



How the Chicago Fed uses longitudinal data to calculate diffusion indexes from its business survey

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November 28, 2017

*The views expressed in this presentation are our own and do not necessarily reflect those of the Federal Reserve Bank of Chicago or of the Federal Reserve System.



Overview of the Chicago Fed Survey of Business Conditions (CFSBC)

- Bi-quarterly survey of Seventh District business leaders
 - Aligned with the Beige Book release schedule
- Started in 2012, indexes start in 2013
- 100–120 people respond each time
- Participants cover a variety of industries
 - Heavy on manufacturing, finance, and real estate
 - Recruited primarily from speech attendees


The CFSBC covers a variety of business activity topics

- Demand for products or services
- Outlook for the US economy
- Employment
- Capital spending
- Wages
- Prices
- Sector-specific questions

Questions are on a 7-level Likert scale

In the past four to six weeks, demand for my firm's products or services has

- increased substantially.
- increased moderately.
- increased slightly.
- not changed.
- decreased slightly.
- decreased moderately.
- decreased substantially.



A typical diffusion index uses data from just one time period

$$Index_t = 100 \times \frac{\# \text{ Positive Responses}_t - \# \text{ Negative Responses}_t}{\# \text{ Responses}_t}$$

Example:

- 100 responses at time t
 - 60 positive
 - 20 negative
- $Index_t = 100 \times \frac{(60-20)}{100} = 40$

