Sentiment Booms Go Wrong

Marco Brianti
Vito Cormun

March 2019

Dissertation Workshop, Boston College

Two long Traditions in Macroeconomics

1. **Changes in expectations** as a driver of economic fluctuations
   - Incentives to anticipate economic developments
     $\Rightarrow$ Pigou (1927); Keynes (1936); Beaudry and Portier (2004, 2006)
   - Incentives to infer other agents' beliefs
     $\Rightarrow$ Angeletos and La'O (2013)

2. **Endogenous cycle**: expansions lead recessions

$\Rightarrow$ Economic fluctuations are driven by **internal forces** which induce recurrent periods of boom and bust

- Over-accumulation during expansions
  $\Rightarrow$ von Mises (1940); Beaudry, Galizia, and Portier (2018, 2019)
- Excess of credit due to overoptimism in financial markets
  $\Rightarrow$ Minsky (1977); Bordalo, Gennaioli, Shleifer (2018)

This paper

1. We empirically estimate **sentiment shocks** and evaluate their effects on U.S. macro and financial variables
   - We define sentiment shocks as **changes in expectations** uncorrelated with economic fundamentals
   - Sentiment shocks trigger **boom-and-bust dynamics** on most macro and financial variables
     - Cycle lasts about 30 quarters
   - Sentiments explain up to **40% of output**
   - Fundamental shocks **do not** trigger boom-and-bust dynamics

2. We want to write a **general equilibrium model** consistent with our empirical findings
   - Derive **sufficient conditions** that matches the findings
   - **Rationalize** why cyclical dynamics arises only after sentiments
   - Today: environment consistent with a broad class of models

Contributions

1. We use Instrumental Variable Local Projection (**IV-LP**) to estimate sentiments shocks
   - Previous literature estimates DSGE models or employ SVAR
     - ⇒ Milani (2011); Levchenko and Pandalai-Nayar (2018)
2. Uncover **new dynamics** in response to sentiment shocks
   - **Informative** for the theoretical literature on sentiments
     - ⇒ Angeletos and La'O (2013); Angeletos et al. (2018)
3. New supportive evidence for the literature on **credit cycles**
   - We propose **structural evidence** in favor of credit booms with negative macroeconomic consequences
     - ⇒ Lopez-Salido, Stein, and Zakrajsek (2017)
4. (Ideally) Theory that displays **boom-and-bust** dynamics conditional on a specific type of shock
   - Hard to get shock specific boom and busts
     - ⇒ Beaudry, Galizia, and Portier (2019)

Roadmap

1. **Empirical Strategy**
2. Empirical Results
3. Test
4. Going Forward

Econometric Strategy

A 2-step procedure:

1. Build an **instrument** Z_t correlated with changes in expectations and orthogonal to economic fundamentals

2. Estimate **dynamic responses** of macro and financial variables using instrumental variable local projection

Data Treatment on Expectations

Quarterly data from 1982 to 2018 of forecasts on macroeconomic variables, X_t^s, made by **Survey of Professional Forecasters**

Objects of interest

- $E_t^i(X_{t+k}^s)$: expectation on X_{t+k}^s given the information set at time t released by professional forecaster i
- $E_t(X_{t+k}^s) = \frac{1}{N}\sum_{i=1}^N E_t^i(X_{t+k}^s)$: average across i of $E_t^i(X_{t+k}^s)$
- $E_{t-1}(\hat{x}_{t+k}^s) = E_{t-1}(X_{t+k}^s)/E_{t-1}(X_t^s) - 1$: expectation of the growth rate of X^s from t to $t+k$ given information set $t-1$
- $R_{t,k}^s = E_t(\hat{x}_{t+k}^s) - E_{t-1}(\hat{x}_{t+k}^s)$: revision from $t-1$ to t on expectation of the growth rate of X^s from t to $t+k$
- R_t is the first principal component of $R_{t,k}^s$

