Credit Spreads and the Severity of Financial Crises

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Questions

- How long and deep is the typical financial crisis?
- Is the GDP path in financial crisis recessions significantly different than in noncrisis recessions?
- What are the pre-conditions for a crisis?

Theory: What is a financial crisis?

- Shock z_t: recessionary shock, lower expected cash-flows on assets held by intermediaries
- Fragility F_t: high leverage/low equity capital, short-term debt, correlated intermediary positions, interconnected exposures

- "Trigger" + "Amplification"
  - Asset price feedback
  - Credit crunch
- Credit spreads rise:
  - Expected default + risk/illiquidity premium

- Kiyotaki-Moore, He-Krishnamurthy,…

Empirics: Identifying financial crises

- Reinhart and Rogoff (2009):

  We mark a banking crisis by two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that marks the start of a string of similar outcomes for other financial institutions.

- Bordo, et. al., (2001):

  We define financial crises as episodes of financial-market volatility marked by significant problems of illiquidity and insolvency among financial-market participants and/or by official intervention to contain those consequences. For an episode to qualify as a banking crisis, we must observe financial distress resulting in the erosion of most or all of aggregate banking system capital.

Identifying financial crises

Schularick and Taylor (2012):

> *In line with the previous studies we define financial crises as events during which a country's banking sector experiences bank runs, sharp increases in default rates accompanied by large losses of capital that result in public intervention, bankruptcy, or forced merger of financial institutions….In a last step, we have sent the crisis dates to colleagues who are country specialists and asked them to confirm the dates that we have listed*

Schularick and Taylor dates:

- Date of bank failures, runs, etc.
- And start date of recession that accompanies the bank failures

Evidence on crisis aftermath

- Typical regression. Given a set of crisis dates:

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + b \times 1_{crisis,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- Underlying relation: $1_{crisis,t}$ if $z_t F_t$ >Threshold

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + \beta \times \boldsymbol{z_t F_t} \times 1_{crisis,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

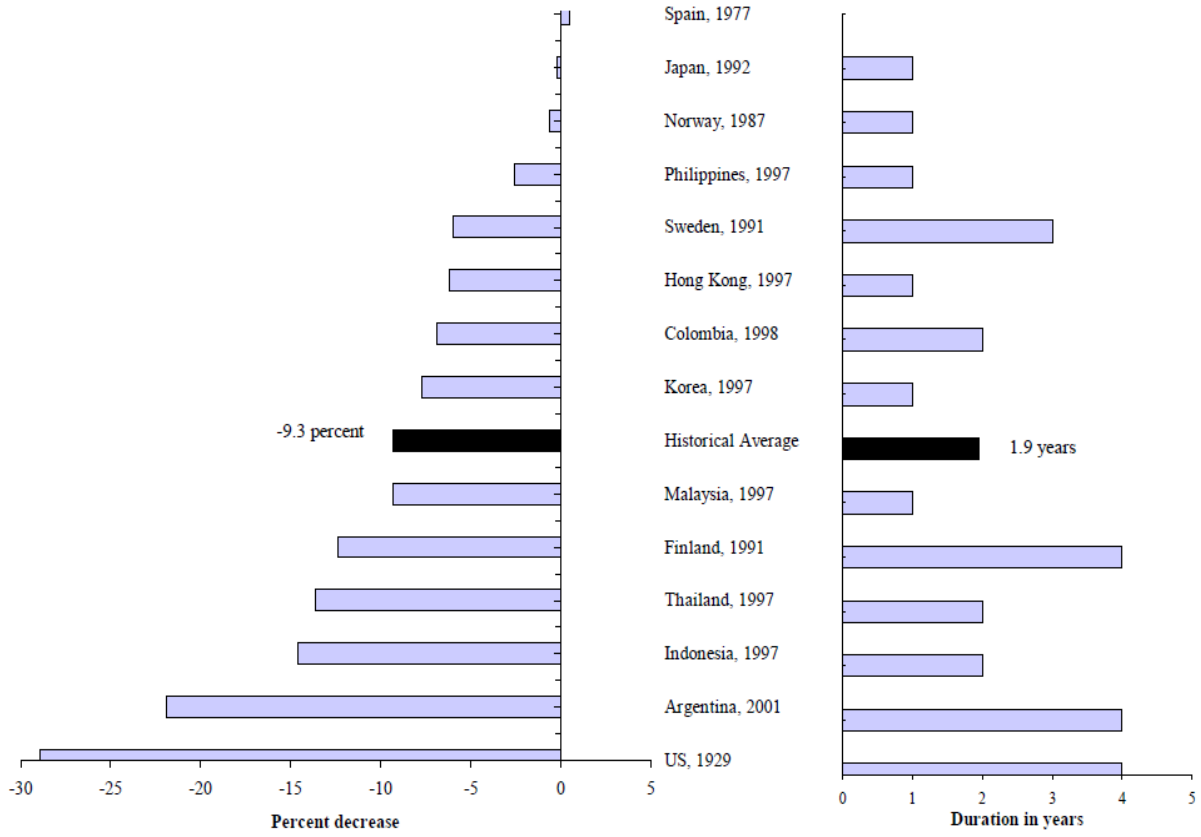
Thresholds and heterogeneity in $z_t F_t$

- Reinhart and Rogoff (2009)
  - -9.3% Peak-to-trough
- Schularick and Taylor (2012)
  - -6%
- Claessens, Kose, Terrones (2009)
  - -2.5%

Figure 4

Past Real Per Capita GDP Cycles and Banking Crises: Peak-to-trough

Percent Decline in Real GDP (left panel) and Years Duration of Downturn (right panel)



Thresholds and heterogeneity in $z_t F_t$

- Reinhart and Rogoff (2009)

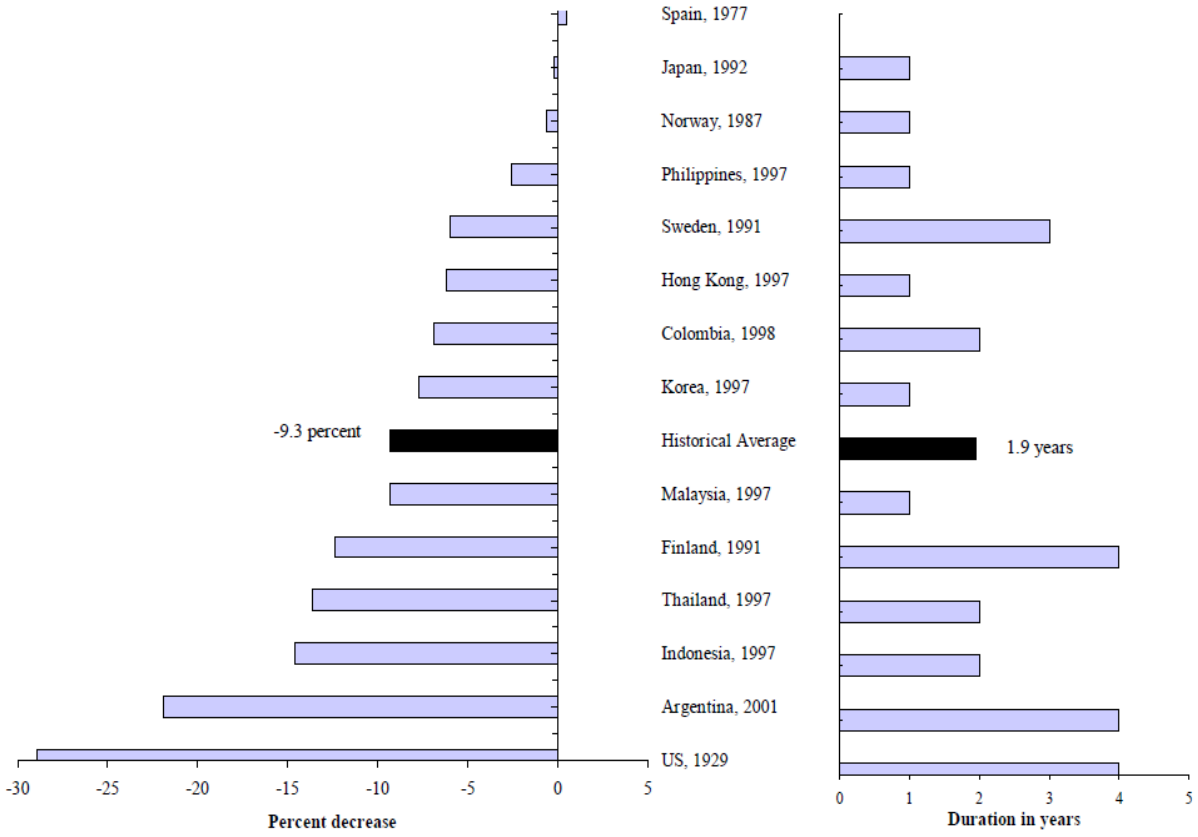
- Romer and Romer (2015):

  - Crisis dating has a "we know one when we see one" feel

Figure 4

Past Real Per Capita GDP Cycles and Banking Crises: Peak-to-trough

Percent Decline in Real GDP (left panel) and Years Duration of Downturn (right panel)



From Bordo and Meissner (2015), Handbook of Macro chapter (forthcoming)

PRE-WWI 1880-1913
Bordo et. al. vs. RR

		Reinhart & Rogoff		% agree	
		No crisis	Banking Crisis	same year	+/-1 yr.
Bordo et. al.	No crisis	672	14	0.52	0.62
	Banking Crisis	6	22		

21 countries (21 in Bordo et. al. & 70 in Reinhart & Rogoff)

1880-1913
RR vs. Taylor

		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 yr.
Reinhart & Rogoff	No crisis	495	16	0.34	0.47
	Banking Crisis	13	15		

17 countries (70 in Reinhart & Rogoff & 17 in Taylor)

1880-1913
Bordo et. al. vs. Taylor

		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 yr.
Bordo et. al.	No crisis	507	17	0.38	0.43
	Banking Crisis	6	14		

17 countries (21 in Bordo et. al. & 17 in Taylor)

(1)Why are credit spreads useful?

