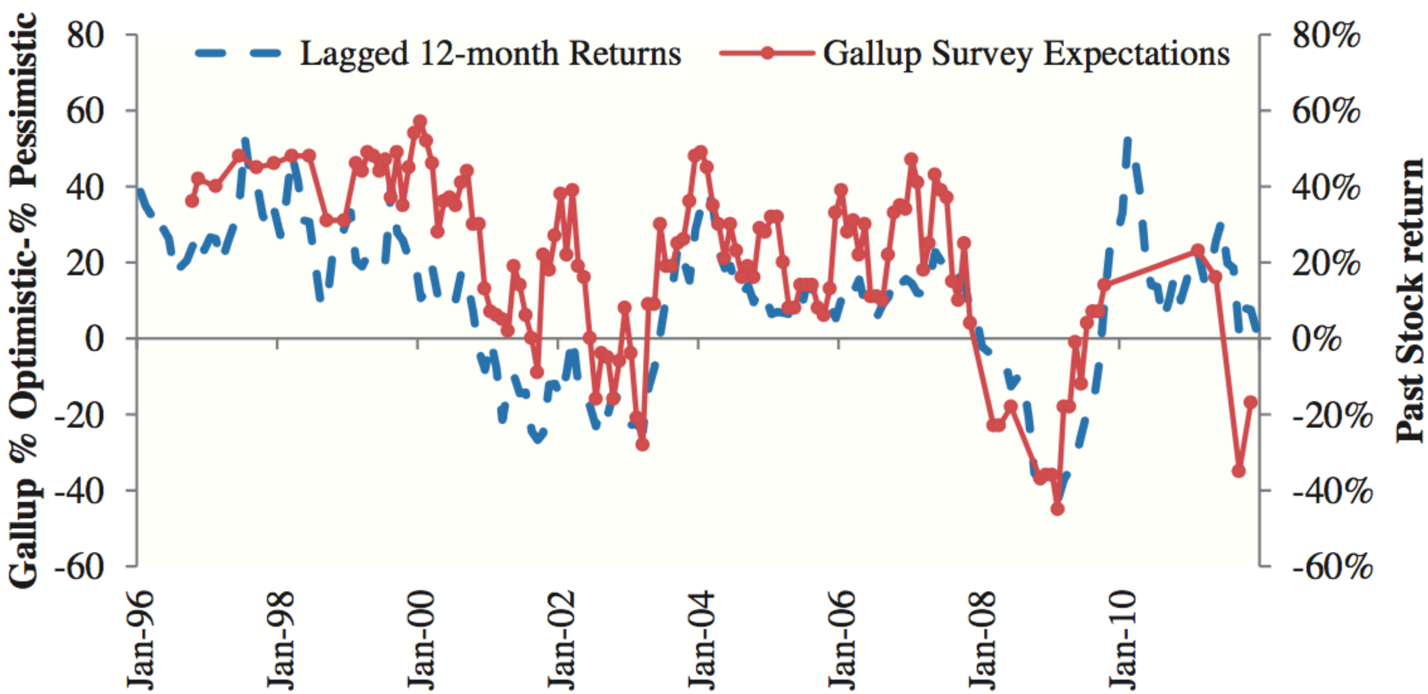
- Excess optimism about future stock returns when past stock returns have been high (Greenwood and Shleifer 2014).

- Excess optimism about a firm's earnings growth when past earnings growth has been high (Gennaioli et al. 2015; Bordalo et al. 2018).

- Forecasts of most macro series are extrapolative. In particular, they exhibit over-reaction to information about the future (Bordalo et al. 2018).

Extrapolative Beliefs

Past stock returns explain survey expectations.



Source: Greenwood and Shleifer (2014).

Predictability of Forecast Errors

Estimate two equations, following Coibion and Gorodnichenko (2015).

