Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations

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1 The views expressed in this presentation are solely my responsibility and should not be interpreted as reflecting the views of the Federal Reserve System or of any other person associated with the Federal Reserve System.
Fluctuations in economic uncertainty and business cycles (Bloom (2014))

Idio risk of HH’s and nfin firms is important determinant of BCs.

- Several channels: wait-and-see effects from capital adjustment frictions (Bloom et al. (2012)); financial frictions (Arellano et al. (2012), Christiano et al. (2014), Gilchrist et al. (2014), and Chugh (2016)); search frictions in the labor market (Schaal (2017)); agency problems in the management of the firm (Panousi and Papanikolaou (2012)); granular effects (Gabaix (2011)); and network effects (Acemoglu et al. (2012)).

Cross-sectional behavior of HHs and nonfin firms follow BCs

- Dispersion (Bloom 2014) and high-order moments of the cross-sectional distribution of many economic variables seem to co-move with BCs, such as nonfinancial firm sales, profit, and employment (Bloom et al. (2016)); household income (Guvenen et al. (2014)); price changes (Luo and Vallenas (2017)); and general stock returns (Kelly and Jiang (2014))

Theories X Data ⇒ surviving theories (e.g. Ilut et al (2017))
Business Cycles (BCs): Theory and Cross-Section Behavior

How about financial firms?

Most models have focused representative financial sector


Few models analyze macro implications of heterogeneous financial sector

▶ Boissay et al (2016) on the effects from moral hazard and asymmetric information in the interbank market, and Martinez-Miera and Repullo (2017) on the effects from search for yield

▶ little on whether the cross-sectional cyclical behavior of financial firms predicted by theory is consistent with the data (exception Coimbra and Rey (2017))

Empirical evidence is also limited

▶ studies on cross-sectional equity volatility focusing on issues related to systemic risk (Giglio et al (2016))

Does cross-sectional behavior of financial firms fluctuate over BCs? Yes!
Does it help us better understand BCs? Yes!
Cross-Sectional Distribution of Stock Returns of Financial Firms

(a) Probability Density Function

(b) Financial Skewness

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

upside tail risks

downside tail risks

<table>
<thead>
<tr>
<th>2006:Q2</th>
<th>2008:Q4</th>
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<tbody>
<tr>
<td>0%</td>
<td>-27%</td>
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</table>
Financial Skewness Tracks Business Cycles

GDP Growth (Right)
Financial Skewness (Left)


Percent Percent

Financial vs Nonfinancial Correlations Logit

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations

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Financial Skewness...

1) ... is a powerful predictor of economic and credit activity

2) ... is largely exogenous, with its shocks leading to sizable macro effects via a financial frictions mechanism

3) ... measures cross-sectional risk on fundamentals faced by financial firms and their borrowers
1) Financial skewness:

powerful predictor of economic and credit activity
### Financial Skewness Predicts Economic Activity, In-Sample

**Dependent Variable:** Mean 4Q Ahead GDP Growth  
**Sample:** 1973Q1 - 2015Q2

#### Regressions Specifications

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
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<tr>
<td>Mean+</td>
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<td>0.73*</td>
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<td>Dispersion+</td>
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<td>Skewness+</td>
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<td>1.60**</td>
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<tr>
<td>Left Kurtosis+</td>
<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>Uncertainty</td>
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<td>0.46**</td>
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<td>Real Fed Funds</td>
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<td>-0.46**</td>
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<td>Term Spread</td>
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<td>0.92***</td>
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<td>GZ Spread</td>
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<td>R²</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.
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

GDP$_{t+h|t−1}$: mean GDP growth $h$ quarters ahead
Sample : 1973Q1 - [1986Q1... 2015Q2]

For each variable $X_t$, forecasts are:

\[ GDP_{t+h|t−1} = \alpha + \sum_{i=1}^{p} \rho_i GDP_{t−i|t−i−1} + \sum_{j=0}^{q} \theta_j X_{t−j} + u_{t+h}. \]

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

\[ \text{R-RMSFE of Variable } Z_t = \frac{\text{RMSFE of Financial Skewness}}{\text{RMSFE of Variable } Z_t} \text{ (in decimals)} \]
Financial Skewness Predicts GDP$_{t+h|t-1}$, Out-of-Sample