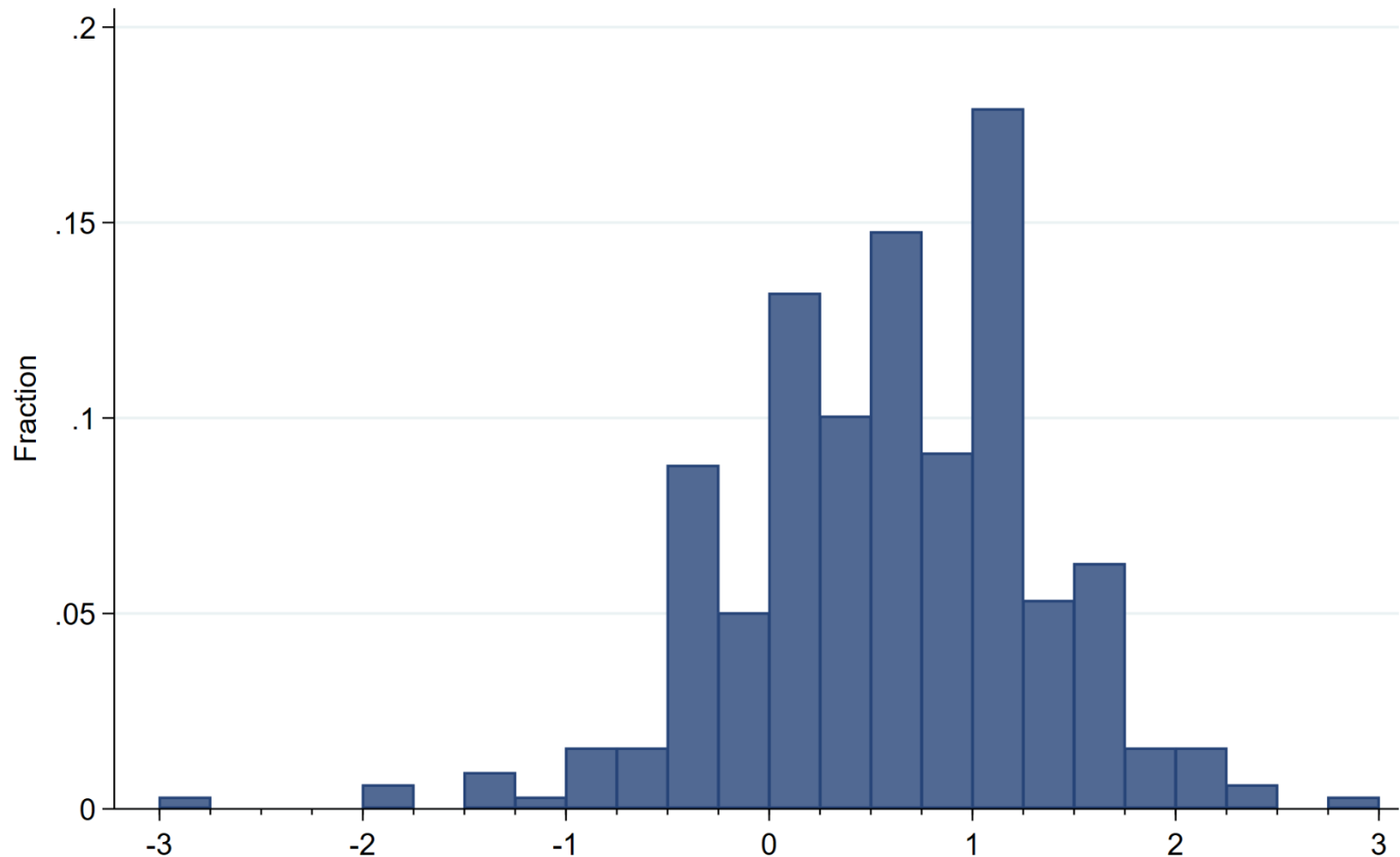


The CFSBC diffusion indexes take into account a respondent's history of responses

- Calculate the indexes relative to participants' *average* responses
 1. Assign numeric values to the Likert scale ranging from -3 to $+3$
 2. Exclude anyone who hasn't responded at least twice
 3. Calculate each respondents average response



The distribution of average responses to the demand question





The CFSBC diffusion index is calculated relative to respondents' average responses

$$100 \times \frac{\# \text{ Above Average Responses} - \# \text{ Below Average Responses}}{\# \text{ Responses}}$$

Example

- Average response: demand increased slightly
 - Above average response: demand increased moderately or significantly
 - Neutral response: demand increased slightly
 - Below average response: demand was unchanged or decreased
- 100 responses
 - 60 above average
 - 20 below average
- $Index = 100 \times \frac{(60-20)}{100} = 40$



We interpret the index in terms of trend growth

$$100 \times \frac{\# \textit{Above Average Responses} - \# \textit{Below Average Responses}}{\# \textit{Responses}}$$