- Over / under reaction in consensus forecasts

$$x_{t+h} - x_{t+h|t} = \beta_0 + \beta_1 \left[x_{t+h|t} - x_{t+h|t-1} \right] + \epsilon_{t,t+h}$$

- Over / under reaction in individual forecasts

$$x_{t+h} - x^i_{t+h|t} = \beta^p_0 + \beta^p_1 \left[x^i_{t+h|t} - x^i_{t+h|t-1} \right] + \epsilon^i_{t,t+h}$$

- $\beta_1 > 0$ underreaction, $\beta_1 < 0$ overreaction

Predictability of Forecast Errors

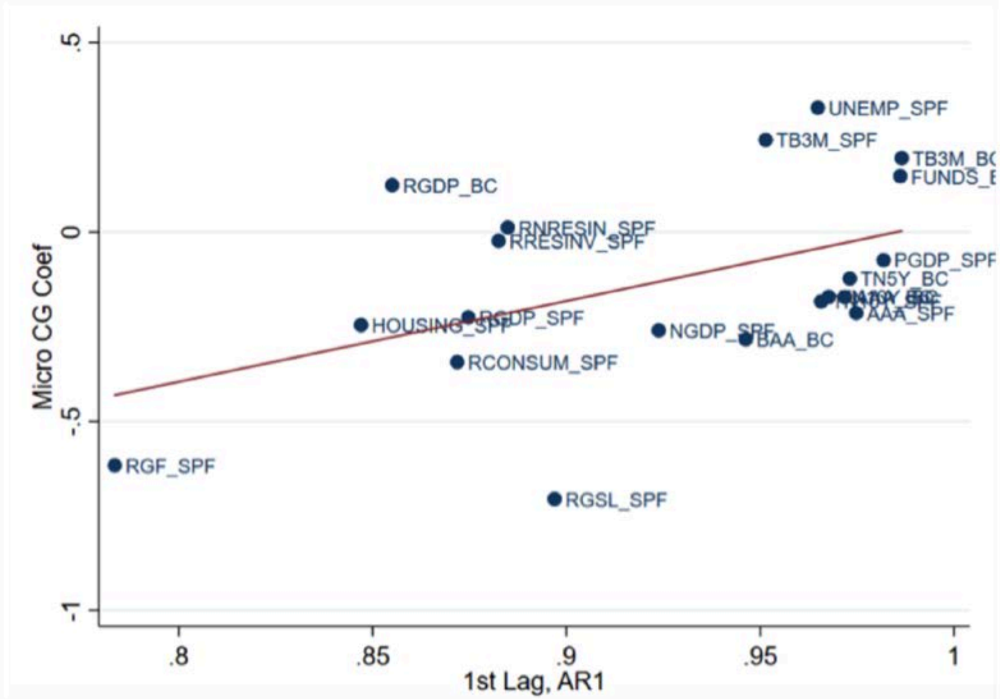
Variable	β_1	β_1^p	β_1^p (f.e.)
Nominal GDP (SPF)	0.48	-0.26	-0.30
Real GDP (SPF)	0.45	-0.23	-0.21
Real GDP (BC)	0.59	0.12	-0.02
GDP Price Index Inflation (SPF)	1.21	-0.07	-0.16
Real Consumption (SPF)	0.18	-0.34	-0.39
Real Non-Residential Investment (SPF)	0.93	0.01	-0.03
Real Residential Investment (SPF)	1.26	-0.02	-0.12
Real Federal Government Consumption (SPF)	-0.44	-0.62	-0.63
Real State&Local Govt Consumption (SPF)	-0.16	-0.71	-0.73
Unemployment (SPF)	0.82	0.33	0.26
Housing Start (SPF)	0.45	-0.25	-0.28
Fed Funds Rate (BC)	0.61	0.15	0.12
3M Treasury Rate (SPF)	0.71	0.24	0.19
3M Treasury Rate (BC)	0.67	0.20	0.16
5Y Treasury Rate (BC)	0.05	-0.12	-0.19
10Y Treasury Rate (SPF)	-0.01	-0.18	-0.23
10Y Treasury Rate (BC)	-0.06	-0.17	-0.25
AAA Corporate Bond Rate (SPF)	-0.01	-0.21	-0.26
AAA Corporate Bond Rate (BC)	0.21	-0.17	-0.22
BAA Corporate Bond Rate (BC)	-0.14	-0.28	-0.34

$p < 0.05$

Source: Bordalo, Gennaioli, Ma, and Shleifer (2018).