- Underlying relation: $1_{crisis,t}$ if $z_t F_t$ >Threshold

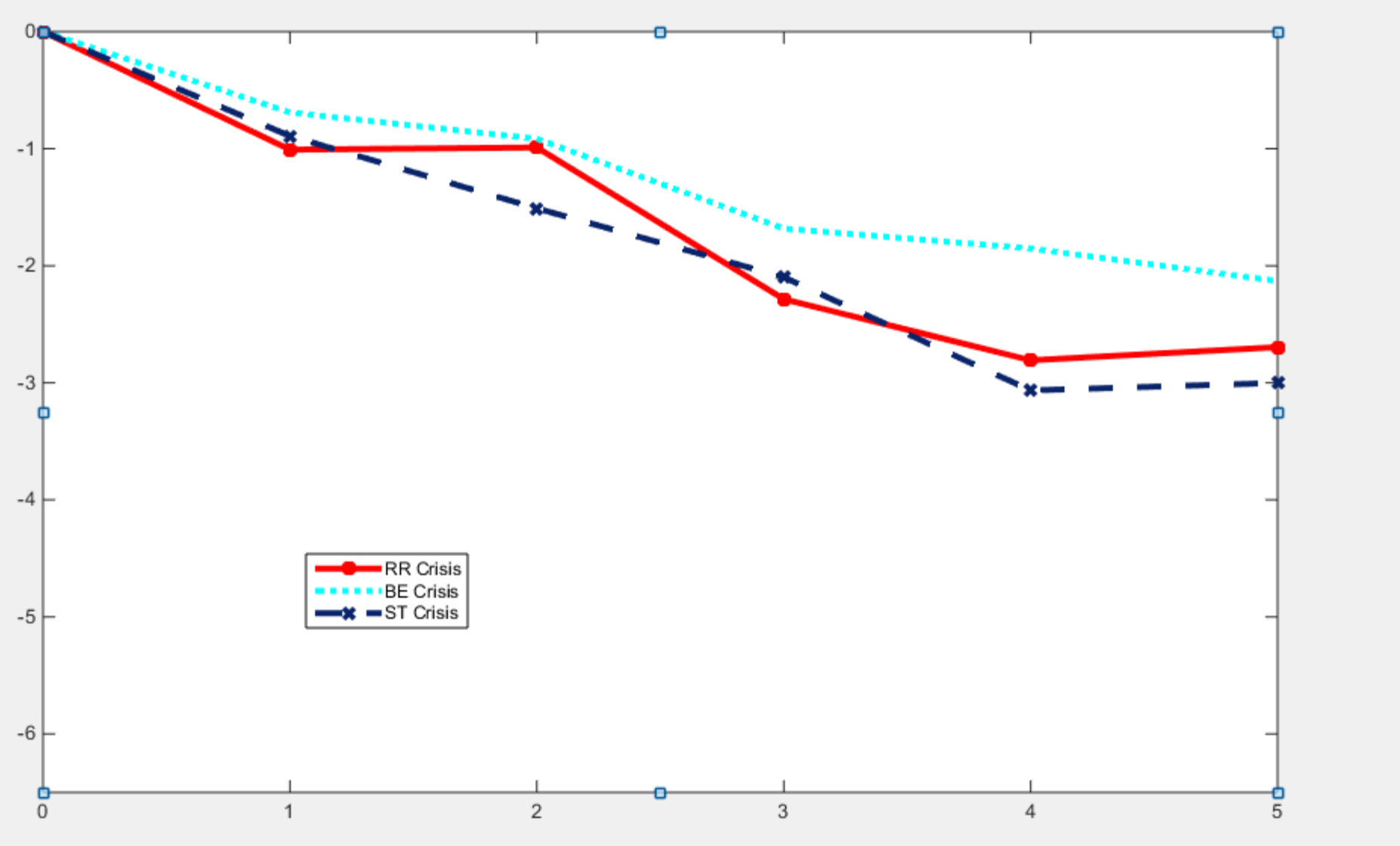
$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + \boldsymbol{\beta} \times \boldsymbol{z_t F_t} \times 1_{crisis,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- Spreads are a (noisy) measure of $\boldsymbol{z_t F_t}$:

$$s_{i,t} = \gamma_i + \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \gamma_2 z_t F_t$$

Default, Risk, Illiquidity

5-Year GDP path; 3 different chronologies



(2)Why are credit spreads useful?

- What should we have expected after 2008?
- Existing literature:

$$E_t\left[\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) \mid crisis\ at\ t = 2008\right]$$

- We can provide:

$$E_t\left[\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) \mid crisis\ at\ t = 2008, s_{i,t=2008}\right]$$

(3)Why are credit spreads useful?

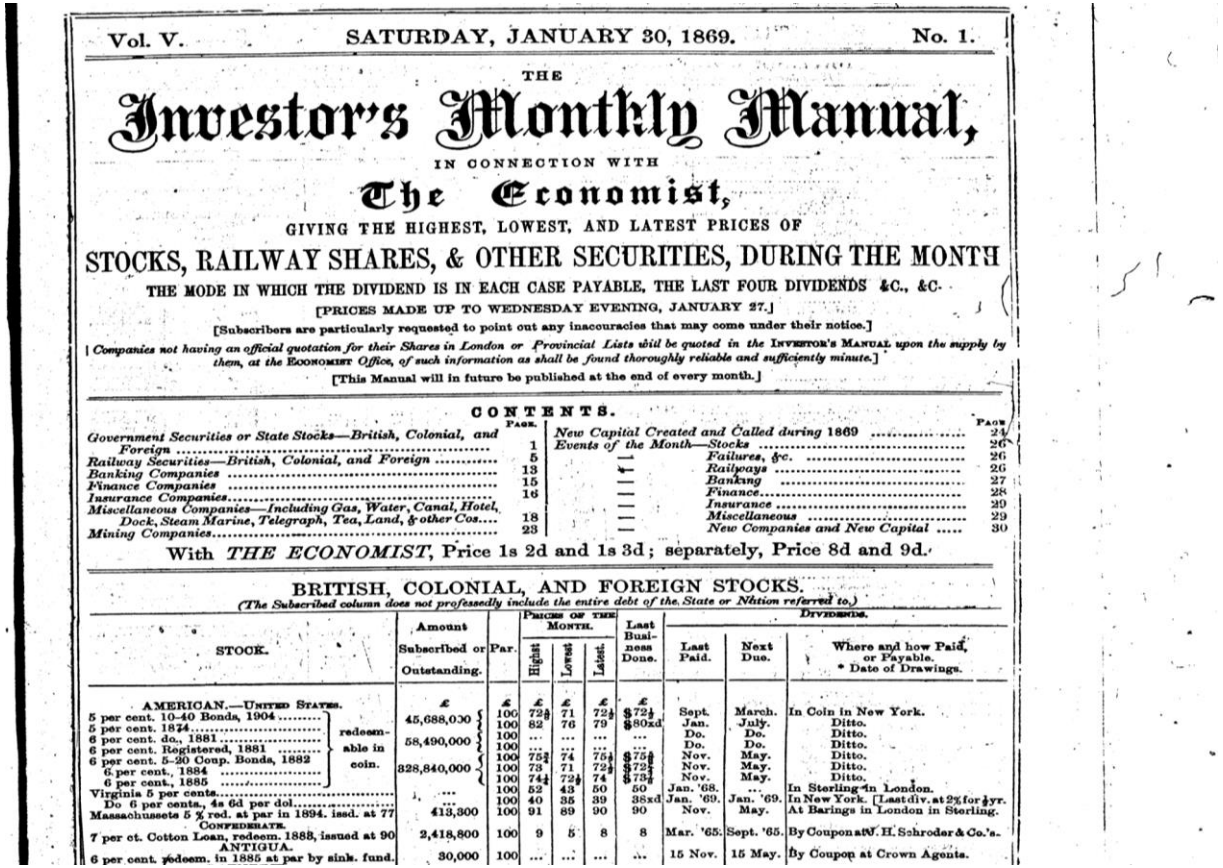
- Investor expectations
  - What did investors expect pre-crisis?
  - How did expectations change?