IV-LP Estimator

Dynamic response of an aggregate variable Y_{t+h} to R_t is

$$Y_{t+h} = \Theta_h^Y R_t + u_{h,t}^Y \tag{1}$$

- R_t is correlated with a sentiment shock $\varepsilon_{1,t}$
- **correlated** with other shocks $\varepsilon_{2:N,t}$ contained in $u_{h,t}^Y$

Equation 1 can be estimated by IV if Z_t satisfies three conditions

1. $E(\varepsilon_{1,t} Z_t) = \alpha \neq 0$ (relevance)
2. $E(\varepsilon_{2:N,t} Z_t) = 0$ (contemporaneous exogeneity)
3. $E(\varepsilon_{1:N,t+j} Z_t) = 0$ for $j \neq 0$ (lead-lag exogeneity)

Instrument Z_t

We estimate instrument Z_t as the unpredictable component of R_t orthogonal to fundamentals,

$$R_t = c + B(L)\Delta TFP_t + \delta W_t + Z_t$$

where,

- ΔTFP is the first difference of TFP
- W_t is a series of controls Robustness Checks
  - Lags of principal components from a large dataset
  - Structural shocks provided by the literature

Importantly, R-Squared are relatively small ($30\% - 50\%$)

$\Rightarrow$ A large part of SPF expectations is unrelated to fundamentals

$\Rightarrow$ Z_t is a relevant instrument

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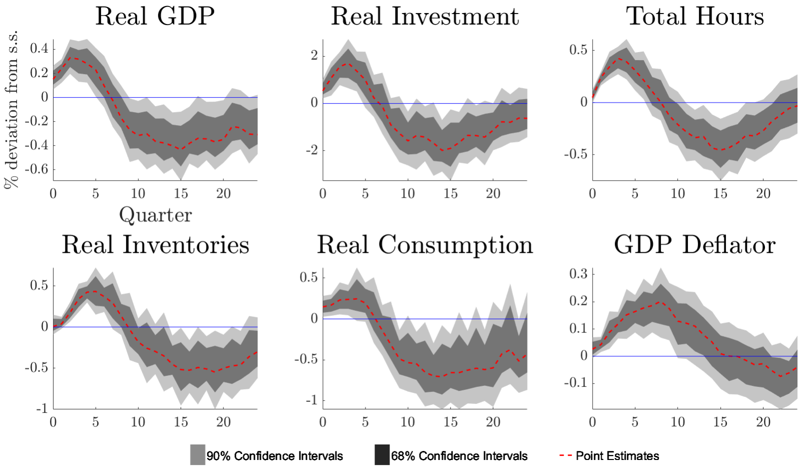
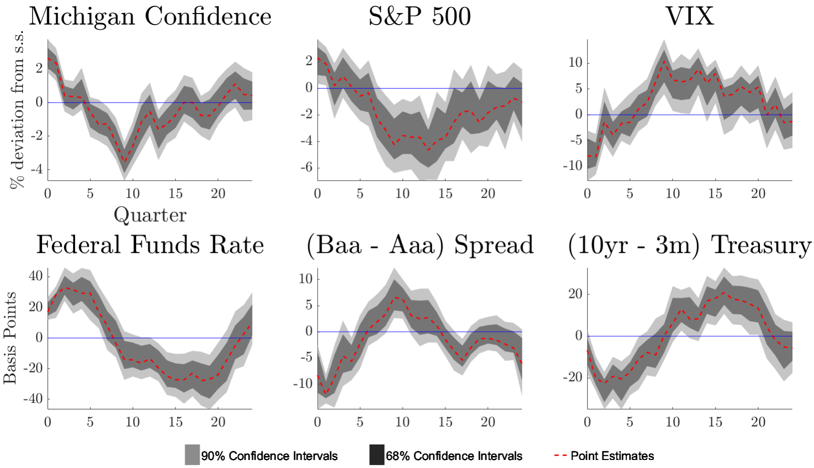
Impulse Responses of Macro Variables to a Sentiment Shock



