Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations[1]

Thiago Ferreira*

*Federal Reserve Board

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[1] Previously presented as "Cross-Section Skewness, Business Cycle Fluctuations and the Financial Accelerator Channel". The views expressed in this paper are solely my responsibility and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System."

Business Cycles: Prediction and Explanation

Fluctuations in economic uncertainty and business cycles

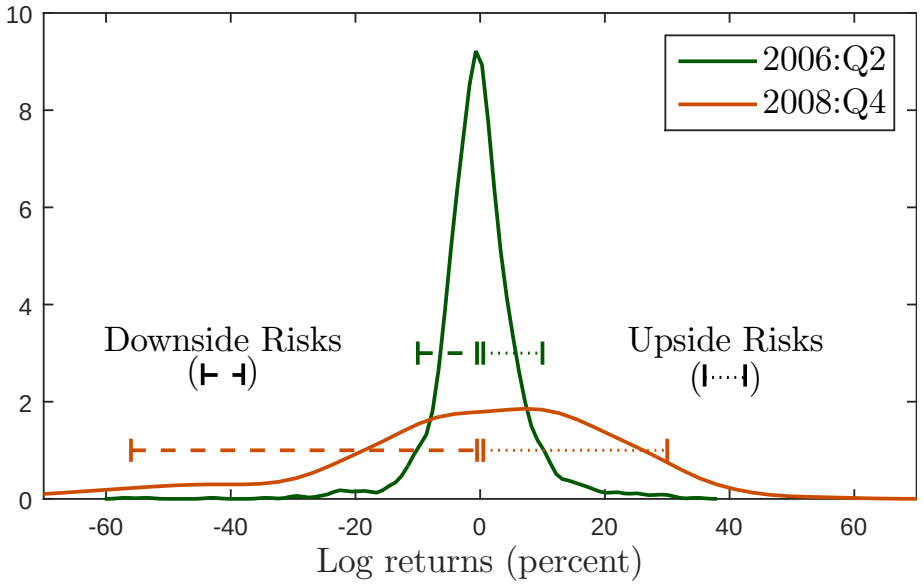
- focus on 2nd moments and aggregate (negative) tail risks

I want to shift the discussion to skewness. Too nerdy?

- captures the comparison of tail risks: upside X downside
- often used in FOMC and ECB comunications

More specifically, can cross-section skewness of asset prices help us predict and understand business cycle fluctuations?

Cross-Sectional Distribution of Stock Returns of Financial Firms



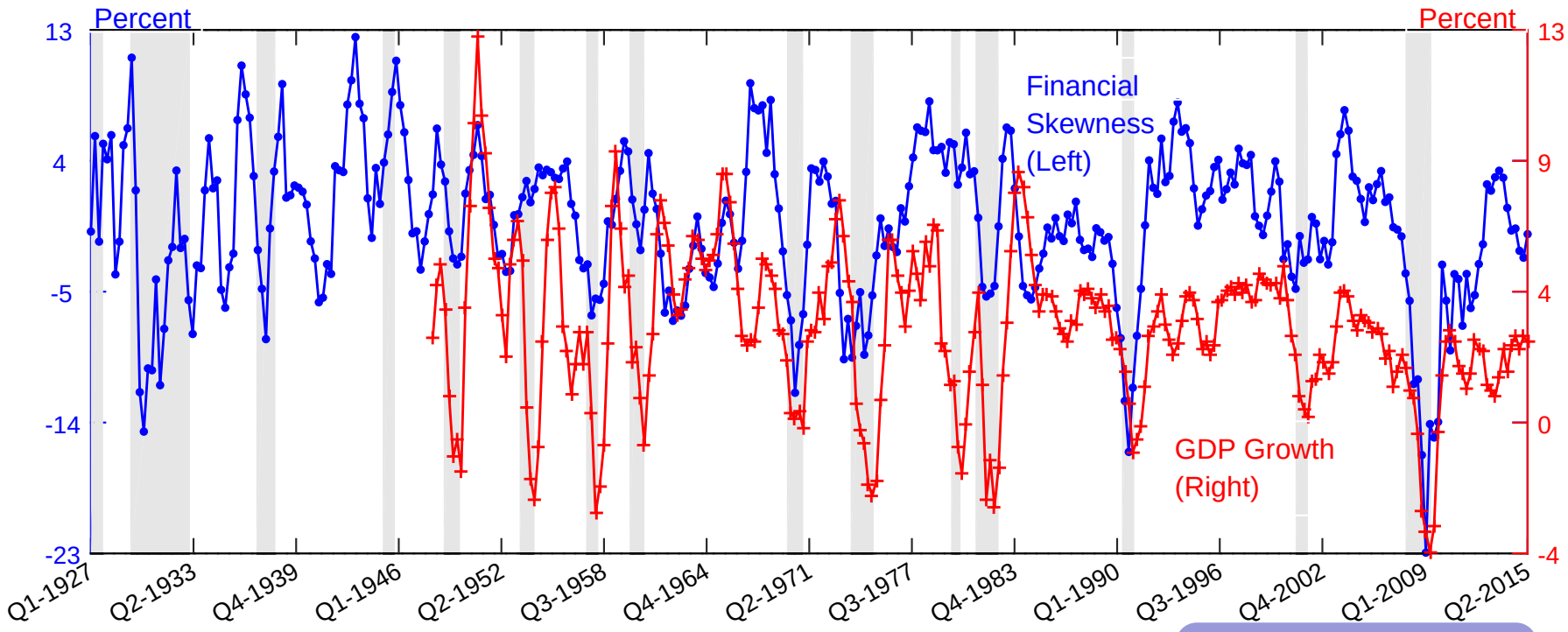
(a) Probability Density Function

	2006:Q2	2008Q4
Median	0%	0%
Skewness	0%	-27%

(b) Cross-Sectional Moments

$$\text{financial skewness}_t = \underbrace{\left(ln\_r_t^{95th} - ln\_r_t^{50th}\right)}_{\text{upside tail risks}} - \underbrace{\left(ln\_r_t^{50th} - ln\_r_t^{5th}\right)}_{\text{downside tail risks}}.$$

Financial Skewness Tracks Business Cycles



Financial vs Nonfinancial
Correlations
Logit

3 main results:

1) Financial skewness is a powerful predictor of economic activity
   - better than many well-known indicators

2) Financial skewness seem to signal future economic performance of financial firms' borrowers

3) Financial skewness shocks are important cyclical drivers, with transmission channel consistent with financial frictions models

Literature Review X Results

Business cycles drivers: cross-sectional skewness is important.

- Idiosyncratic firms' behavior is important driver of BC. Focus on 2^{nd} moments:
  Bloom et al (2012), Arellano et al (2012), Christiano et al (2014), Chugh (2016), Schaal (2015), Panousi and Papanikolaou (2012), Gabaix (2011); Acemoglu et al (2011).
- Tail risks are important for BC. Most focus on aggregate downside risks:
  Barro (2006), Gabaix (2012), and Gorio (2012).

Asset prices predict business cycles: financial skewness does particularly well.