Kernel of Truth

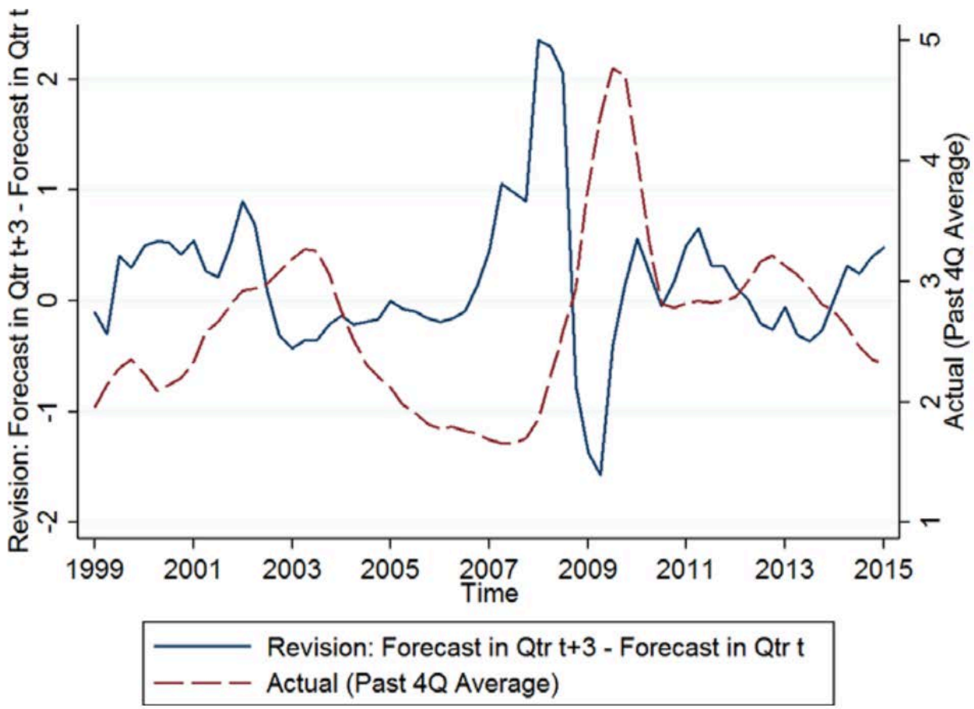
- Individual level β_1^p closer to zero for more persistent series
  - Both rational and diagnostic revisions become larger



  - Significant correlation, even removing overlapping series.

Overreaction in Credit Markets

When the current spread is low, forecasts are revised upwards. When the current spread is high, forecasts are revised downwards.



Source: Bordalo, Gennaioli, and Shleifer (2018).

Overreaction in Credit Markets

When the current spread is low, forecasts are revised upwards. When the current spread is high, forecasts are revised downwards.

Forecast Revisions of Credit Spreads

Quarterly time series regression: the dependent variable is the forecast revision (quarter $t+3$ forecast of credit spread in quarter $t+4$ minus quarter t forecast of credit spread in quarter $t+4$); the independent variable is actual credit spread averaged over quarters $t-4$ to $t-1$, where $t-1$ is the latest quarterly credit spread prior to the forecast. Standard errors in parentheses are Newey-West, with the automatic bandwidth selection of Newey and West (1994).

	Revision (1)
Current spread	−0.36
	(−2.13)
Constant	1.13
	(2.44)
Observations	64
R^2	0.15

Source: Bordalo, Gennaioli, and Shleifer (2018).

Instability from Beliefs: A Program

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Representativeness and Beliefs

- Challenge: what are the foundations of overreaction?

- Kahneman and Tversky: many errors in assessing probabilities can be viewed as due to focusing on what is representative in light of data.