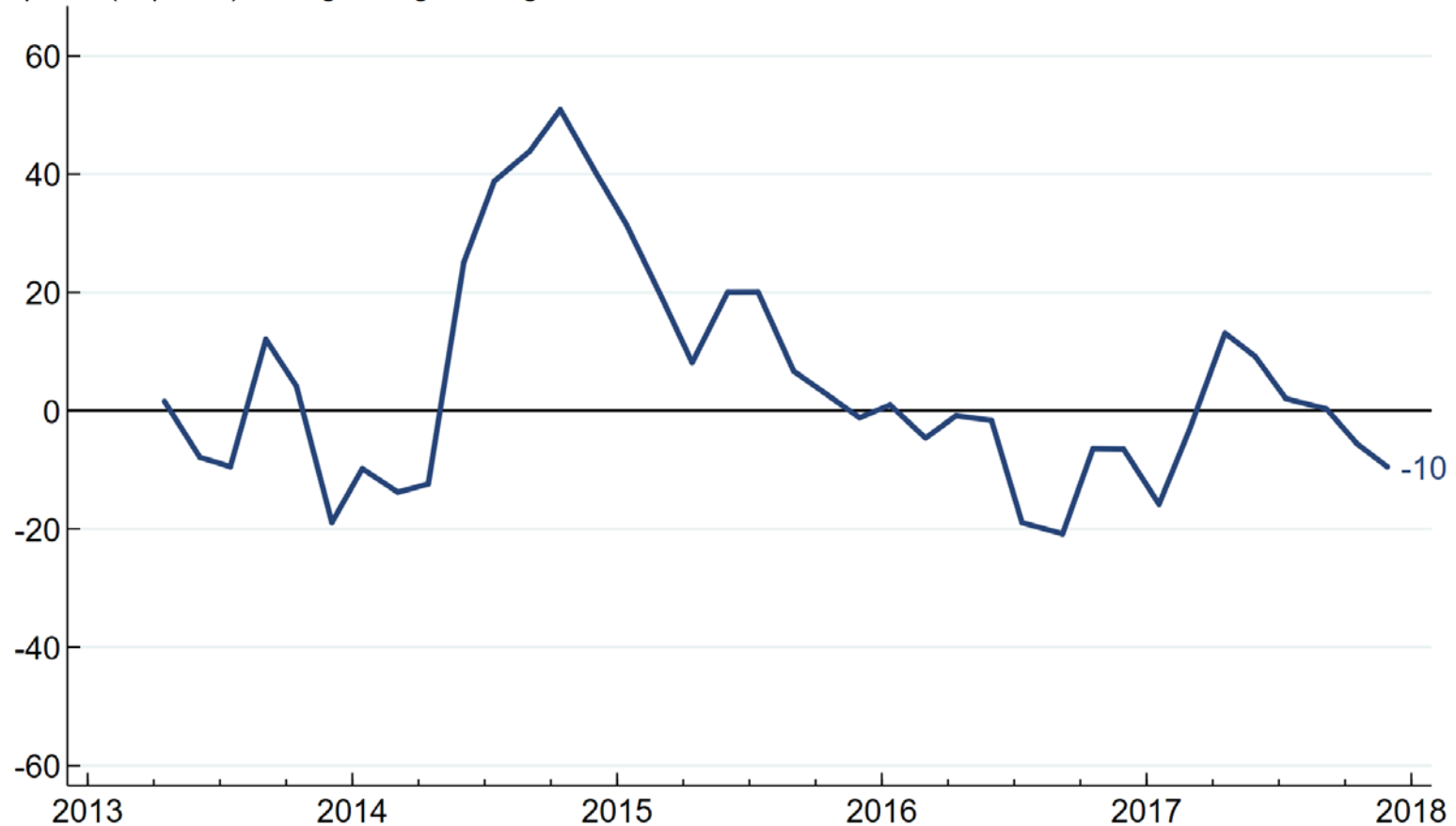
- Positive value = overall growth above trend
- Neutral value = overall growth at trend
- Negative value = overall growth below trend