- Despite importance in BC theory, CS risk is not important in forecasting:
  Lit reviews: Stock and Watson (2003) and Ng and Wright (2013).
- Bond markets may signal better than stocks about economic fundamentals:
  Philippon (2009), Gilchrist and Zakrajsek (2012), and Lopez-Salido et al. (2017).

Data Evidence

1st: Financial Skewness Predicts Economic Activity

- better than: well-known bond spreads (e.g., GZ (2012))
  measures of uncertainty (e.g., Jurado et al (2015))
  other cross-section moments (fin + nfin)
- both in expansions and recessions
- using in-sample and out-of-sample regressions
- several measures of economic activity

Financial Skewness Predicts Economic Activity, In-Sample

Dependent Variable: Mean 4Q Ahead GDP Growth

Sample: 1973Q1 - 2015Q2

	Regressions Specifications											
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Mean^{+}		1.19***									0.73*	
Dispersion^{+}			-0.15*								1.07**	
Skewness^{+}				1.20***							1.60**	1.00***
Left Kurtosis^{+}					0.71**						0.26	
Right Kurtosis^{+}						0.46**					-1.06***	
Uncertainty							-0.46**					0.24
Real Fed Funds								-0.44				0.18
Term Spread									0.92***			1.03***
GZ Spread										-0.55**		-0.49
R^2	0.08	0.29	0.11	0.28	0.17	0.11	0.19	0.12	0.28	0.23	0.40	0.54

$^{+}$Moments of the cross-section distribution of returns are for returns from financial firms

All regressors are standardized, so we can compare the magnitude of their coefficients. For each regressor, I include its current and one-period lagged value, with reported coefficients being the sum of current and lagged effect. Coefficients measure the effect in GDP-growth (in percentage) of a sustained increase of 1 std in the regressor.

Financial Skewness Predicts Economic Activity, In-Sample

1) is one of the variables that single-handedly most explain future GDP growth
   - Comparing R^2's and columns (2)-(10)

2) has predictive power robust to the inclusion of many other variables.
   - Such as other moments, financial uncertainty, GZ spread: columns (11)-(12)
   - In all regressions, financial skewness is stat-sig and has intuitive effects.

3) is specially informative about the cycle
   - In regressions (11)-(12) for un/weighted measures: one of largest coefficients
   - 1 std $\downarrow$ in financial skewness: $\downarrow$ of 1%-1.6% in mean GDP growth over next 4Q's

4) is powerful predictor of many other variables: not shown
   (Consumption, Investment, Hours, U-rate)

Financial Skewness Predicts $GDP_{t+h|t-1}$, Out-of-Sample

Sample: 1973Q1 - [1986Q1...2015Q2]

For each variable X_t, I forecast GDP growth using regressions:

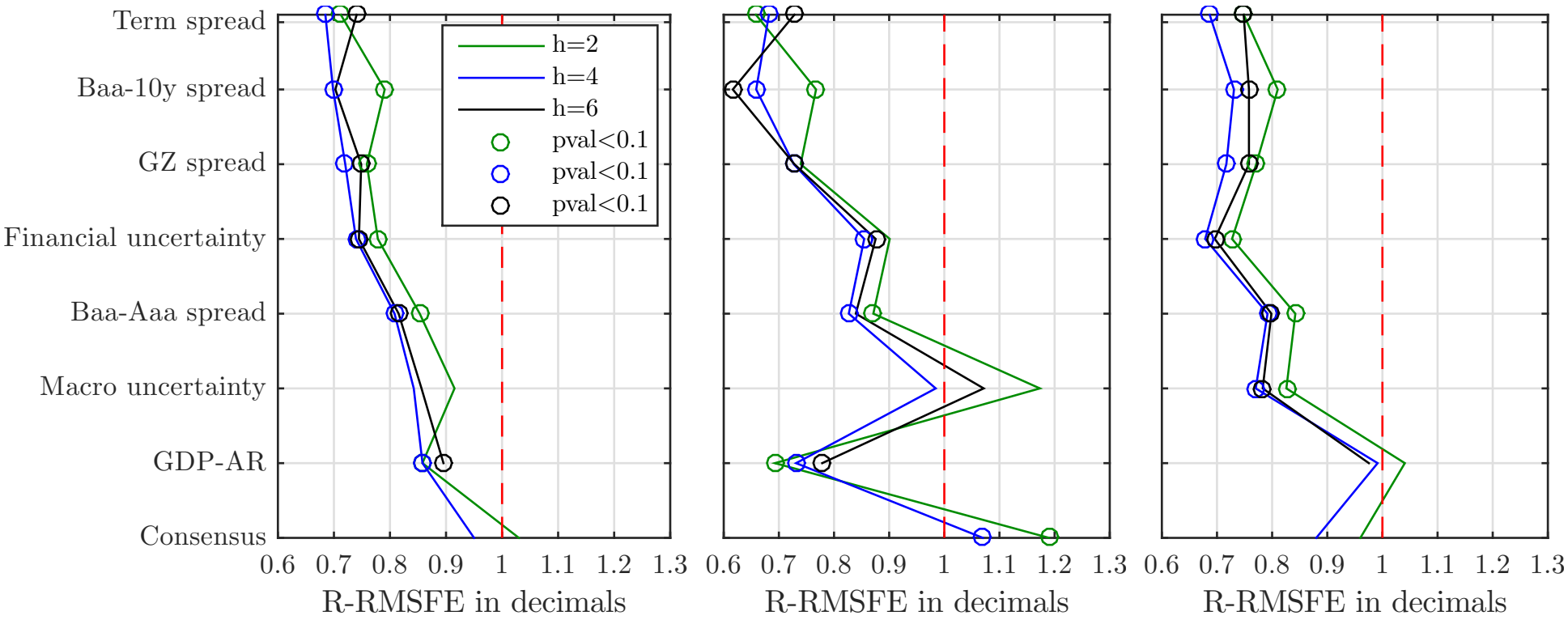
$$GDP^{X_t}_{t+h|t-1} = \alpha + \sum_{i=1}^{p} \rho_i GDP_{t-i|t-i-1} + \sum_{j=0}^{q} \theta_j X_{t-j} + u_{t+h}.$$

Performance of financial skewness relative to variable X_t is:

$$\text{R-RMSFE of Variable } X_t = \frac{\text{RMSFE of Financial Skewness}}{\text{RMSGE of Variable } X_t} \text{ (in decimals)}$$

Financial Skewness Predicts $GDP_{t+h|t-1}$, Out-of-Sample

$$\text{R-RMSFE} = \frac{\text{RMSE of Financial Skewness}}{\text{RMSE of Other Variable}} \text{ (in decimals)}$$