- Kahneman and Tversky (1983)'s definition of representativeness: "an attribute is representative of a class if it is very diagnostic, that is, if the relative frequency of this attribute is much higher in that class than in a relevant reference class."

- Gennaioli and Shleifer (2010) model this idea.

Formalization

- Assess the probability of type t conditional on data D. The true distribution is $\Pr(t|D)$. Representativeness of t is:

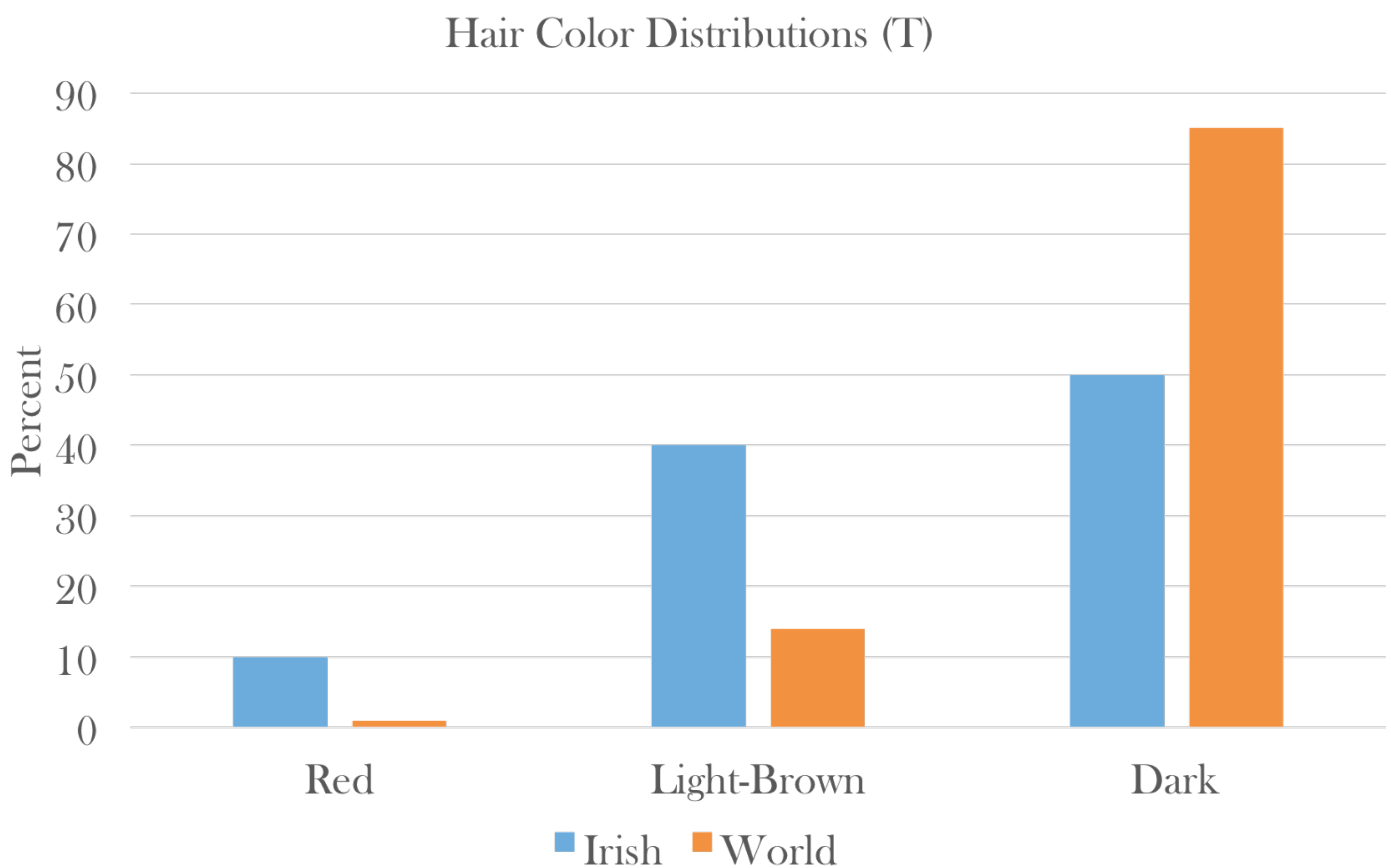
$$\frac{\Pr(t|D)}{\Pr(t|-D)}$$

- The representative type is one that has become relatively more likely in light of current data D, relative to comparison data $-D$. ($-D$ can be another group or past information.)