Impulse Responses of Financial Variables to a Sentiment Shock



Variance Explained by Sentiment Shocks

	Impact	*1 Year*	*2 Years*	*5 Years*
Real GDP	9.38%	19.81%	16.50%	37.72%
Real Investment	4.95%	19.69%	15.06%	35.96%
Total Hours	1.50%	23.38%	14.87%	25.21%
Real Consumption	4.51%	6.70%	5.50%	32.21%
S&P 500	1.68%	6.98%	24.32%	36.83%
VIX	0.09%	8.05%	8.14%	11.84%
(Baa - Aaa) Spread	0.00%	8.37%	16.64%	24.55%
(10yr - 3m) Treasury	0.01%	1.82%	5.54%	16.82%

Takeaways

- Sentiment shocks generate cycles of 6 to 7 years in both real and financial variables
  - $\Rightarrow$ Conditional to a positive sentiment shock, booms precede recessions
  - $\Rightarrow$ Shocks to the fundamentals do not trigger the same dynamics
    Results
- Sentiment shocks account for the bulk of fluctuations over the 4- to 6-year horizon
  - $\Rightarrow$ Changes in expectation orthogonal to fundamentals are related to a large share of economic activity

Robustness Checks

- Detrending techniques: first difference, linear, quadratic, Hodrick-Prescott and Band-pass
- Bivariate VAR via Cholesky identification Results
  - Instrument ordered first
  - VAR needs 8 lags to capture the full dynamics
- Choice of lags and controls to build instrument Z_t
  - News shocks à la Barsky and Sims (2011)
  - Future utilization-adjusted TFP
- SPF forecasts on Real and Nominal GDP, Real Consumption, Real Investment, and Industrial Production
- Use alternative measures of expectations derived from Michigan Consumer Survey

Roadmap

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2. Empirical Results
3. **Test**
4. Model
5. Conclusions

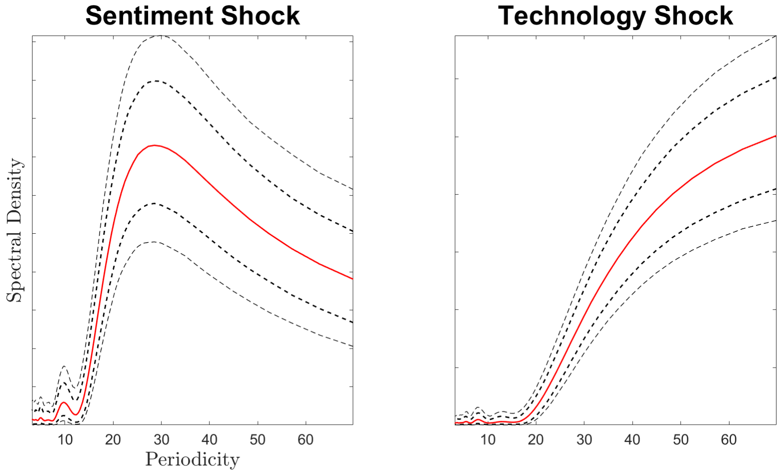
Test over the Frequency Domain

If the spectral density of a time series displays a ***peak*** *at a given frequency, this is an indicator of* ***cyclical phenomena*** *at that frequency.*

We follow two steps,

1. We estimate the empirical spectral density of U.S. aggregates conditional to sentiment shocks
   - ⇒ Use impulse responses as truncate moving average conditional on one shock Technicalities
2. Test whether or not the spectrum display a significant and substantial peak at business-cycle frequencies
   - ⇒ Compare the part explained at business-cycle frequencies vs the part explained at lower frequencies Technicalities

Intuition: Conditional Spectral Density of Real GDP



Implementation and Results

We extend Canova (1996) and Beaudry et al. (2019) conditioning only on one shock

H_0: Spectral density of the impulse response is **weakly increasing** in the periodicity

$\Rightarrow$ Which is the case for AR(1) responses with persistence parameter $\in [0, \ 1)$