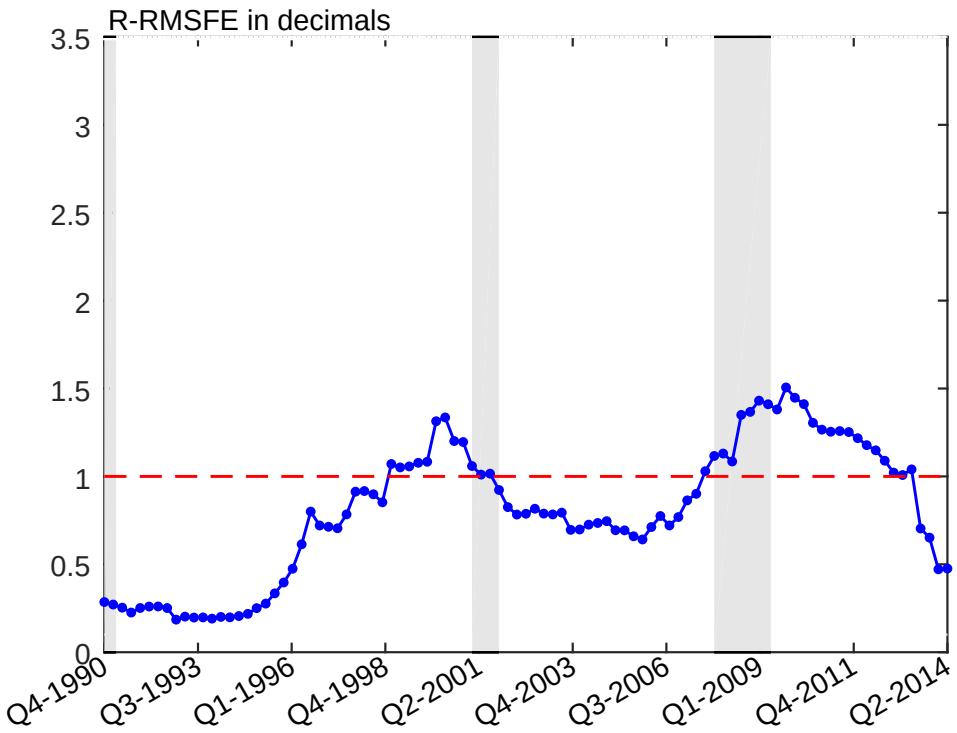
(c) Full Sample (d) Recessions (e) Expansions

Financial Skewness Predicts $GDP_{t+h|t-1}$, Out-of-Sample

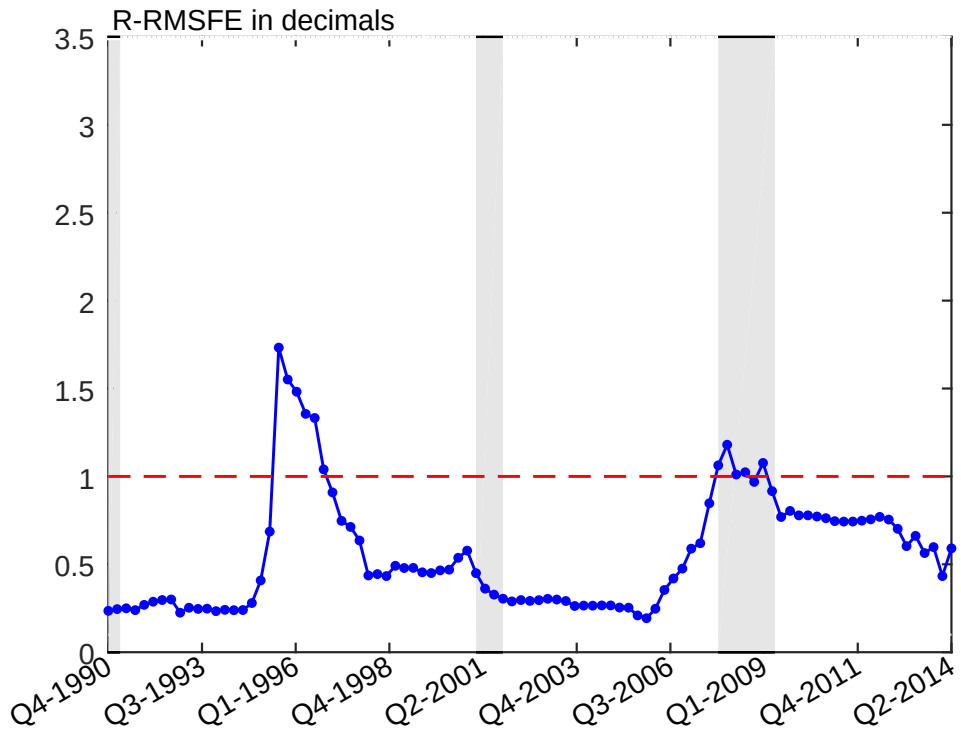
Financial skewness has highest predictive power for GDP growth

- Lowest RMSEs with most results stat. significant
- Differences economically significant: up to 38% of improvement
- Also, better than other distribution measures

Rolling RMSE Ratios: financial skewness predicts well most of the time



(f) Macro Uncertainty



(g) GZ-Spread

Other Rolling RMSE ratios tell similar story.

Interpreting

Financial Skewness

2nd: Financial Skewness is informative because...

...reflects future economic performance of financial firms' borrowers

Financial firms focus on specific loan markets, diversifying some

- CS distributions of returns of financial firms have less dispersion and thinner tails than those of nonfinancial firms.

Stock markets price future economic performance of borrowers

- Data on asset quality (ROA and LSSF) explain about 75% of financial skewness
- ROA and LSSF released between 1 and 1.5 months after the reference quarter

Financial skewness also lead credit conditions

- especially loan growth

Financial sector holds smaller cross-section risks

	Sample 1927-2015			Sample 1947-2015		
	financial	nonfinancial	difference	financial	nonfinancial	difference
Mean	3.3	3.7	-0.5	2.9	3.4	-0.5
Dispersion	36.5	49.2	-12.7***	35.8	58.8	-23.0***
Skewness	-0.4	-0.1	-0.3	-1.1	-2.0	0.9**
Left kurtosis	-7.1	-9.0	1.9***	-7.9	-12.1	4.3***
Right kurtosis	7.2	9.1	-1.9***	7.0	11.0	-4.0***