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

(c) Full Sample

(d) Recessions

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

Financial skewness most often predicts GDP growth relatively well

- Lowest RMSE, 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

Other Rolling RMSE ratios tell similar story.
Financial Skewness Predicts Loans$_{t+h|t-1}$, Out-of-Sample

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

- Term spread
- Baa-10y spread
- GZ spread
- Financial uncertainty
- Baa-Aaa spread
- Macro uncertainty
- EBP
- Loan-AR

(h) Full Sample

(i) Recessions

(j) Expansions

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Financial Skewness Predicts Loans_{t+h|t−1}, Out-of-Sample

Financial skewness most often predicts loan growth relatively well

▶ Lowest RMSE with most results stat. significant
▶ Differences economically significant: up to 42% of improvement

Financial skewness predicts other credit variables, but it does particularly well for loan growth
2) Financial skewness (using BVAR & DSGE):

largely exogenous, with its shocks leading to sizable macro effects via a financial frictions mechanism
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:

- cross-section skewed risk shocks \(\Rightarrow\) productivity of borrowing firms’ projects
- (un-modeled events) \(\Rightarrow\) lending capacity of financial firms
Distribution of Returns and the Financial Accelerator

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

$$X_i^t = \begin{cases} 
\frac{\omega_i^t R_t^c Q_t - 1 \bar{K}_t^i - Z_i^t B_i^t}{N_t^i}, & \text{if } \omega_i^t R_t^c Q_t - 1 \bar{K}_t^i - Z_i^t B_i^t \geq Z_i^t B_i^t \\
0, & \text{otherwise}
\end{cases}$$

- **endogenous distribution of $X_i^t$:** $\omega_t$, $R_t^c$ and $L_t$ are endogenous variables
- $\omega_t^i$ follows a mixture of two log-normal distributions
  - $\mathbb{E}(\omega_t^i) = 1$, $\text{Std}(\omega_t^i) = sd_t$ and $m_1^t$ 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 $\tilde{x}_t^\nu = \log(\tilde{\omega}_t^\nu - \omega_t)$ and $\tilde{\omega}_t^\nu$ is the $\nu^{th}$ percentile of cdf $F_t(\cdot | \omega_t > \omega_t)$. 
NK-DSGE with financial accelerator channel: 1964-2015

2nd 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 ($Mean^{fin}_{t}$)</td>
<td>equity and meas-error</td>
</tr>
<tr>
<td>Baa - US_10y</td>
<td></td>
</tr>
<tr>
<td>$Disp^{fin}<em>{t}$ and $Skew^{fin}</em>{t}$</td>
<td>$sd_{t}$ and $m^{1}_{t}$ news about them up to 4Q in advance</td>
</tr>
</tbody>
</table>

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Primacy of Skewness Shocks: Hist + Var Decomp’s

(k) GDP (7 | 41 %)

(l) Investment (9 | 51 %)

(m) Credit (6 | 35 %)

(n) Baa spread (16 | 50 %)

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Skewness shocks

FinSkew largely exo
- FEVD: majority of FinSkew

Macro effects:
- IRF: GDP falls 0.3-0.75%

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

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
Dispersion shocks

- FEVD of GDP = 0-3%
- IRF ≈ 0
3) Financial skewness

measures cross-sectional risk on fundamentals faced by financial firms and their borrowers
1st Interpretation: Risks Faced by Credit Demand
Cross-Sectional Risks on Investment Projects of Borrowers

Financial firms’ stocks anticipate BCs because:
► lending relationships make them well interconnected
► asset diversification purges nonfinancial idio risk ⊥ to aggregate outcomes

Results corroborating this interpretation:
► financial skewness correlated with measures of credit demand’s health
► financial skewness predicts loan growth better than debt growth
► financial skewness predicts GDP better than nfin CS moments
► CS distributions of stock returns of financial firms are less dispersed and thinner-tailed relative to nonfin ones
2nd Interpretation: Risks Faced by Credit Supply

Cross-Sectional Risks on Lending Capacity of Financial Sector

Financial firms’ stocks anticipate BCs because:

- adverse shocks push financial firms against capital and liquidity constraints
- these shocks then tilt financial firm’s risks to the downside
- then, causing less lending and less GDP growth

Results corroborating this interpretation:

- financial skewness correlated with measures of distress faced by financial firms
- financial skewness predicts loan growth better than debt growth
Financial sector holds smaller cross-section risks