Data: Credit spreads, crisis dates, GDP

- 1869-1930 across 14 countries
- 1930-present from various central banks and other data sets (Datastream, GFD) for more recent credit spreads
  - High grade minus low grade corporate spread
  - Corporate bond index to government bond
- We cross this data with crisis dates from Reinhart-Rogoff and Schularick-Taylor and Bordo-Eichengreen-Klingebiel-Martinez
  - Crisis dating 0/1: Crisis if there are significant bank failures/runs or government bailouts of the financial sector
  - ST dates: recessions with and without financial crises
- Total of 672 country-year observations, and 44 ST crises

Credit spreads: 1869-1929

- Individual bond prices on banks, sovereigns, railroad, etc.
  - Over 4000 unique bonds, 200,000 bond / years
- We convert to yield to maturity
- Spread = high 10th percentile avg yield minus low 10th percentile avg yield



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THE

Investor's Monthly Manual,

IN CONNECTION WITH

The Economist,

GIVING THE HIGHEST, LOWEST, AND LATEST PRICES OF

STOCKS, RAILWAY SHARES, & OTHER SECURITIES, DURING THE MONTH

THE MODE IN WHICH THE DIVIDEND IS IN EACH CASE PAYABLE, THE LAST FOUR DIVIDENDS &C., &C.

[PRICES MADE UP TO WEDNESDAY EVENING, JANUARY 27.]

[Subscribers are particularly requested to point out any inaccuracies that may come under their notice.]

[*Companies not having an official quotation for their Shares in London or Provincial Lists will be quoted in the* INVESTOR'S MANUAL *upon the supply by them, at the* ECONOMIST *Office, of such information as shall be found thoroughly reliable and sufficiently minute.*]

[This Manual will in future be published at the end of every month.]

CONTENTS.

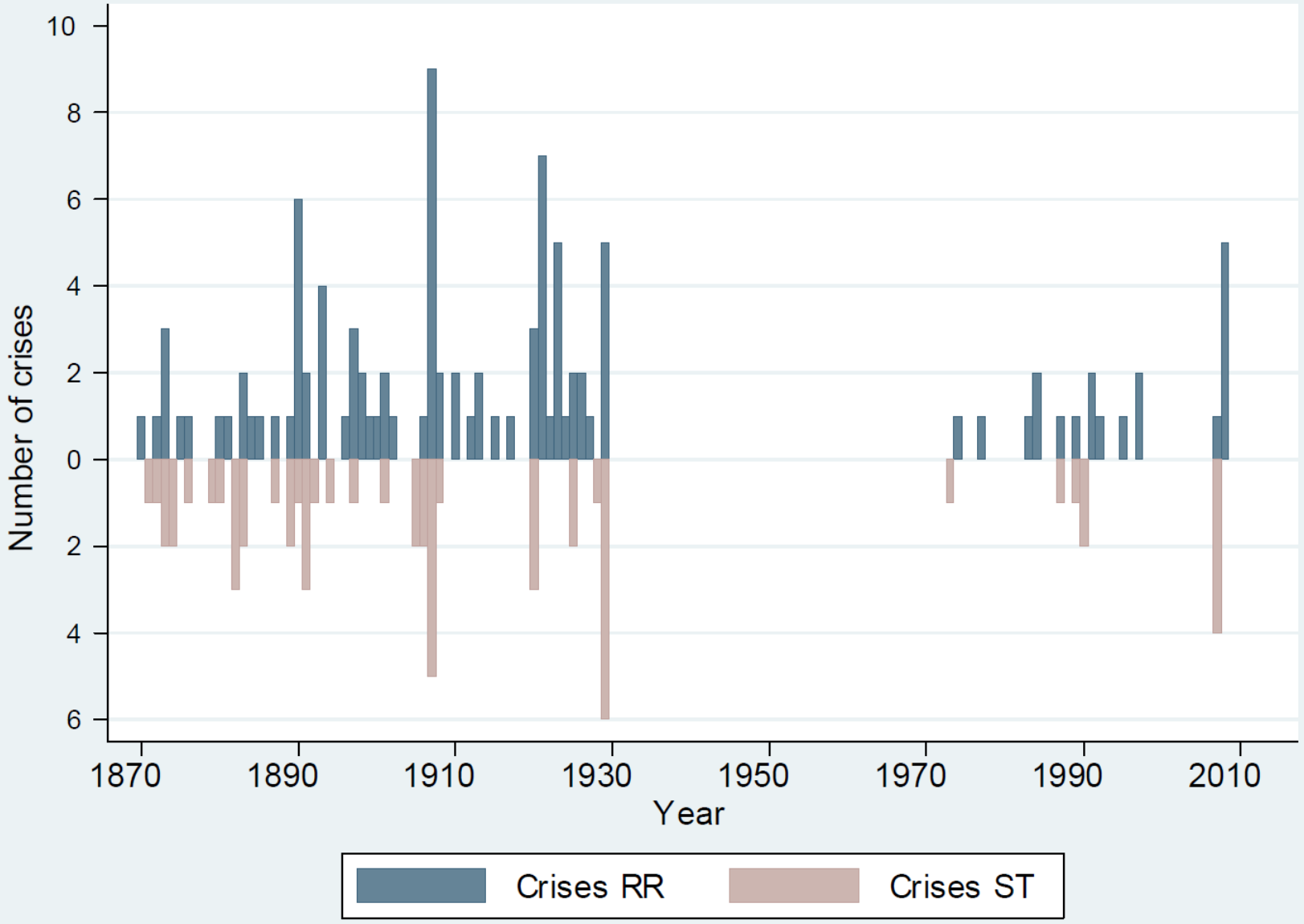
With *THE ECONOMIST*, Price 1s 2d and 1s 3d; separately, Price 8d and 9d.

BRITISH, COLONIAL, AND FOREIGN STOCKS.

(*The Subscribed column does not professedly include the entire debt of the State or Nation referred to.*)

STOCK.	Amount Subscribed or Outstanding.	Par.	Prices of the Month. Highest.	Lowest.	Latest.	Last Business Done.	Dividends. Last Paid.	Next Due.	Where and how Paid, or Payable. * Date of Drawings.
AMERICAN.—UNITED STATES.	£	£	£	£	£	£			
5 per cent. 10-40 Bonds, 1904 (redeemable in coin.)	45,688,030	100	72⅜	71	72½	$72½	Sept.	March.	In Coin in New York.
5 per cent. 1874		100	82	76	79	$80xd	Jan.	July.	Ditto.
6 per cent. do., 1881	58,490,000	100	...	...	...	...	Do.	Do.	Ditto.
6 per cent. Registered, 1881		100	...	...	...	...	Do.	Do.	Ditto.
6 per cent. 5-20 Coup. Bonds, 1882		100	75¾	74	75¼	$75⅝	Nov.	May.	Ditto.
6 per cent., 1884	328,840,000	100	73	71	72½	$72½	Nov.	May.	Ditto.
6 per cent., 1885		100	74¼	72½	74	$73¼	Nov.	May.	Ditto.
Virginia 5 per cents	...	100	52	43	50	50	Jan. '68.	...	In Sterling in London.
Do 6 per cents, 4s 6d per dol.	...	100	40	35	39	38xd	Jan. '69.	Jan. '69.	In New York. [Last div. at 2% for ½ yr.
Massachussets 5 % red. at par in 1894. issd. at 77	413,300	100	91	89	90	90	Nov.	May.	At Barings in London in Sterling.
CONFEDERATE.									
7 per ct. Cotton Loan, redeem. 1883, issued at 90	2,418,800	100	9	5	8	8	Mar. '65.	Sept. '65.	By Coupon at W. H. Schroder & Co.'s.
ANTIGUA.									
6 per cent. redeem. in 1885 at par by sink. fund.	30,000	100	...	...	...	...	15 Nov.	15 May.	By Coupon at Crown Agents.