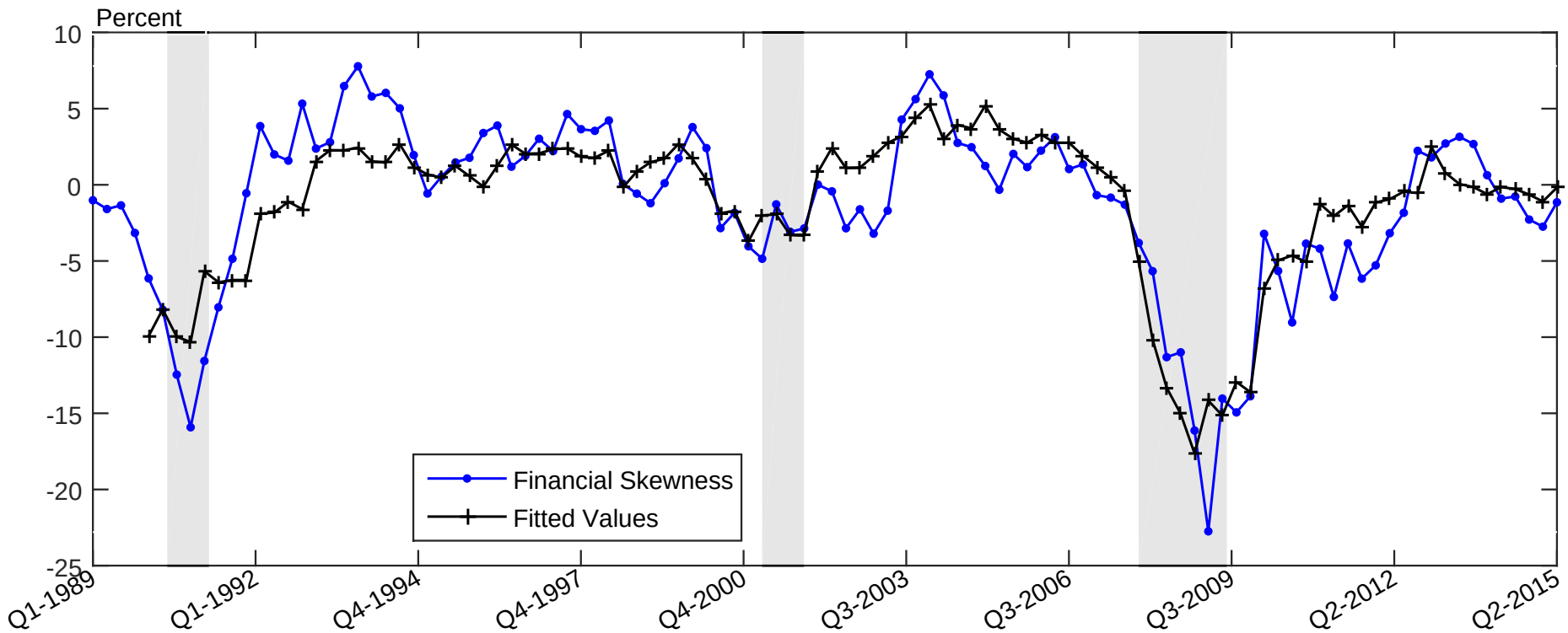
Financial { Mean: stat the same; Dispersion: smaller; Skewness: somewhat higher; Left tail: thinner; Right tail: thinner } than Nonfinancial

Financial skewness reflects future performance of borrowers

- Data on asset quality of financial firms (ROA and LSSF) explain 76% of financial skewness . . .
  - ROA and LSSF released 1-1.5 months after the reference quarter
- . . . while data measuring financial stresses and private sector GDP forecasts add little.

		AFCI	EBP	VIX	Term Spread	$GDP^{Consensus}_{t\|t-1}$	$GDP^{Consensus}_{t+2\|t-1}$
ROA	3.7***	3.5***	3.6***	3.5***	4.0***	3.4***	3.4***
LSSF	-2.1***	-1.6***	-1.6***	-1.4***	-1.9***	-1.8***	-1.8***
Variable		-0.8*	-0.7*	-1.3***	0.6**	0.8**	0.7*
R^2	0.76	0.76	0.76	0.79	0.76	0.76	0.76

What explain financial skewness? Part II



(h) Fitted Values from Return on Assets and Lending Standards

Structural Analysis:

DSGE Model and BVARs

3nd: Structural Analysis - BVAR and DSGE Models

14 variables: macro, financial and stock market cross-sectional moments.

In both BVAR and DSGE model, financial skewness shocks:

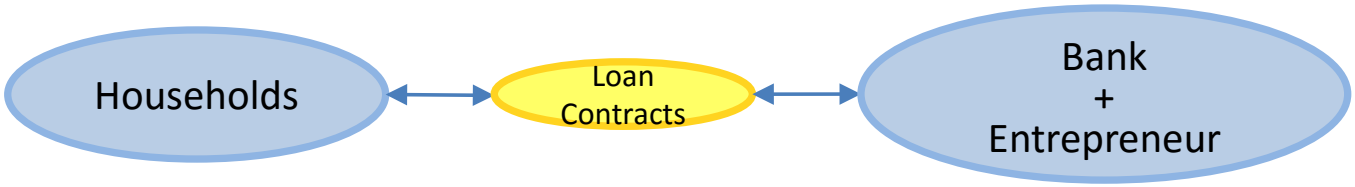
- have a transmission channel consistent with financial frictions models
- are important business cycle drivers and have sizable economic effects
- account for most of the fluctuations in financial skewness
- drive out other shocks, including dispersion ones

NK-DSGE with financial accelerator channel

Similar to Christiano et al (2014) in its bells and whistles

Why this model?
- cross-section shocks generates business cycles
- endogenous cross-section distribution
- compare widely used DSGE model against BVAR

Re-interpretation of the model:



Bank+Entrepreneur Cross-section risk $\Rightarrow$
- nonfin CS risk after some diversification (e.g, dotcom)
- fin CS risk (e.g, Lehman)

Distribution of Returns and the Financial Accelerator

Define *gross realized equity return* of entrepreneur i at period t:

$$X_t^i = \begin{cases} \frac{\omega_t^i R_t^c Q_{t-1} \overline{K}_t^i - Z_t^i B_t^i}{N_t^i}, & \text{if } \omega_t^i R_t^c Q_{t-1} \overline{K}_t^i \geq Z_t^i B_t^i \\ 0, & \text{otherwise} \end{cases} = \begin{cases} \left[\omega_t^i - \overline{\omega}_t\right] R_t^c L_t, & \text{if } \omega_t^i \geq \overline{\omega}_t \\ 0, & \text{otherwise.} \end{cases}$$

- *endogenous distribution of* X_t^i: $\overline{\omega}_t$, R_t^c and L_t are *endogenous variables*
- ω_t^i follows a mixture of two log-normal distributions
  - $\mathbb{E}(\omega_t^i) = 1$, $\text{Std}(\omega_t^i) = sd_t$ and m_t^1 proxies skewness

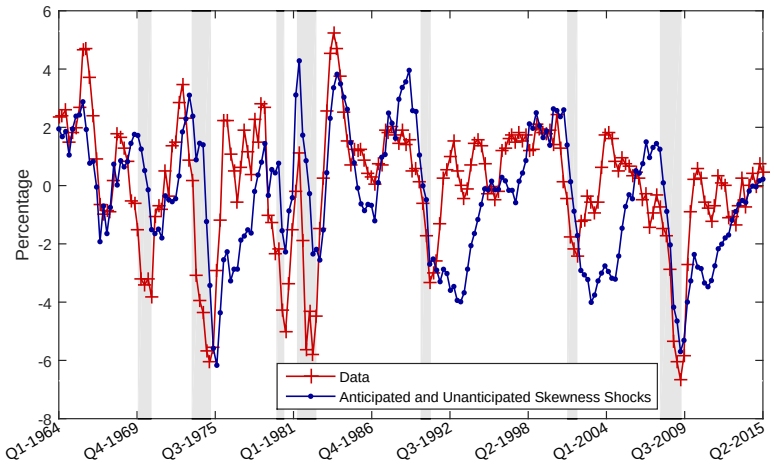
For instance, cross-section skewness of the model is: $(\widetilde{x}_t^{95} - \widetilde{x}_t^{50}) - (\widetilde{x}_t^{50} - \widetilde{x}_t^{5})$, where $\widetilde{x}_t^v = \log(\widetilde{\omega}_t^v - \overline{\omega}_t)$ and $\widetilde{\omega}_t^v$ is the v^{th} percentile of cdf $F_t(\cdot|\omega_t > \overline{\omega}_t)$.