**Table:** Times Series Averages of Distribution Measures (in Percent)

<table>
<thead>
<tr>
<th></th>
<th>Sample 1947-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>financial</td>
</tr>
<tr>
<td>Mean</td>
<td>2.9</td>
</tr>
<tr>
<td>Dispersion</td>
<td>35.8</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.1</td>
</tr>
<tr>
<td>Left kurtosis</td>
<td>-7.9</td>
</tr>
<tr>
<td>Right kurtosis</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Financial

\[
\begin{align*}
\text{Mean:} & \quad \text{stat the same} \\
\text{Dispersion:} & \quad \text{smaller} \\
\text{Skewness:} & \quad \text{somewhat higher} \\
\text{Left tail:} & \quad \text{thinner} \\
\text{Right tail:} & \quad \text{thinner}
\end{align*}
\]

than Nonfinancial
Financial skewness correlates with...

- credit demand conditions: ROA, LSSF
- distress faced by financial firms: AFCI, EBP, UC, RA, term-spread
- but not with current & lagged macro conditions: $\hat{\text{GDP}}_{t-1}$, GDP$_{t-5}$
- thus, evidence against reverse causality

| Variable | AFCI | EBP | UC | RA | Term Spread | GDP$_{t-1}$ | GDP$_{t-1|t-5}$ |
|----------|------|-----|----|----|-------------|-------------|----------------|
| ROA      | 3.2***| 2.7***| 3.1***| 3.0***| 2.9*** | 3.8*** | 3.0*** | 4.2*** |
| LSSF     | -3.4***| -2.1*| -2.7**| -2.1**| -2.6*** | -2.9*** | -3.2*** | -3.4*** |
| Variable | -1.9  | -1.0 | -2.1**| -1.6*| 1.2  | 0.4  | -1.4  |
| $R^2$    | 0.36  | 0.38 | 0.37 | 0.39 | 0.38  | 0.37  | 0.36  | 0.37  |
Summarizing: Financial Skewness...

1) ... is a powerful predictor of economic and credit activity

2) ... is largely exogenous, with its shocks leading to sizable macro effects via a financial frictions mechanism

3) ... measures cross-sectional risk on fundamentals faced by financial firms and their borrowers
Going forward:

This paper points to an agenda for business cycle theories

- not only financial firms play an active role
- but the cross-sectional distribution of their equity is strongly cyclical
- and is an important veil for signaling macroeconomic fundamentals.
Cross-Section Skewness: Financial X Nonfinancial

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Stock Market Cross-Sectional Skewness and Business Cycle Fluctuations
### Correlations

<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>

(a) Correlations with Expansion Indicator

<table>
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<th>Sample</th>
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<th>Nonfinancial Skewness</th>
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<tbody>
<tr>
<td>1947-2015</td>
<td>0.40</td>
<td>0.36</td>
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<tr>
<td>1985-2015</td>
<td>0.69</td>
<td>0.41</td>
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(b) Correlations with GDP 4Q-growth
1926-2015: Financial Skewness Tracks Business Cycles

Logit Regression
Dependent Variable: NBER Expansion Indicator

<table>
<thead>
<tr>
<th>Variables</th>
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<th>(2)</th>
<th>(3)</th>
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<th>(9)</th>
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<tr>
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<td>-1.11***</td>
<td>-1.36***</td>
<td>-1.24***</td>
<td>-1.35***</td>
<td>-1.22***</td>
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<td>-1.77***</td>
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<tr>
<td>Expansion Lag</td>
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<td>Mean +</td>
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<td>0.43</td>
<td>-0.92*</td>
<td>-0.98*</td>
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<td>Baa-Aaa</td>
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<td>-0.24**</td>
<td>0.23</td>
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<tr>
<td>Pseudo $R^2$</td>
<td>0.53</td>
<td>0.58</td>
<td>0.54</td>
<td>0.57</td>
<td>0.54</td>
<td>0.53</td>
<td>0.55</td>
<td>0.62</td>
<td>0.63</td>
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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]
What explain Financial skewness? Part II

Financial Skewness

Return on Assets

Percent

(q) Return on Assets

Lending Standards

Percent

(r) Lending Standards

The graphs depict the financial skewness and return on assets (q) as well as lending standards (r) over various quarters from Q1-1989 to Q2-2015. The x-axis represents the quarters, and the y-axis shows the percent values for each measure. The graphs illustrate the trends and changes in financial skewness and lending standards over time.