Data coverage



Still need post-war data:

France, Italy, Spain

Mexico, Brazil, Argentina

Specifications

- Panel data regressions (country i, horizon k):

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + b \times s_{i,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- t-stats cluster by country
- Controls: lagged spreads, GDP growth

- Interact with crisis dummies

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + 1_{crisis} \times [a^c + b^c \times s_{i,t} + b^c_{-1} \times s_{i,t-1}] +$$
$$1_{no-crisis} \times [b^{nc} \times s_{i,t} + b^{nc}_{-1} \times s_{i,t-1}] + c' x_t + \epsilon_{i,t+k}$$

Specification and Normalization

- Panel data regressions (country i, horizon k):

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + b \times s_{i,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- Raw spreads don't work. Need to normalize spread:

$$\hat{s}_{i,t} = \frac{spread_{i,t}}{\overline{spread_i}}$$

- Similar results if we normalize by median, compute z-scores, convert to percentile. Results weaker but significant if we use rolling normalization

$$\text{Peak-to-trough}_{i,t} = a + b_1\,\hat{s}_{i,t} + b_2\,\hat{s}_{i,t-1} + b_1\,\Delta lev_{i,t} + \varepsilon_{i,t}$$

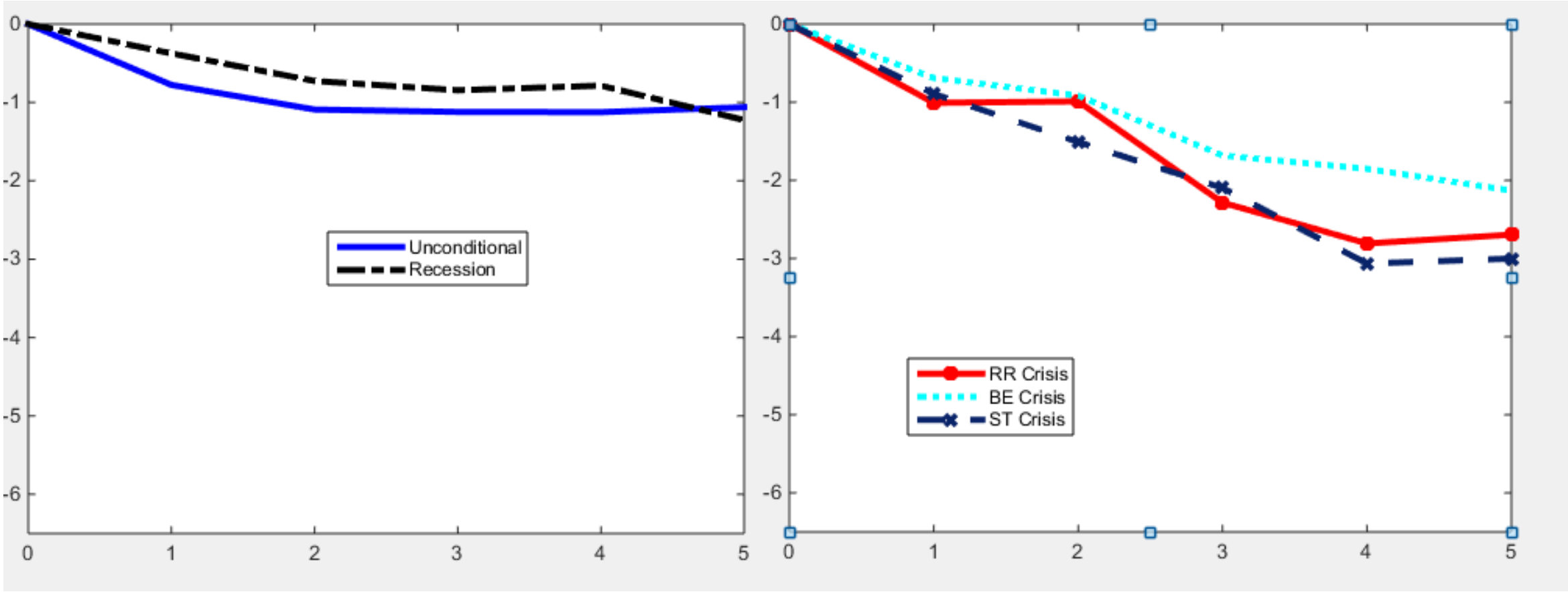
VARIABLES	(1) Crisis	(2) Crisis	(3) Crisis	(4) Crisis	(5) Crisis	(6) Recess	(7) Recess	(8) Recess
$\widehat{s}_{i,t}$	-2.52	-6.42		-4.50	-6.15	-1.55	-1.97	-1.97
	(0.62)	(1.40)		(1.32)	(1.53)	(0.49)	(1.10)	(1.21)
$\widehat{s}_{i,t-1}$		4.88		6.72	4.70		0.21	0.22
		(1.60)		(2.20)	(1.72)		(1.23)	(1.36)
$\Delta\widehat{s}_{i,t}$			-6.75					
			(1.47)					
$\Delta lev_{i,t}$					-25.75			12.96
					(17.55)			(18.38)
Observations	44	44	44	39	34	100	100	80
Drop Depression				Y				
R-squared	0.27	0.39	0.32	0.24	0.42	0.07	0.06	0.06
Variation in Realized Severity $\sigma(decline)$	7.6	7.6	7.6	4.8	8.3	7.2	7.2	7.6
Variation in Expected Severity $\sigma(E_t[decline])$	4.0	4.9	4.4	2.5	5.7	2.0	2.0	2.3

Forecasting crisis severity:

Comparing GDP outcomes with and w/o crises

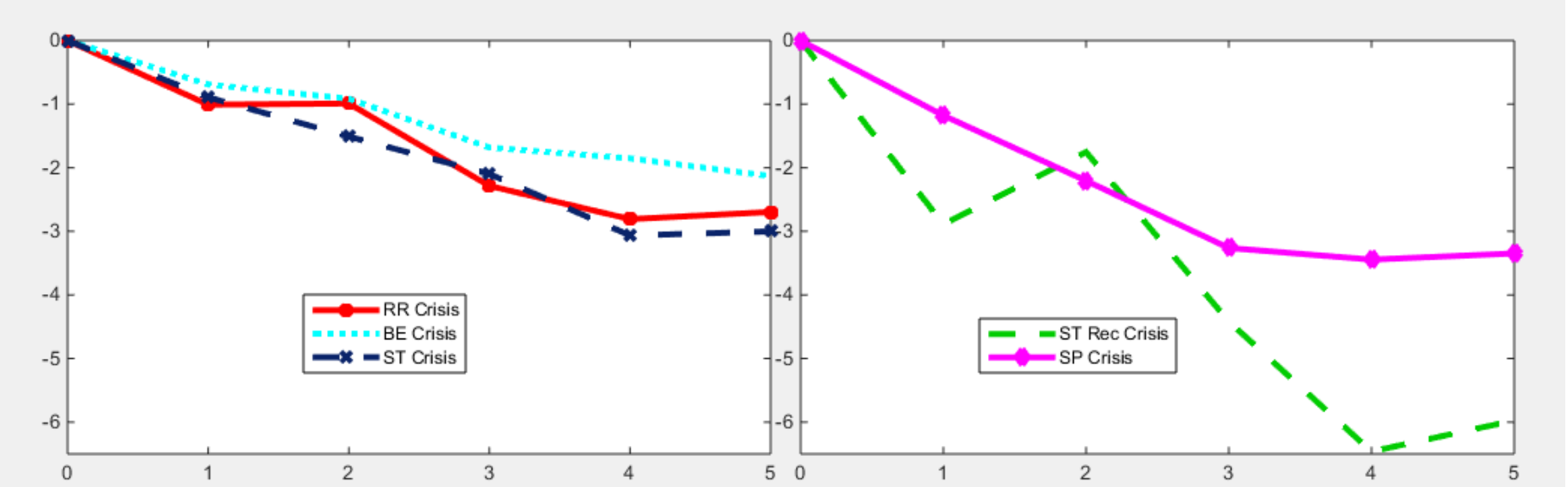
- Ideal experiment:
  - Underlying structural shock, z_t, the same in two economies.
  - Economy A: levered financial sector, financial crisis, financial recession
  - Economy B: no financial crises, and we have a non-financial recession
- In data:
  - We can compare output growth for 100 basis point change in spreads during financial crises versus outside of crises.
  - $E[GDP\ growth\ |spread + 100\ bps, crisis\ ]$-$E[GDP\ growth\ |spread, crisis\ ]$
  - It is likely that $z_t^{recession}$ (per 100bp) is larger than z_t^{crisis}