NK-DSGE with financial accelerator channel: 1964-2015

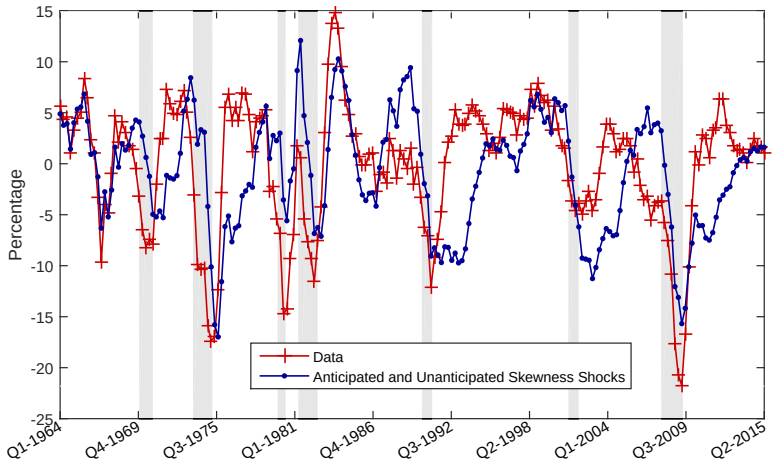
1st Step: 1964-2006, Taylor Rule;
2nd Step: 2002-2015, Taylor Rule with news; re-estimate shocks autocorr and std;

Observable variables	Shocks
GDP	permanent TFP-growth
Consumption	inter-temporal discount
Investment	capital adjustment cost (IS-shock)
Hours worked	transitory TFP
Real wage	price-markup
Fed Funds rate	monetary policy
OIS 1Y-ahead (2002-2015)	news on monetary policy
PCE core inflation	inflation trend/target
Relative price of Investment	investment price
Real credit	government/NX residual
Equity ($Mean_t^{nfin}$)	equity and meas-error
Baa - US_10y	
$Disp_t^{nfin}$ and $Skew_t^{fin}$	sd_t and m_t^1 news about them up to 4Q in advance

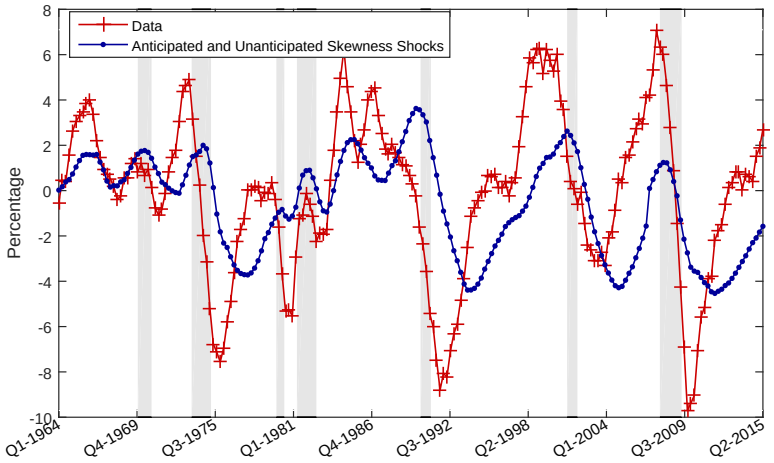
Primacy of Skewness Shocks: Hist + Var Decomp's



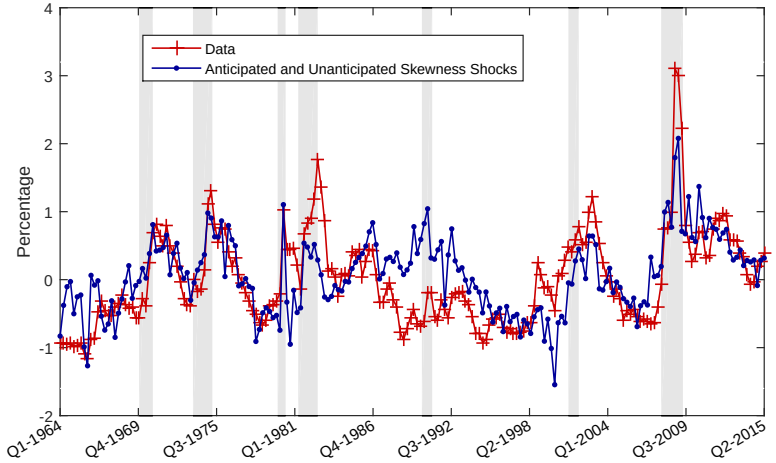
(i) GDP (7 | 41 %)



(j) Investment (9 | 51%)



(k) Credit (6 | 35%)



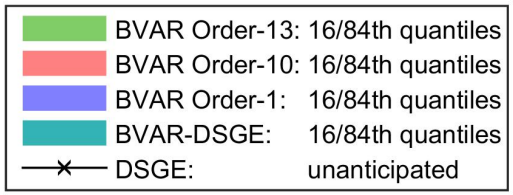
(l) Baa spread (16 | 50%)