- Representative types easily come to mind and are overweighted in judgment.

- Proof of concept: probability that an Irish person has red hair?

Irish Example



Source: Bordalo, Coffman, Gennaioli, and Shleifer (2016).

Diagnostic Beliefs

- θ-over-weighting of representative types:

$$\Pr^{\theta}(t|D) = \Pr(t|D)\left[\frac{\Pr(t|D)}{\Pr(t|-D)}\right]^{\theta} Z$$

- Rational expectations are a special case for $\theta = 0$.
- Beliefs are forward looking and depend on true DGP.
- Testability (can distinguish from adaptive expectations).
- Key distortions: kernel of truth.

Portability

- Over-weighting of representative types unifies the explanation of:
  - Lab experiments on conjunction fallacy, disjunction fallacy, base rate neglect (Gennaioli and Shleifer 2010).
  - Social psychology of stereotypes and data on beliefs about political groups (Bordalo et al. 2016).
  - Experiment on gender and self confidence (Bordalo et al. 2016).

- But also, can be used to model expectations in finance and macroeconomics:
  - Analyst expectations of future corporate earnings.
  - Analyst expectations of future spreads and interest rates.
  - Forecaster expectations of macroeconomic variables.

Intertemporal Inference

- Forecast the AR(1) variable (with normal shocks):

$$x_{t+1} = \rho x_t + \epsilon_{t+1}$$

- Data D is news received at $t, \epsilon_t = x_t - \rho x_{t-1}$. Diagnostic distribution:

$$f_t^\theta(x_{t+1}) = f(x_{t+1}|x_t)\left[\frac{f(x_{t+1}|x_t)}{f(x_{t+1}|\rho x_{t-1})}\right]^\theta Z_t$$

- Overweight states whose likelihood has gone up.

Intertemporal Inference

- The diagnostic distribution $f_t^{\theta}(x_{t+1})$ is normal with same variance as the true one, and with mean:

$$\mathbb{E}_t^{\theta}(x_{t+1}) = \rho x_t + \theta\rho(x_t - \rho x_{t-1})$$

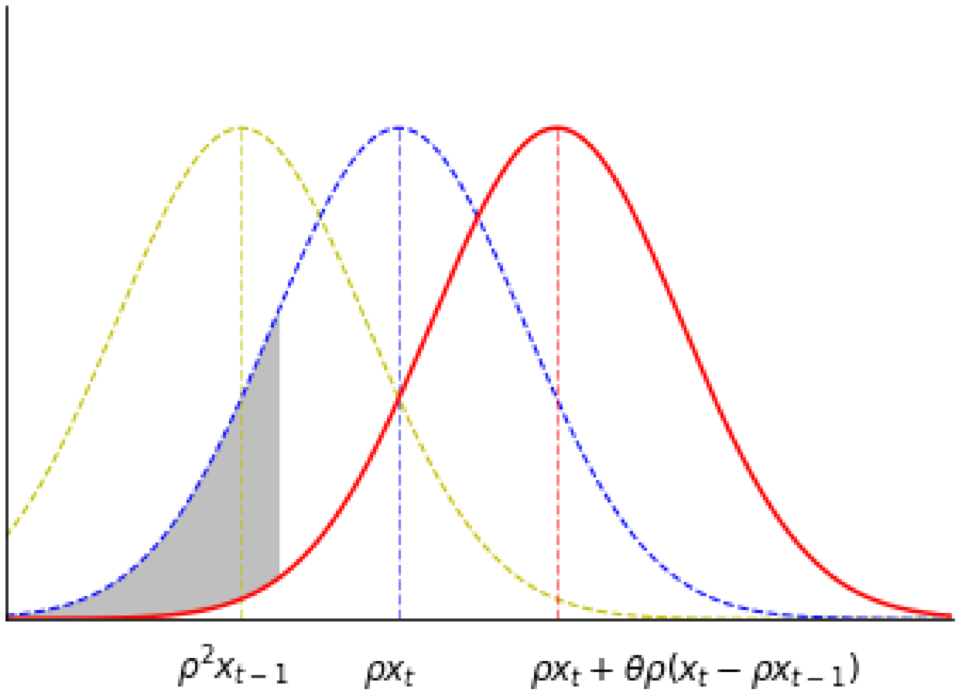
- Extrapolation: past changes are projected into the future.