Alternative chronologies



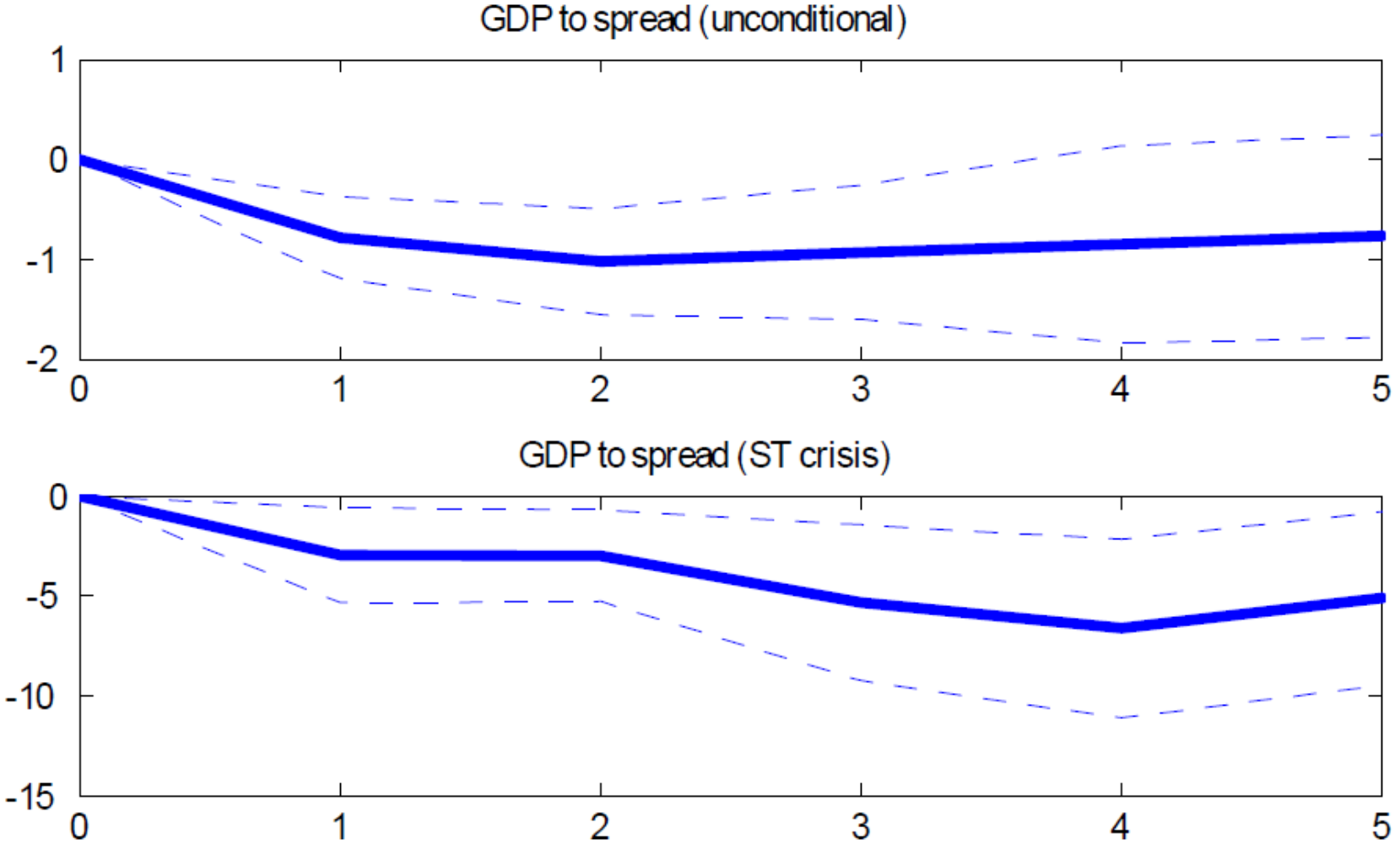
$E[GDP\ growth\ |spread + 100\ bps, crisis\ ]$-$E[GDP\ growth\ |spread, crisis\ ]$

Dating using recession start (our preferred approach)



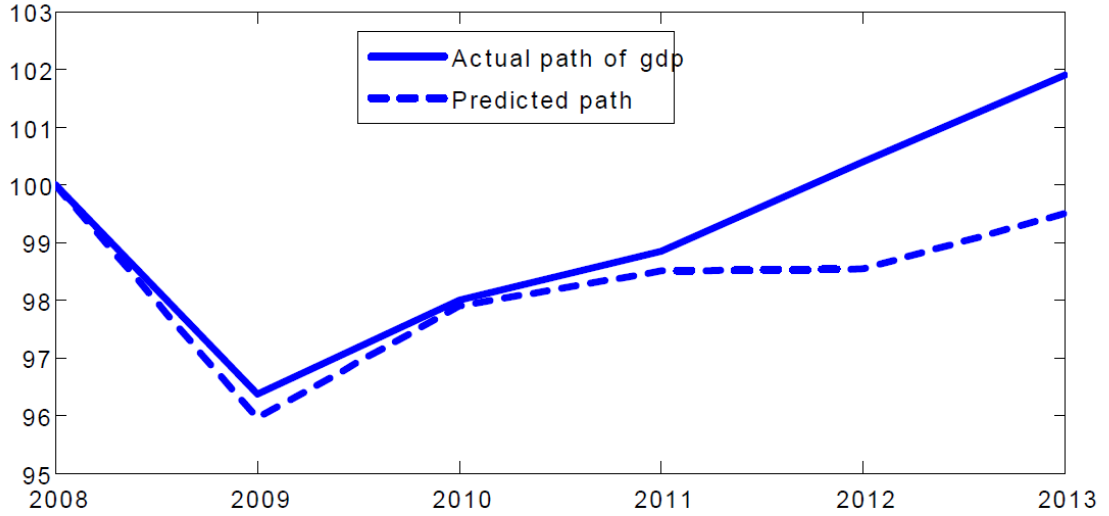
- If z_t shock at t, bank failure at t , and we use spread at $t-1$ ➔ weaker signal
  - Should get smaller effects (measurement error), more imprecisely estimated
  - But we dont

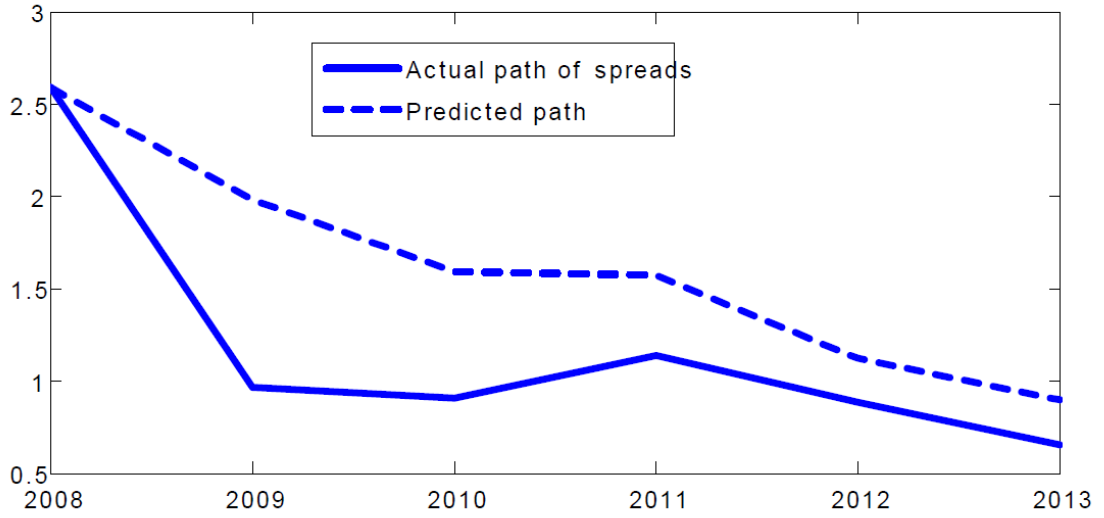
Impulse response to +100bps (Jorda projection)



$E[GDP\ growth\ |spread + 100\ bps, crisis\ ]$-$E[GDP\ growth\ |spread, crisis\ ]$

2008 Actual and Predicted (using ST dates)





Summary, so far

- Recessions with financial crises are deeper and more protracted than recessions without financial crises
- 2008 recession and slow recovery inline (*better?*) with past crises
- Confirms findings of the literature (RR and ST)
  - Using a better approach
  - Offering more precise estimates

- Next: the “surprise”

$$\text{Peak-to-trough}_{i,t} = a + b_1\,\hat{s}_{i,t} + b_2\,\hat{s}_{i,t-1} + b_1\,\Delta lev_{i,t} + \varepsilon_{i,t}$$

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Level of spread and future output growth

- Underlying relation: $1_{crisis,t}$ if $z_t F_t$ >Threshold

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + \boldsymbol{\beta} \times \boldsymbol{z_t F_t} \times 1_{crisis,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- Spreads:

$$s_{i,t} = \gamma_i + \quad \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \quad \gamma_2 z_t F_t$$

$$s_{i,t-1} = \gamma_i + \quad \gamma_1 \times E_{t-1} \ln\left(\frac{y_{i,t+k-1}}{y_{i,t-1}}\right)$$

Level of spreads in normal recession

- Spreads:

$$s_{i,t} = \gamma_i + \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \gamma_2 Z_t F_t$$

- Friedman-Kuttner, Stock-Watson, Gilchrist-Zakrajsek about the <u>level</u>

$$\text{Peak-to-trough}_{i,t} = a + b_1\,\hat{s}_{i,t} + b_2\,\hat{s}_{i,t-1} + b_1\,\Delta lev_{i,t} + \varepsilon_{i,t}$$

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Spread changes=losses

- Underlying relation: $1_{crisis,t}$ if $z_t F_t$ >Threshold

$$\ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) = a_i + a_t + \boldsymbol{\beta} \times \boldsymbol{z_t F_t} \times 1_{crisis,t} + c' x_{i,t} + \epsilon_{i,t+k}$$

- Spread changes = losses by credit investors (e.g. banks)