Our headline index—based on the product demand question

CFSBC Activity Index

2-period (1-quarter) moving average, through 11/2017



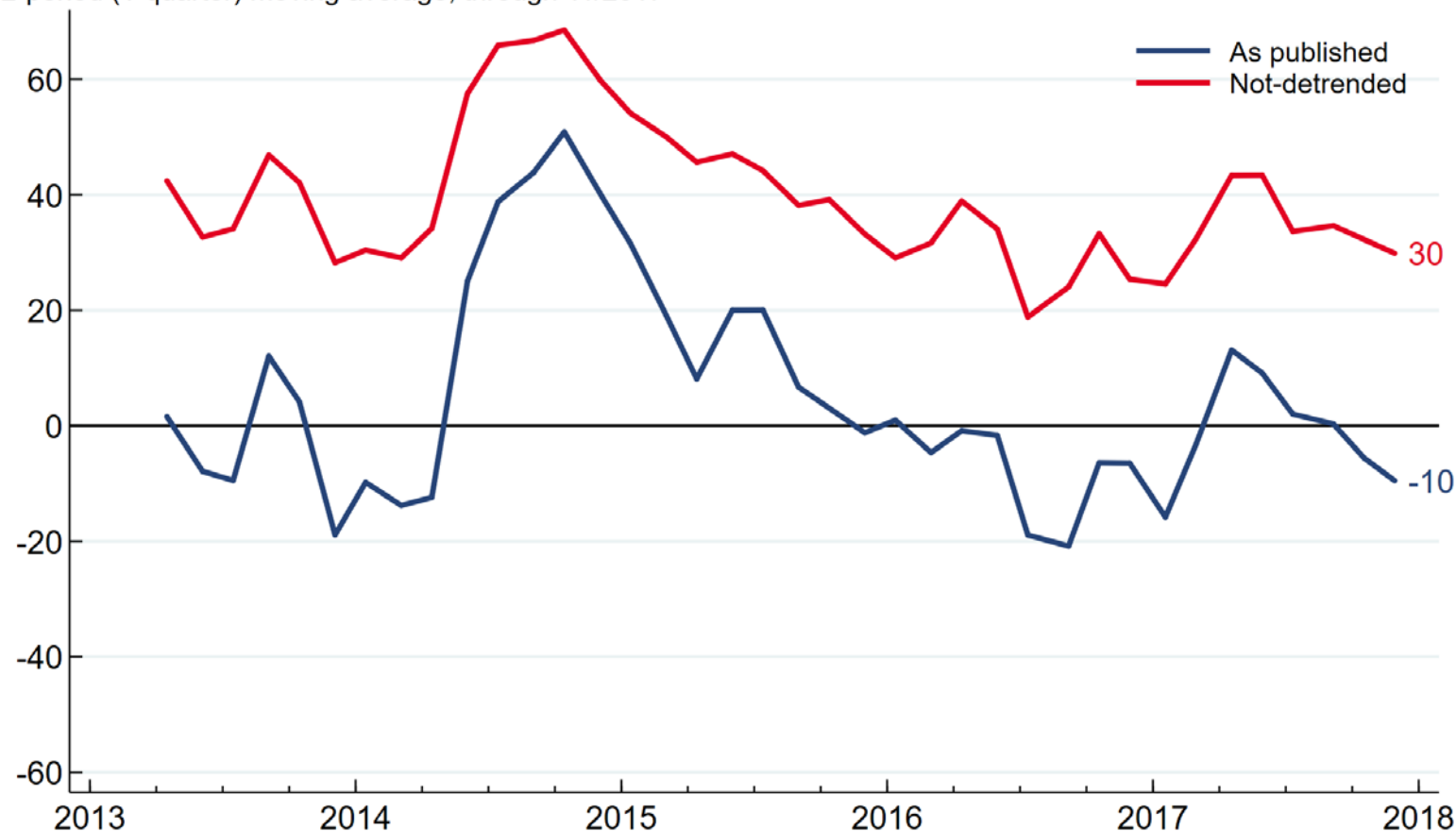
Calculating a diffusion index based on respondents' averages has advantages and disadvantages

- Advantages
 - Adjusts for a non-random sample
 - Controls for firm- and industry-specific trends
 - Controls for individual biases
 - Has a nice interpretation (its relative to trend)
- Disadvantages
 - Subject to revision
 - Requires reliable respondents