- Neglect of risk: after good news, the left tail is underweighted.

- Forward looking: updating more aggressive when persistence ρ is higher (Lucas 1976).

Intertemporal Inference

- The diagnostic distribution after good news, $x_t - \rho x_{t-1} > 0$



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Credit Cycles in Reduced Form

- Interest rate spread falls in expected future productivity $\mathbb{E}_t^\theta(A_{t+1})$

$$r_t = b_0 - b_1 \mathbb{E}_t^\theta(A_{t+1})$$

  - Higher expected productivity implies lower default risk.

- Lending and capital increases in expected future productivity $\mathbb{E}_t^\theta(A_{t+1})$

$$K_{t+1} = a_0 + a_1 \mathbb{E}_t^\theta(A_{t+1})$$

  - Time to build, lower cost of capital.

- All this is microfounded in BGS (2018).

Credit Cycles in Reduced Form

- Suppose productivity follows an AR(1):

$$A_{t+1} = \rho A_t + \epsilon_{t+1}$$

- Then credit spreads and investment follow:

$$r_t = b_0(1-\rho) + \rho r_{t-1} - \rho b_1(1+\theta)\epsilon_t + b_1\rho^2\theta\epsilon_{t-1}$$

$$K_t = a_0(1-\rho) + \rho r_{t-1} + \rho a_1(1+\theta)\epsilon_t - a_1\rho^2\theta\epsilon_{t-1}$$

  - ARMA (1,1): over-reaction to current news, reversal of past news
  - Predictable cycles in prices and quantities: excess optimism in good times, on average wanes next period.

Predictions

- Fluctuations in optimism due to diagnostic beliefs can account for key credit cycles facts:
  - Rising high yield share in good times
  - Predictability of low bond returns afterwards
  - Predictability of future spikes in spread and lower subsequent GDP growth
  - Excess volatility in credit spreads determined by θ
  - Over-reaction to news by credit market forecasters

- We are not at the level of full quantification, but we have used expectations data to back out the value of θ.

Forecast Errors and θ

- The model yields predictions on predictability of forecast errors from forecast revisions:

$$\frac{cov\left(x_{t+1} - \mathbb{E}_t^\theta(x_{t+1}), \mathbb{E}_t^\theta(x_{t+1}) - \mathbb{E}_{t-1}^\theta(x_{t+1})\right)}{var\left(\mathbb{E}_t^\theta(x_{t+1}) - \mathbb{E}_{t-1}^\theta(x_{t+1})\right)} = -\frac{\theta(1+\theta)}{(1+\theta)^2 + \rho^2\theta^2}$$

- Matching this to the credit spreads data yields $\theta \approx 0.9$.
- For analysts' earnings growth forecasts, we get $\theta \approx 1.1$.
- For macroeconomic foecasts, we get θ ranging from 0.4 to 1.4.

- Important to assess stability of θ and quantitative implications.

Takeaways

- Use of expectations data allows us to make progress. Data suggests that rational expectations may be too restrictive.

- Evidence consistent with over-reaction to news. This opens the way for financial instability to come from beliefs.

- A psychologically founded model of representativeness and beliefs yields main qualitative facts of credit cycles and expectations.

- Open problems:
  - understanding rigidity and underreaction
  - more realistic macro models
  - Bubbles and richer dynamics
  - quantification

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