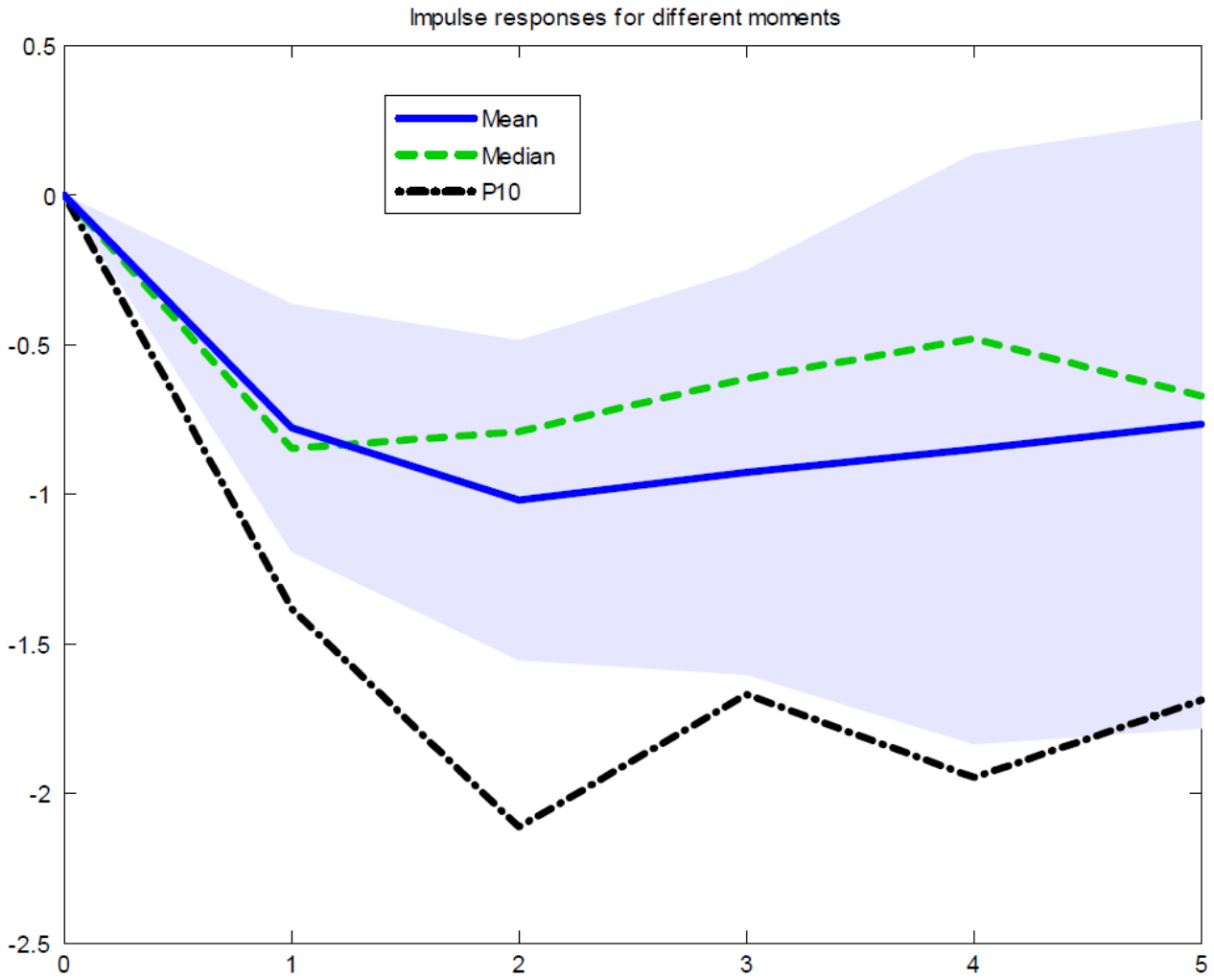
$$s_{i,t} - s_{i,t-1} = \gamma_1 \times \left[E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) - E_{t-1} \ln\left(\frac{y_{i,t+k-1}}{y_{i,t-1}}\right)\right] + \quad \gamma_2 z_t F_t$$

- *Crises are spread surprises; but do all spread surprises end in crises?*

Spread spikes and skewness

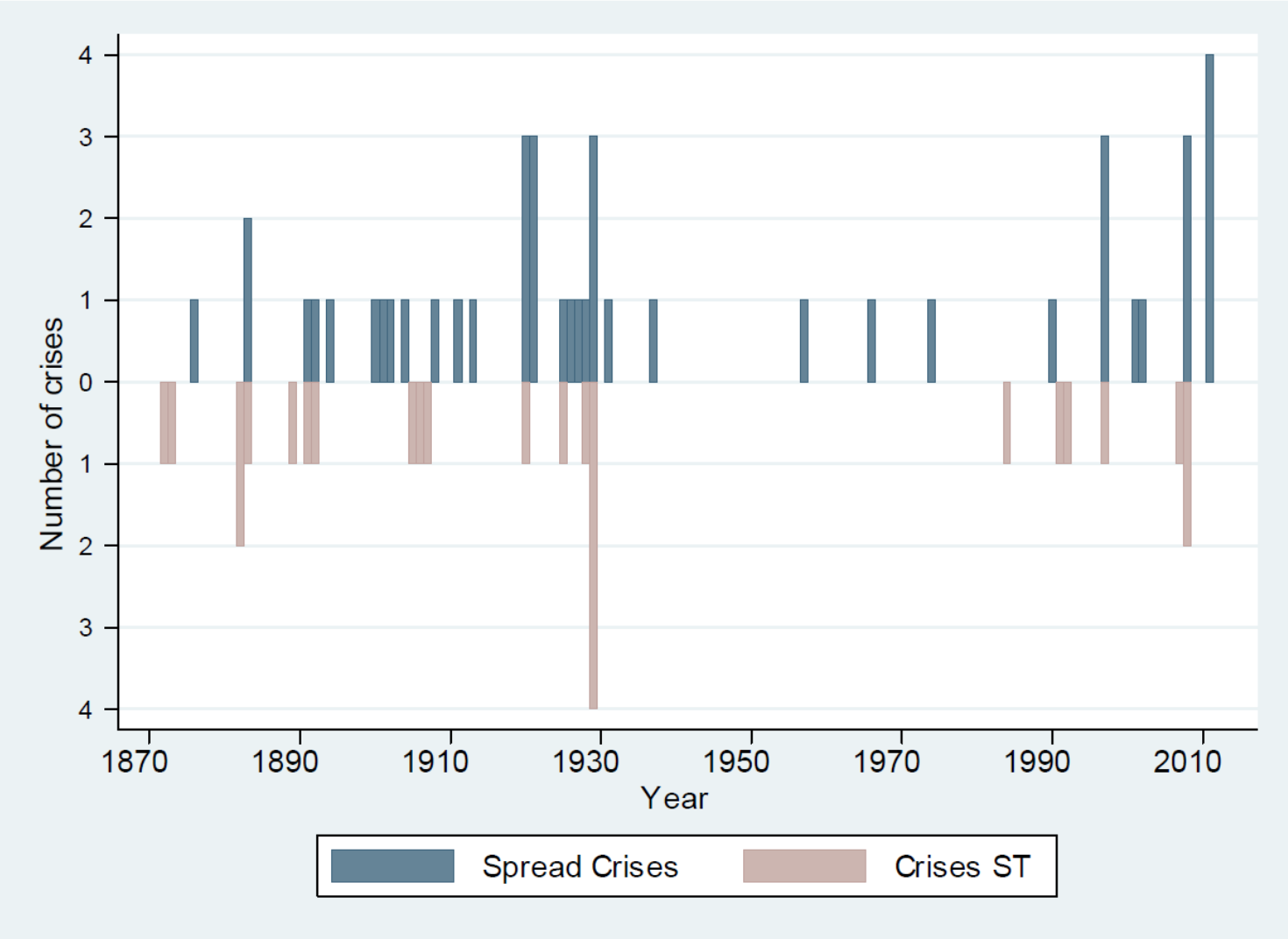
Quantile Regressions					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Q 90th	Q 75th	Q Median	Q 25th	Q 10th
$\widehat{s}_{i,t}$	-0.40	-0.45	-0.85	-1.17	-1.39
	(0.26)	(0.16)	(0.14)	(0.18)	(0.30)
$\widehat{s}_{i,t-1}$	0.85	0.75	0.66	0.87	0.99
	(0.30)	(0.18)	(0.16)	(0.20)	(0.34)
Observations	898	898	898	898	898
Country FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Pseudo R2	0.10	0.07	0.05	0.09	0.13

Skewness in GDP outcomes



IMPULSE RESPONSE FROM QUANTILE REGRESSION

Big losses & ST Crises



$$\text{SpreadCrisis} = 1 \; if \begin{cases} \hat{s}_{i,t} - \hat{s}_{i,t-1} in\ 90th\ percentile \\ Change\ in \frac{D}{P} > median \end{cases}$$

When do losses end in real crises? If F_t is high

When is an increase in spreads particularly bad for GDP?										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	1yr	1yr	2yr	2yr	3yr	3yr	4yr	4yr	5yr	5yr
SpreadCrisis	-3.11		-4.11		-4.48		-3.99		-2.51	
	(0.69)		(0.94)		(1.22)		(1.48)		(1.71)	
(SpreadCrisis) x		-4.07		-5.82		-8.48		-9.59		-7.92
(HighLeverage)		(0.88)		(1.20)		(1.53)		(1.83)		(2.13)
Observations	393	388	390	385	387	382	384	379	381	376
R-squared	0.63	0.64	0.70	0.71	0.71	0.73	0.69	0.72	0.69	0.71
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Leverage = 5 year growth in Credit/Money from Schularick and Taylor (2012)

Financial and real disturbances

- 1970 Penn Central crisis, 1998 LTCM crisis
  - Spike in spreads: asset prices suggest crisis dynamic
  - But crisis dissipates, with little pass through to real economy