CFSBC indexes are “detrended”, so they’re centered at zero

CFSBC Activity Index

2-period (1-quarter) moving average, through 11/2017

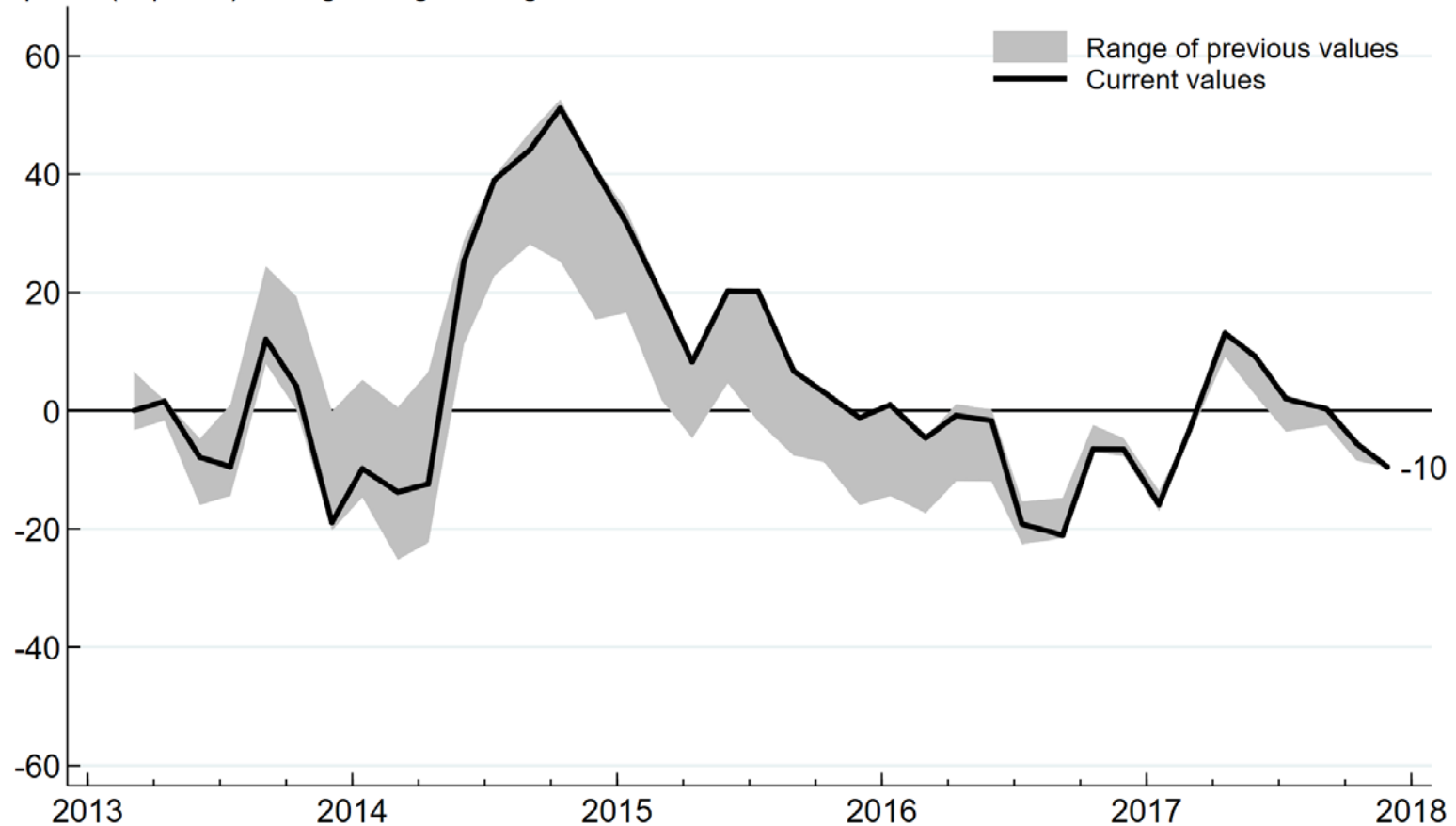