Results,

	Sentiment Shock	*Technology Shock*
Real GDP	0.001	0.999
Real Investment	0.002	0.999
Total Hours	0.000	0.998
Real Consumption	0.104	0.999

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Going Forward

Consider the following system,

$$Y_t = \alpha_1 X_t + \alpha_2 Y_{t-1} + \varepsilon_t^Y$$

$$X_t = \beta_1 X_{t-1} + \beta_2 Y_{t-1} + \varepsilon_t^X$$

If $\alpha_2 > 0$ and $\beta_1 > 0$, and $\alpha_1 < 0$ and $\beta_2 > 0$, one can generate cyclical dynamics in Y_t after a change of ε_t^Y but not after ε_t^X.

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Possible interpretation: X_t as financial fragility and Y_t as output.

- $\Rightarrow$ A sentiment shock ($\uparrow \epsilon_t^Y$) generates an increase in output ($\uparrow Y_t$) and a future deterioration of the underlying financial conditions ($\uparrow X_{t+1}$).
- $\Rightarrow$ A technology shock ($\downarrow \epsilon_t^Y$) increases output ($\uparrow Y_t$) and improves financial conditions ($\downarrow X_t$).

Conclusions and Future Work

We uncover new dynamics in response to shocks uncorrelated with fundamentals.

Results hold across various specifications.

We sympathize with the idea of inefficient credit booms. These can emerge due to moral hazard due to limited liability, pecuniary externality, countercyclical information acquisition or irrational behavior

- Can we devise a framework that nests all these channel together?

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5. **Appendix**

Technical Details on Empirical Strategy

- Forecast horizon k from SPF data is either 3 or 4
- Forecasted variables X^s are real GDP, nominal GDP, real consumption, real investment, and industrial production
- If Y_t is non-stationary,
  - Detrend Y_t with low-frequency filters
  - Take the first difference of Y_t and $\Gamma_h^Y = \sum_{i=0}^{h} \Theta_h^Y$ is the response of Y_{t+h}
- Bootstrap method is from Kilian and Kim (2011)

Bootstrapping Technique

1. Consider tuple $\Lambda^Y_{h,t} = \{Y_{t+h} \quad R_t \quad W_t \quad u^Y_{h-1,t+h}\}$

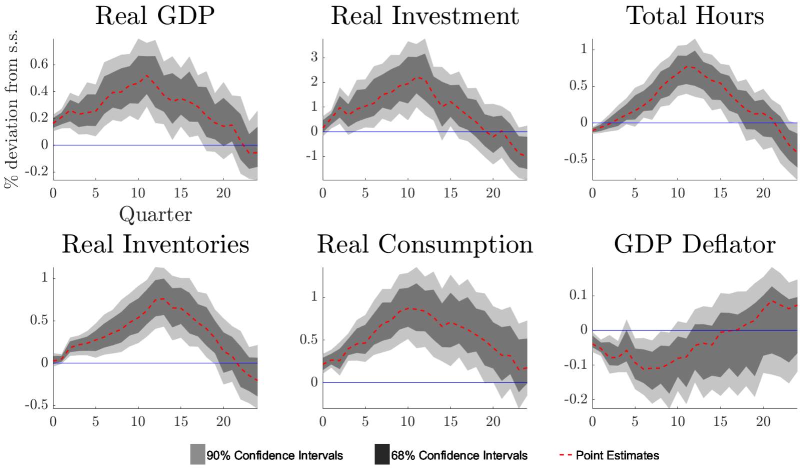
2. Create $\Lambda^Y_{h,t,1}$ of the same length of T of $\Lambda^Y_{h,t}$ where $\Lambda^Y_{h,t,1}$ is formed by randomly extracted blocks of length l from $\Lambda^Y_{h,t}$