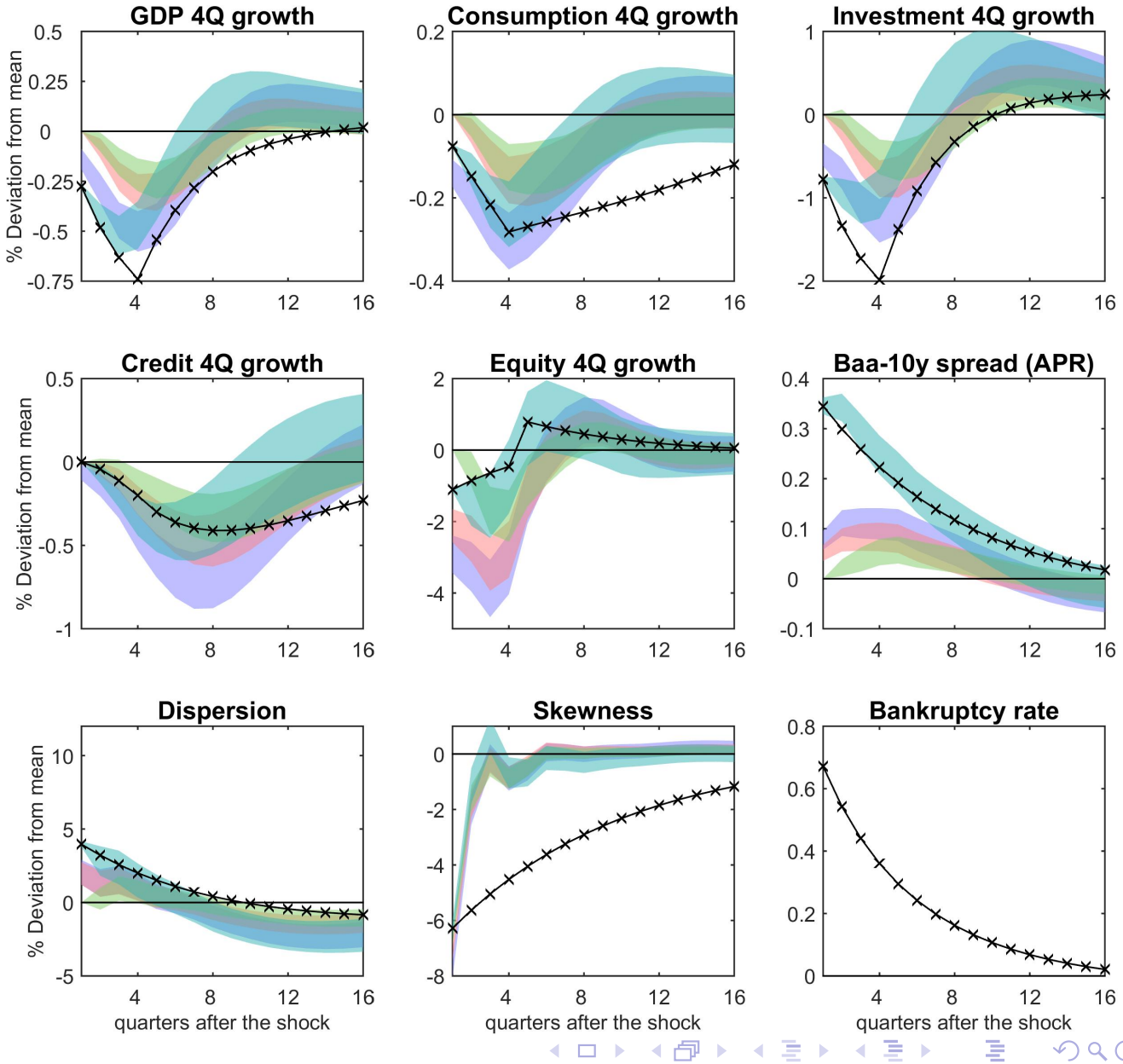
Skewness shocks:

- FEVD: GDP = 5-20%
- IRF: GDP falls 0.3-0.75%
- FEVD: majority of FinSkew

Fin-friction transmission

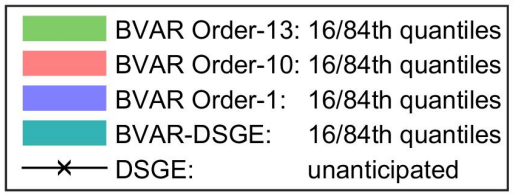
- IRFs: general picture
- ↑ Baa-10y ⇒ Larger IRFs
- DSGE IRFs ≈ BVAR IRFs

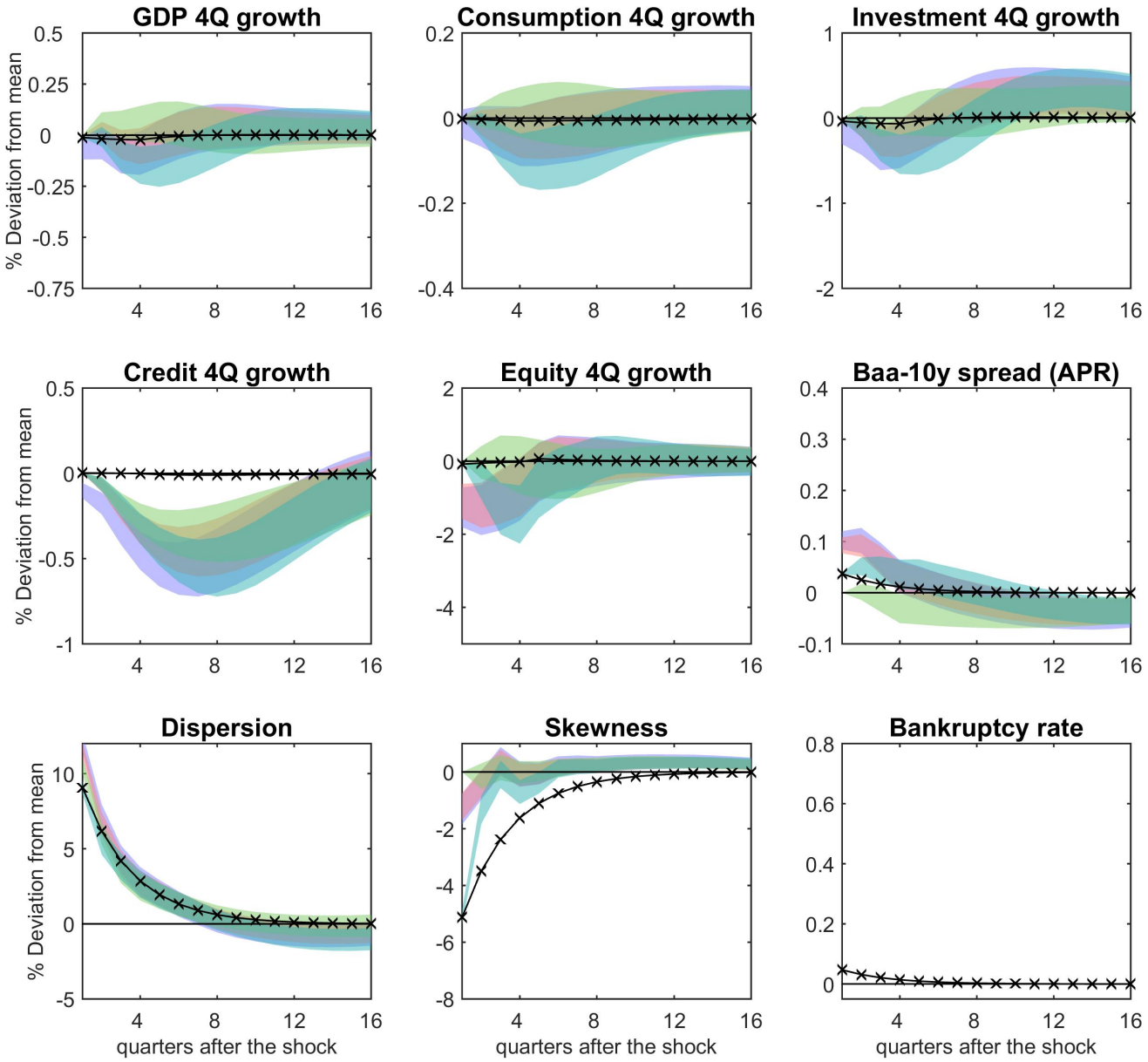




Dispersion shocks:

- FEVD of GDP = 0-3%
- IRF ≈ 0





Conclusion:

- Financial skewness is a powerful predictor of economic activity
- Financial skewness seem to signal future economic performance of financial firms' borrowers
- Financial skewness shocks are important cyclical drivers