Revisions to the CFSBC Activity Index are small

CFSBC Activity Index

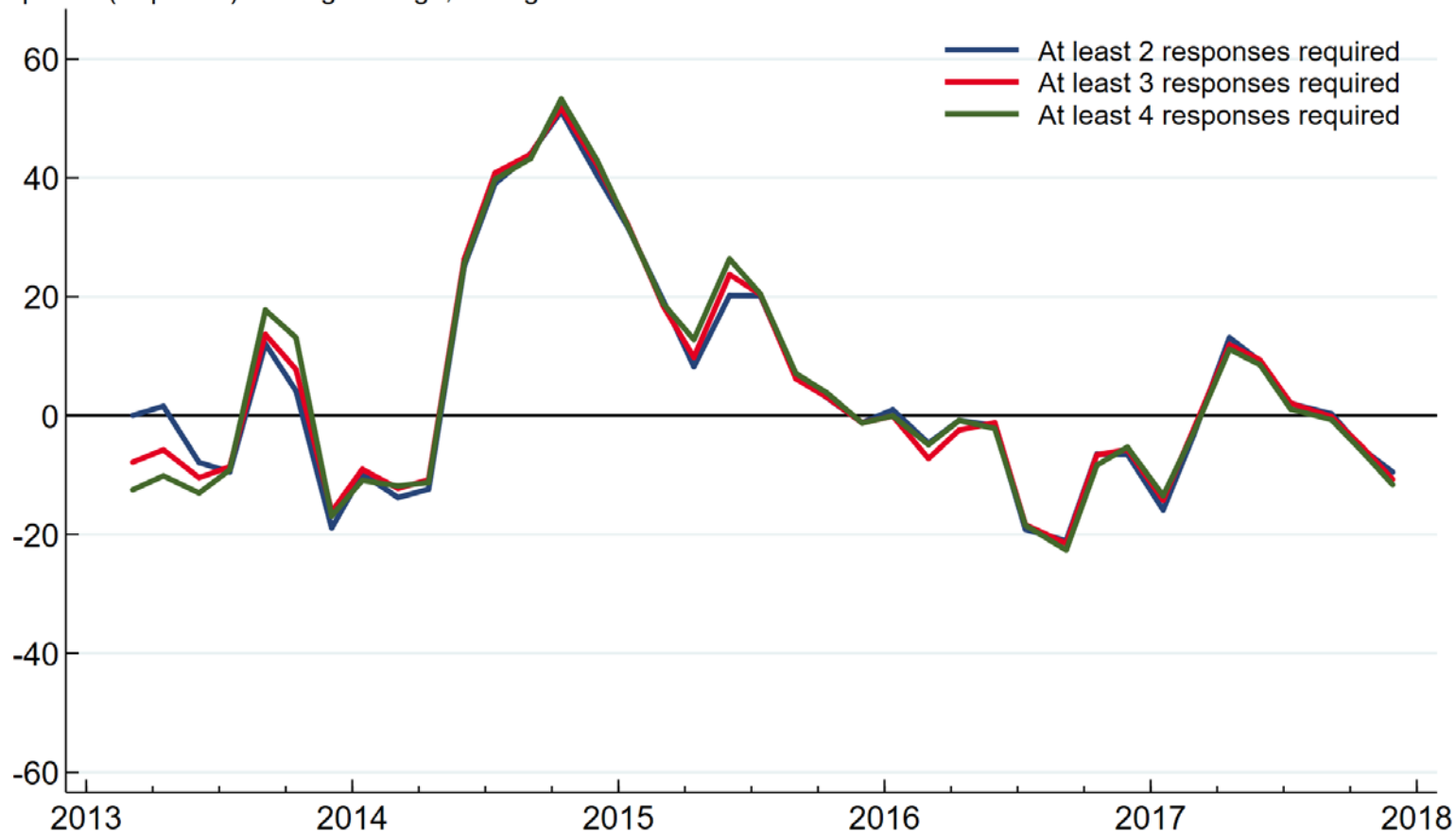
2-period (1-quarter) moving average, through 11/2017



