Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations

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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 communications

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

(b) Cross-Sectional Moments

financial skewness\(_t\) = \[\left(\ln r_{t}^{95th} - \ln r_{t}^{50th}\right) - \left(\ln r_{t}^{50th} - \ln r_{t}^{5th}\right)\]

upside tail risks - downside tail risks

<table>
<thead>
<tr>
<th></th>
<th>2006:Q2</th>
<th>2008Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Skewness</td>
<td>0%</td>
<td>-27%</td>
</tr>
</tbody>
</table>

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Financial Skewness Tracks Business Cycles

Financial vs Nonfinancial Correlations

Logit

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations

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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 2nd moments:

▶ 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

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1)</th>
<th>(2)</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
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<td>Mean(^+)</td>
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<td>0.73*</td>
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<td>Dispersion(^+)</td>
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<td>1.07**</td>
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<td>Skewness(^+)</td>
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<td>1.60**</td>
<td>1.00***</td>
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<td>Left Kurtosis(^+)</td>
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<td>0.71**</td>
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<td>0.26</td>
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<tr>
<td>Right Kurtosis(^+)</td>
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<td>-0.46**</td>
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<td>-1.06***</td>
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<td>-0.46**</td>
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<td>Real Fed Funds</td>
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<td>Term Spread</td>
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<td>0.92***</td>
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<td>0.18</td>
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<td>GZ Spread</td>
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<td>1.03***</td>
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<tr>
<td>(R^2)</td>
<td>0.08</td>
<td>0.29</td>
<td>0.11</td>
<td>0.28</td>
<td>0.17</td>
<td>0.11</td>
<td>0.19</td>
<td>0.12</td>
<td>0.28</td>
<td>0.23</td>
<td>0.40</td>
<td>0.54</td>
</tr>
</tbody>
</table>

\(^+\) 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.

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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 ↓ in financial skewness: ↓ 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:

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

Performance of financial skewness relative to variable $X_t$ is:

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

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

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

<table>
<thead>
<tr>
<th></th>
<th>Sample 1927-2015</th>
<th>Sample 1947-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>financial</td>
<td>nonfinancial</td>
</tr>
<tr>
<td>Mean</td>
<td>3.3</td>
<td>3.7</td>
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<tr>
<td>Dispersion</td>
<td>36.5</td>
<td>49.2</td>
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<tr>
<td>Skewness</td>
<td>-0.4</td>
<td>-0.1</td>
</tr>
<tr>
<td>Left kurtosis</td>
<td>-7.1</td>
<td>-9.0</td>
</tr>
<tr>
<td>Right kurtosis</td>
<td>7.2</td>
<td>9.1</td>
</tr>
</tbody>
</table>

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.

| Variable  | AFCI  | EBP   | VIX   | Term Spread | GDP\text{Consensus}_{t-1} | GDP\text{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*                         |                               |
| R²        | 0.76  | 0.76  | 0.76  | 0.79        | 0.76                     | 0.76                         | 0.76                         |
What explain financial skewness?  

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

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Structural Analysis:

DSGE Model and BVARs
3rd: 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

⇒

- 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 $t$:

$$X_i^t = \begin{cases} \frac{\omega_i^t R_c^t Q_{t-1} K^t_i - Z^t_i B^t_i}{N^t_i}, & \text{if } \omega_i^t R_c^t Q_{t-1} K^t_i - Z^t_i B^t_i \geq Z^t_i B^t_i \\ 0, & \text{otherwise} \end{cases} = \begin{cases} \frac{\omega_i^t - \bar{\omega}_t}{R_c^t L_t}, & \text{if } \omega_i^t \geq \bar{\omega}_t \\ 0, & \text{otherwise.} \end{cases}$$

- **endogenous distribution of $X_i^t$:** $\bar{\omega}_t$, $R_c^t$ and $L_t$ are **endogenous variables**
- $\omega_i^t$ follows a mixture of two log-normal distributions
  - $\mathbb{E}(\omega_i^t) = 1$, $\text{Std}(\omega_i^t) = sd_t$ and $m^1_t$ proxies skewness

For instance, cross-section skewness of the model is: $(\tilde{x}_t^{95} - \tilde{x}_t^{50}) - (\tilde{x}_t^{50} - \tilde{x}_t^{5})$, where $\tilde{x}_t^\nu = \log(\tilde{\omega}_t^\nu - \bar{\omega}_t)$ and $\tilde{\omega}_t^\nu$ is the $\nu^{th}$ percentile of cdf $F_t(\cdot | \omega_t > \bar{\omega}_t)$. 
NK-DSGE with financial accelerator channel: 1964-2015

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

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

Percentage

Skew_{fin}^4Q-ave (left axis)
GDP 4Q-growth (right axis)
## Correlations

(a) Correlations with Expansion Indicator

<table>
<thead>
<tr>
<th>Sample</th>
<th>Financial Skewness</th>
<th>Nonfinancial Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1926-2015</td>
<td>0.34</td>
<td>0.31</td>
</tr>
<tr>
<td>1985-2015</td>
<td>0.58</td>
<td>0.48</td>
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</table>

(b) Correlations with GDP 4Q-growth

<table>
<thead>
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<th>Sample</th>
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<th>Nonfinancial Skewness</th>
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</thead>
<tbody>
<tr>
<td>1947-2015</td>
<td>0.40</td>
<td>0.36</td>
</tr>
<tr>
<td>1985-2015</td>
<td>0.69</td>
<td>0.41</td>
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### Logit Regression

**Dependent Variable:** NBER Expansion Indicator

<table>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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</thead>
<tbody>
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<td>-1.55***</td>
<td>-1.11***</td>
<td>-1.36***</td>
<td>-1.24***</td>
<td>-1.35***</td>
<td>-1.22***</td>
<td>-1.73***</td>
<td>-1.77***</td>
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<td>Expansion Lag Mean</td>
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<td>4.55</td>
<td>3.93</td>
<td>4.38</td>
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<td>4.23</td>
<td>4.04</td>
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<td>1.17***</td>
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<td>1.71**</td>
<td>1.68**</td>
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<td>0.43</td>
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<td>-0.92*</td>
<td>-0.98*</td>
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<td>-0.24**</td>
<td>0.23</td>
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<tr>
<td>Pseudo R²</td>
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<td>0.54</td>
<td>0.53</td>
<td>0.55</td>
<td>0.62</td>
<td>0.63</td>
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</tbody>
</table>

+ 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

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
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