Cross-Section Skewness: Financial X Nonfinancial

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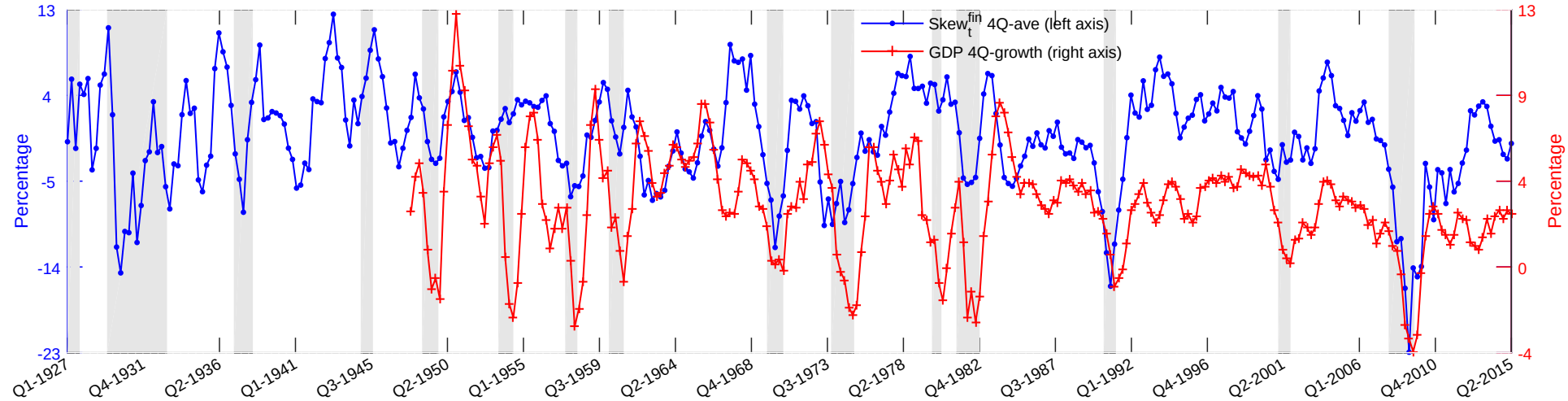

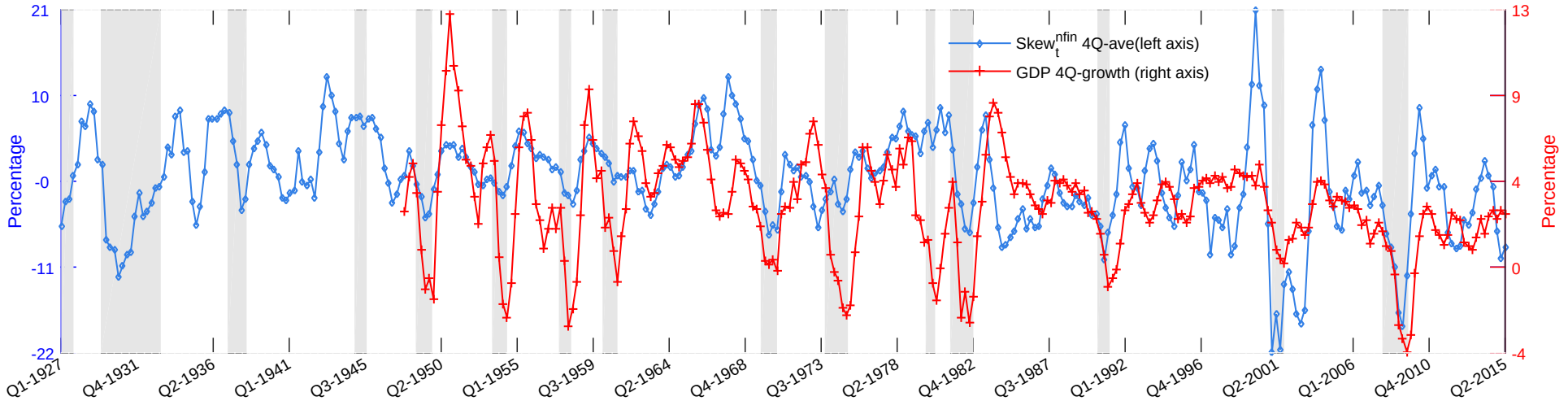

Correlations

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Sample	Financial Skewness	Nonfinancial Skewness
1926-2015	0.34	0.31
1985-2015	0.58	0.48

(a) Correlations with Expansion Indicator

Sample	Financial Skewness	Nonfinancial Skewness
1947-2015	0.40	0.36
1985-2015	0.69	0.41

(b) Correlations with GDP 4Q-growth

1926-2015: Financial Skewness Tracks Business Cycles

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Logit Regression

Dependent Variable: NBER Expansion Indicator

Variables	Regressions with Unweighted Distribution Measures (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-1.26***	-1.55***	-1.11***	-1.36***	-1.24***	-1.35***	-1.22***	-1.73***	-1.77***
Expansion Lag	4.12	4.55	3.93	4.38	4.11	4.23	4.04	5.02	5.05
Mean^{+}		1.17***						1.33***	1.23**
Dispersion^{+}			-0.34					-0.44	-0.68
Skewness^{+}				1.17***				1.71**	1.68**
Left Kurtosis^{+}					0.43			-0.92*	-0.98*
Right Kurtosis^{+}						0.20		-0.69	-0.64
Baa-Aaa							-0.24**		0.23
Pseudo R^2	0.53	0.58	0.54	0.57	0.54	0.53	0.55	0.62	0.63

$^{+}$Moments of the cross-section distribution of returns are for returns from financial firms

All regressors are standardized, so we can compare the magnitude of their coefficients. For each regressor, I include its current and one-period lagged value, with reported coefficients being the sum of current and lagged effect.

1926-2015: Financial Skewness Tracks Business Cycles

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Financial Skewness:

1) is one of the variables that single-handedly most explain NBER-indicator.
   - Comparing R^2's of columns (2)-(7)

2) has explanatory power robust to the inclusion of many other variables.
   - Such as other moments and credit spreads in columns (8)-(10).
   - In all regressions, financial skewness is stat-sig and has intuitive effects.

3) is specially informative about the cycle
   - In regressions (9)-(10) for un/weighted measures: one of largest coefficients
   - 2 std decrease in financial skewness: 52% prob of recession