3. Estimate $\Theta^Y_{h,1}$ from $\Lambda^Y_{h,t,1}$ using IV-LP estimator

4. Redo first 3 steps $B = 2000$ times and get $\Theta^Y_{h,b}$ where $b = 1, \ldots, B$

5. Select confidence bands of $\Theta^Y_{h,b}$ across b for all h

Impulse Responses of Macro Variables to a Technology Shock



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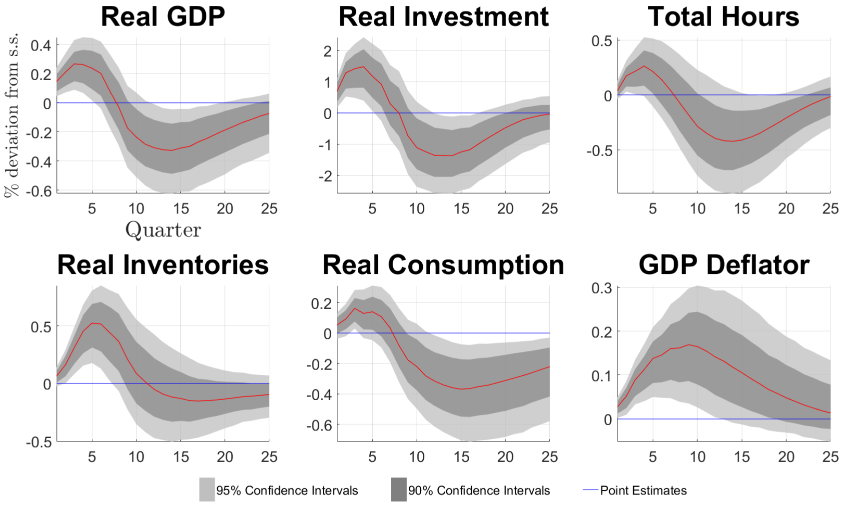
Impulse Responses to a Sentiment Shock using a VAR(8)



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Technicalities: Derive the Spectrum from Impulse Responses

1. Use empirical responses as an approximation for the conditional MA representation of Y_t

$$Y_t = \underbrace{B_0 \varepsilon_{1,t} + B_1^Y \varepsilon_{1,t-1} + \dots}_{B(L)\varepsilon_t} \approx \underbrace{\hat{\Theta}_0^Y \varepsilon_{1,t} + \dots + \hat{\Theta}_H^Y \varepsilon_{1,t-H}}_{\hat{\Theta}(L)\varepsilon_t}$$

2. Define the spectrum as,

$$S_Y(\omega) = \frac{\sigma_\varepsilon^2}{2\pi} B(e^{-i\omega}) B(i\omega) \approx \frac{\hat{\sigma}_\varepsilon^2}{2\pi} \hat{\Theta}(e^{-i\omega}) \hat{\Theta}(e^{i\omega})$$

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Technicalities: Define Test Statistics

1. Define

$$D_1 = \int_{\omega \in \Omega_1} \frac{\sigma_\varepsilon^2}{2\pi} B(e^{-i\omega}) B(i\omega) \approx \sum_{\omega \in \Omega_1} \frac{\hat{\sigma}_\varepsilon^2}{2\pi} \hat{\Theta}(e^{-i\omega}) \hat{\Theta}(e^{i\omega})$$

   and

$$D_2 = \int_{\omega \in \Omega_2} \frac{\sigma_\varepsilon^2}{2\pi} B(e^{-i\omega}) B(i\omega) \approx \sum_{\omega \in \Omega_2} \frac{\hat{\sigma}_\varepsilon^2}{2\pi} \hat{\Theta}(e^{-i\omega}) \hat{\Theta}(e^{i\omega})$$

   where Ω_1 represents a frequency neighborhood around 25-35 quarters and Ω_2 around 60-70 quarters

2. The test statistic is $D = D_1 / D_2$.

3. $H_0 : D \leq 1$
   $\Rightarrow$ Note that $D = 1$ under a white noise while it is smaller than one for an AR(1) with positive persistence

4. Compute p-value using bootstrap methods

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