Conclusion: Shock/loss ($= z_t$) X Fragility ($= F_t$) leads to crisis, protracted recession

- Spreads:

$$s_{i,t} = \gamma_i + \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \gamma_2 z_t F_t$$

- Instead:

$$s_{i,t} = \gamma_i + \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \gamma_2 z_t F_t + \gamma_3 z_t L_t$$

If F_t is low, smaller pass through to real sector

Spreads and fragility

- In crisis:

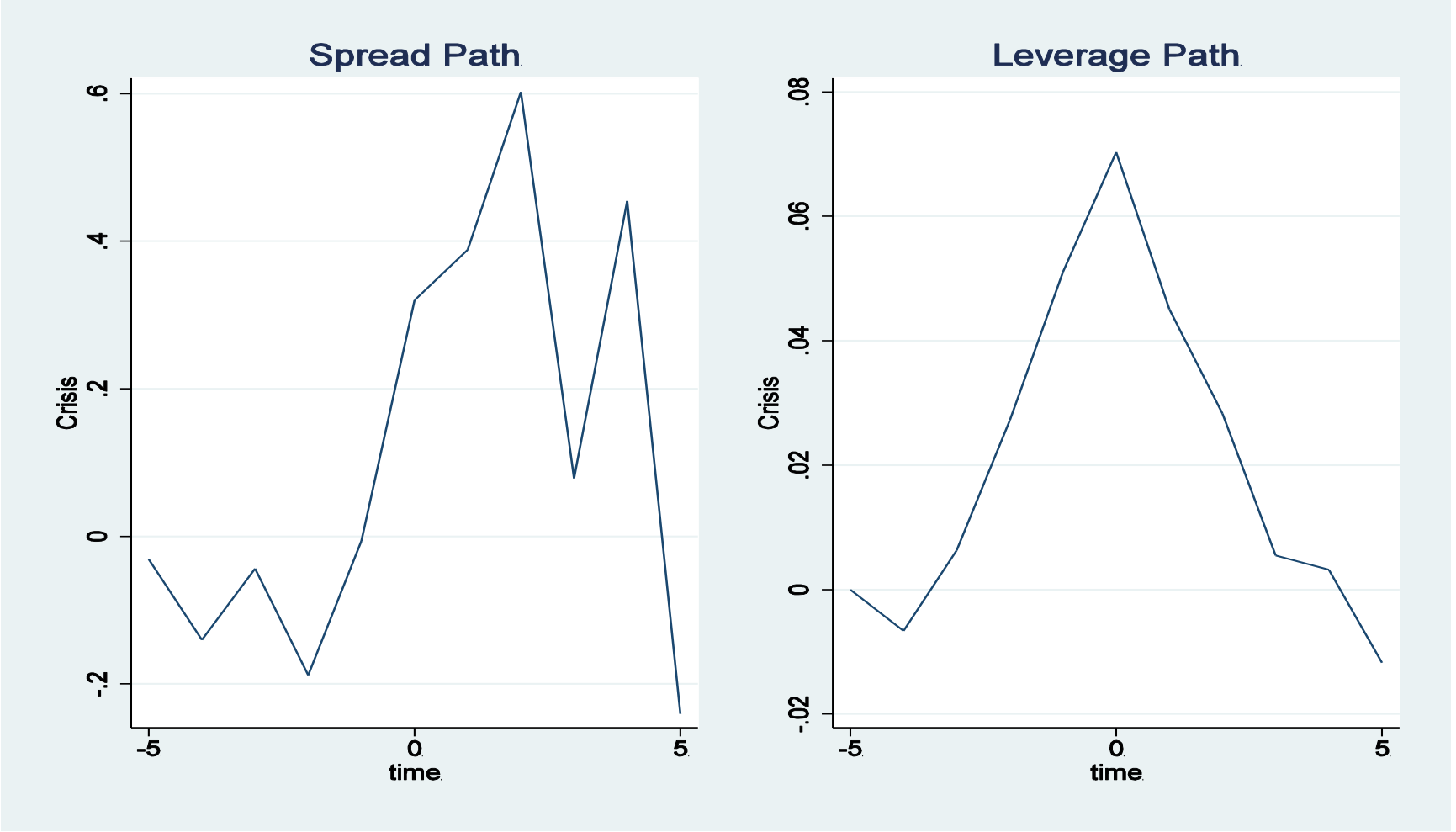
$$s_{i,t} = \gamma_i + \quad \gamma_1 \times E_t \ln\left(\frac{y_{i,t+k}}{y_{i,t}}\right) + \quad \gamma_2 z_t F_t$$

- Pre-crisis, growth in F_t is observable

$$s_{i,t-1} = \gamma_i + \quad \gamma_1 \times Prob(z_t > \underline{z}) E_{t-1}\left[\ln\left(\frac{y_{i,t+k-1}}{y_{i,t-1}}\right) | crisis\right]$$

As F_t rises

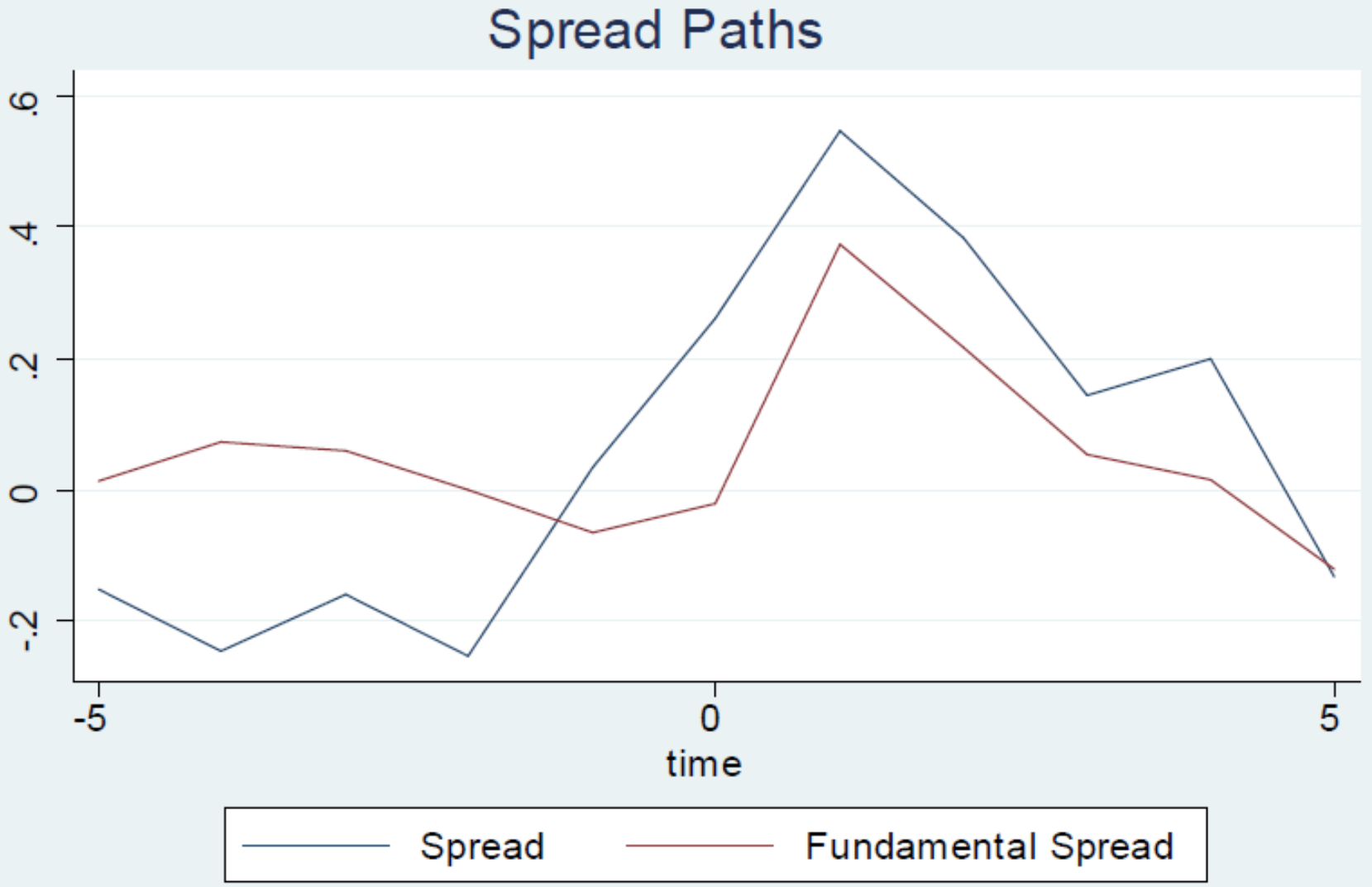
Crisis build-up (ST crises)



Spread are too low before crises:

VARIABLES	(1) ST	(2) ST	(3) ST	(4) ST	(5) RR	(6) RR	(7) RR	(8) RR
$1_{t-5,t-1}$	-0.18	-0.20	-0.24	-0.23	-0.19	-0.11	-0.24	-0.15
	(0.10)	(0.09)	(0.14)	(0.12)	(0.08)	(0.07)	(0.11)	(0.11)
ΔLev_{t-1}			1.31	1.51			1.25	1.38
			(2.01)	(1.44)			(2.00)	(1.43)
ΔGDP_t			-3.97	-4.48			-4.14	-4.62
			(1.95)	(3.03)			(2.01)	(3.07)
ΔGDP_{t-1}			-1.41	-1.59			-1.37	-1.56
			(2.05)	(2.04)			(2.06)	(2.04)
Observations	861	861	635	635	861	861	635	635
R-squared	0.01	0.51	0.05	0.56	0.02	0.51	0.05	0.56
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	Y	N	Y	N	Y	N	Y

Spreads over the cycle (ST Crises)



0 means

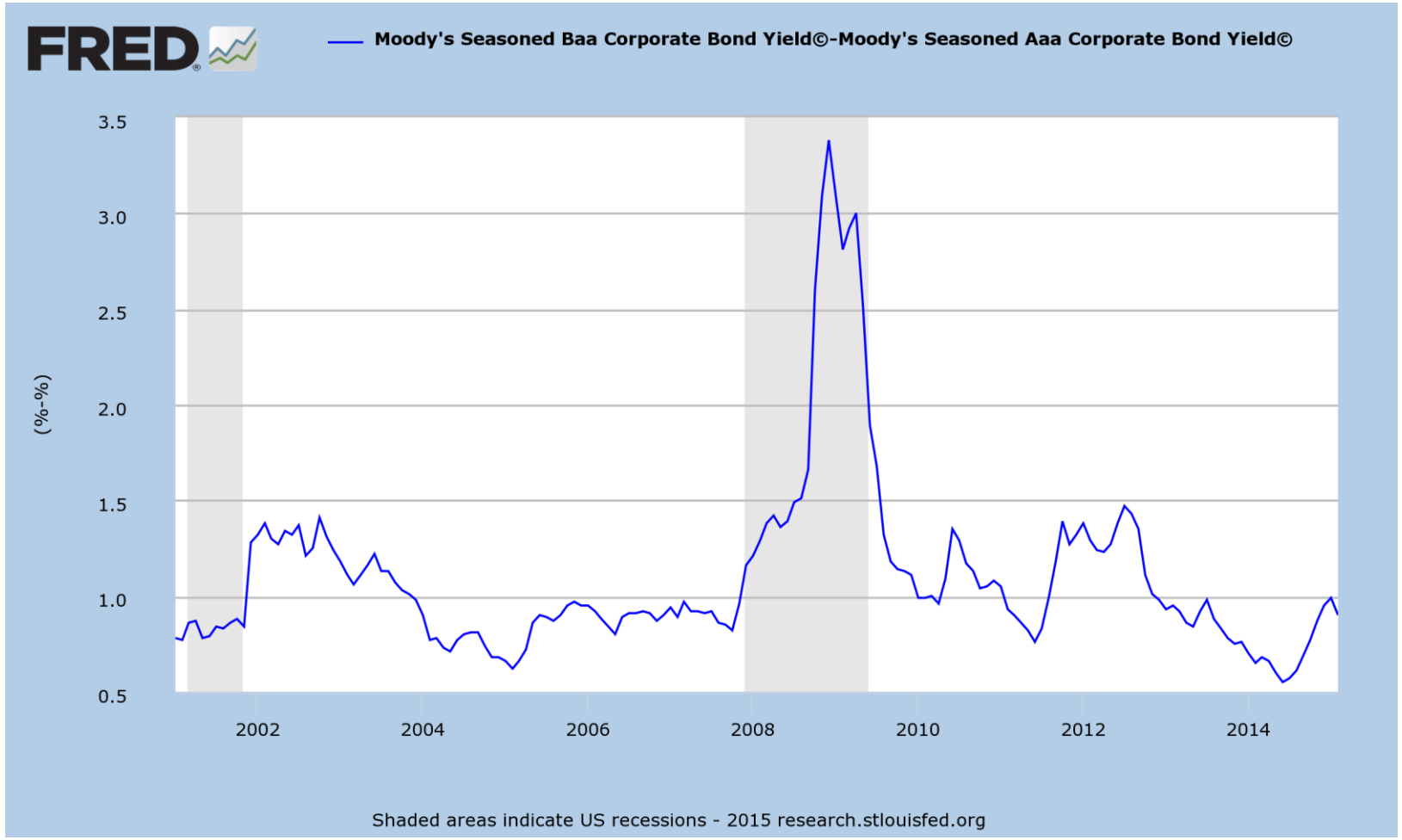
$$spread_{i,t} = \overline{spread_i}$$

Conclusion

- Aftermath of financial crises is deep and protracted recession
  - Effect of crisis lasts many years
  - We use *variation* in severity indexed by spreads
  - Results consistent with Reinhart-Rogoff, Schularick-Taylor
- Spikes in spreads + real fragility = Losses + Amplification
  - Lead to poor GDP outcomes (Kiyotaki-Moore, He-Krishnamurthy)
  - Pure financial disturbances can be disconnected from real activity
- Crises are preceded by unusually low spreads
  - Spreads pre-crisis do not price an increase in fragility
  - “Surprise” is a key dimension of crises (Caballero-Krishnamurthy, Gennaioli-Shleifer-Vishny)

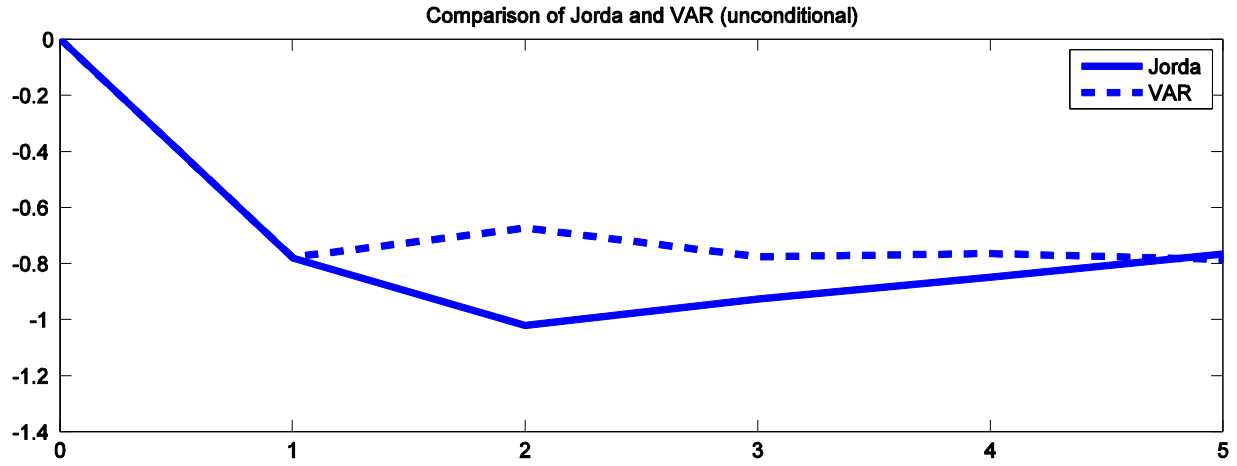
Extra pictures

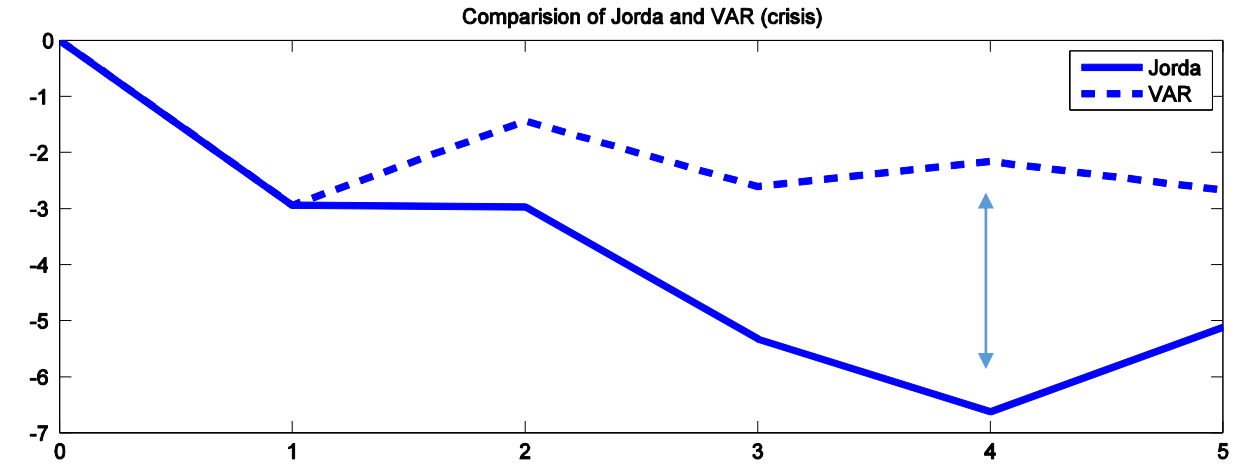
Spreads recover quickly, GDP drop persists



Spreads recover quickly, GDP drop persists

Initial spread matters many years out





2008 Actual and Predicted