Financial Skewness Predicts GDP$_{t+h|t-1}$, Out-of-Sample

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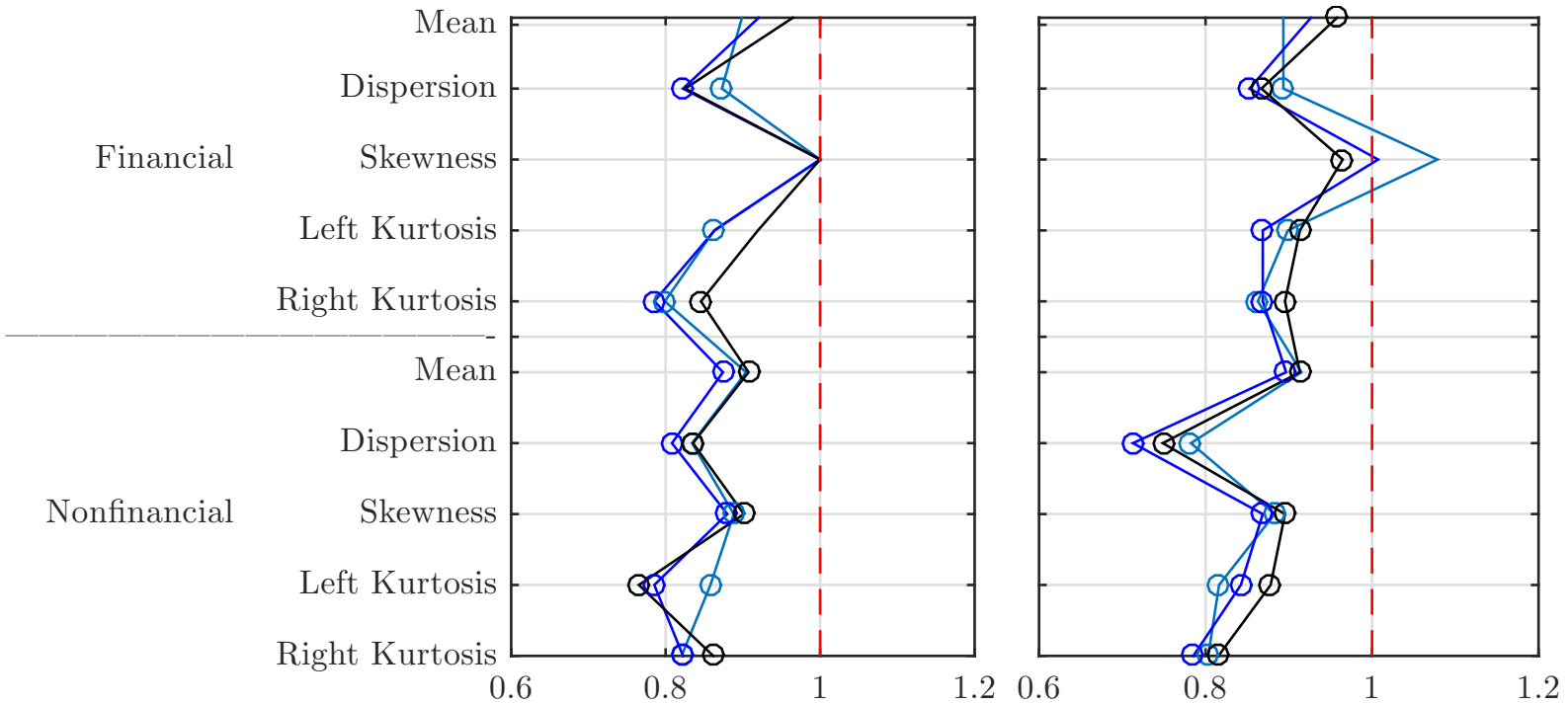
Sample: 1973Q1 - [1986Q1...2015Q2]

RMSE of Financial Skewness Relative to other Variables (in decimals)



(m) Nonweighted Measures (n) Weighted Measures

What explain Financial skewness? Part II

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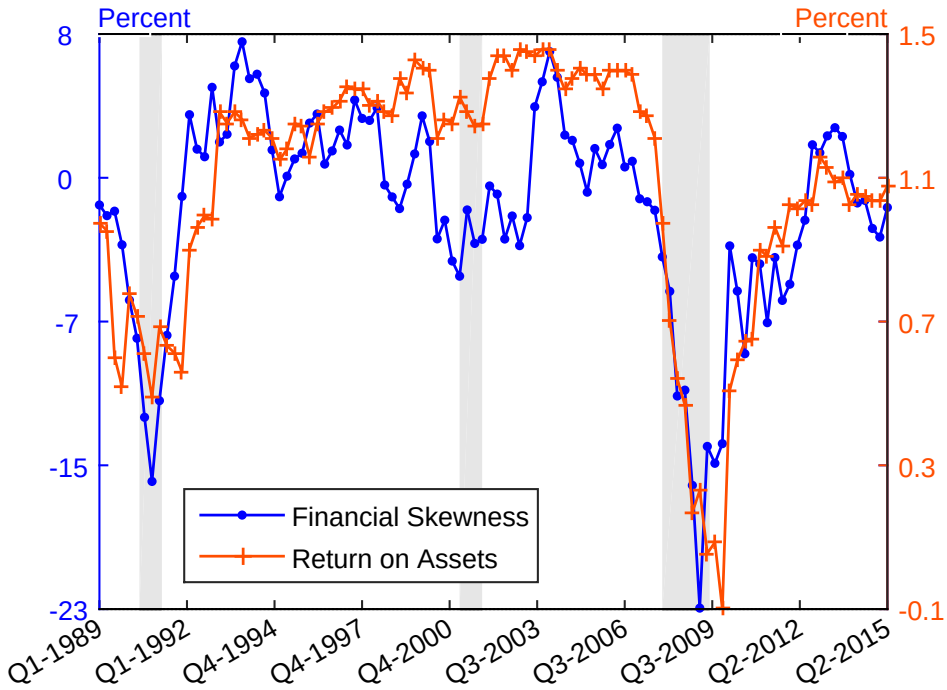
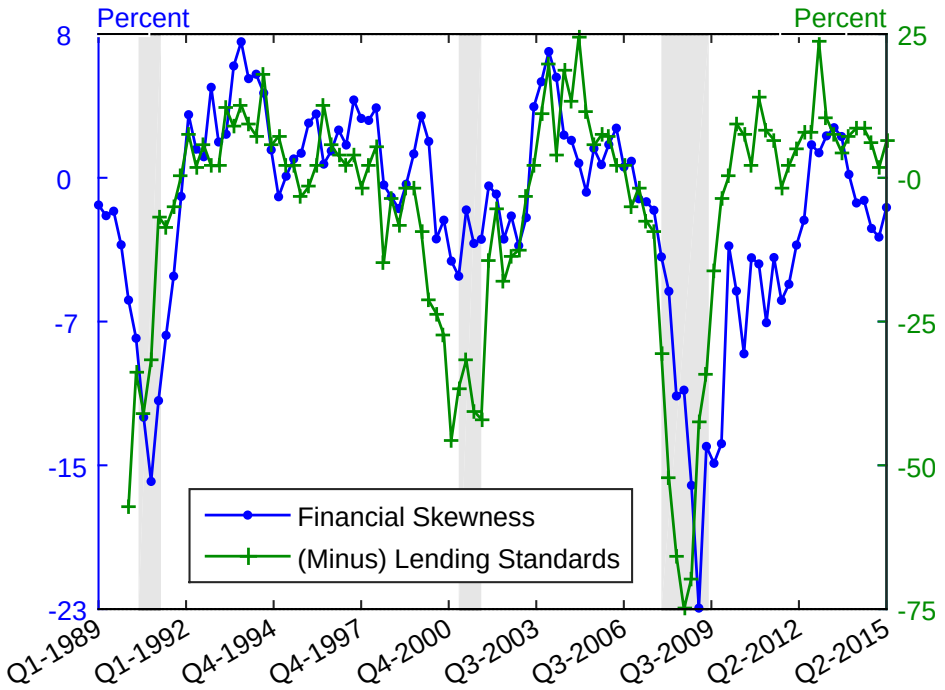


(o) Return on Assets



(p) Lending Standards