Increasing the required number of responses from two makes little difference

CFSBC Activity Index

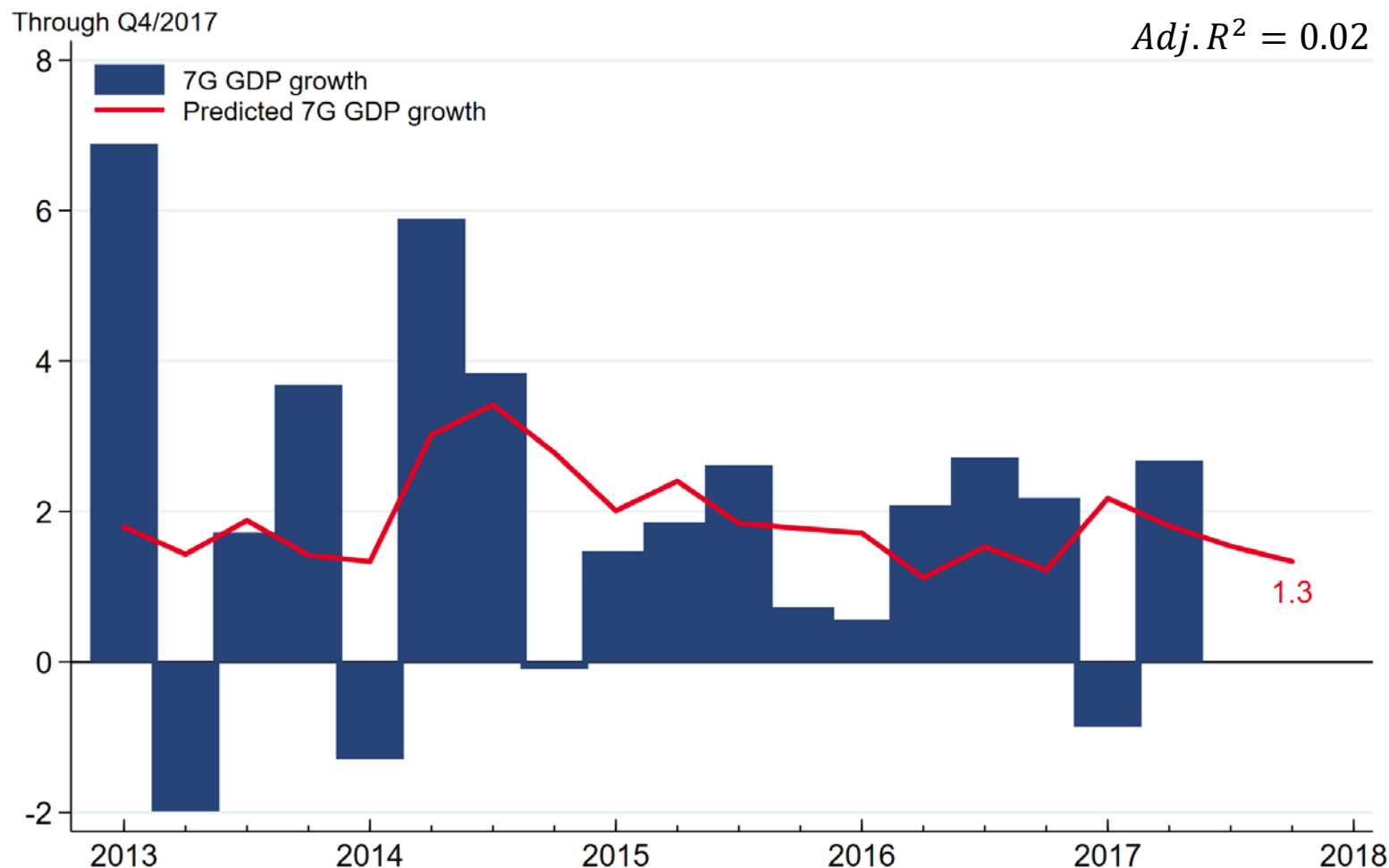
2-period (1-quarter) moving average, through 11/2017



So far, the CFSBC Activity Index has tracked both regional and national growth pretty well

- Next few slides show fitted values from regressions of other indicators on the CFSBC Activity Index
 - Chicago Fed District's GDP—hasn't tracked very well
 - US real GDP—has tracked well until recently
 - Chicago Fed's Midwest Economy Index—has tracked quite well

The CFSBC Activity Index hasn't tracked real GDP growth in the Chicago Fed's District very well



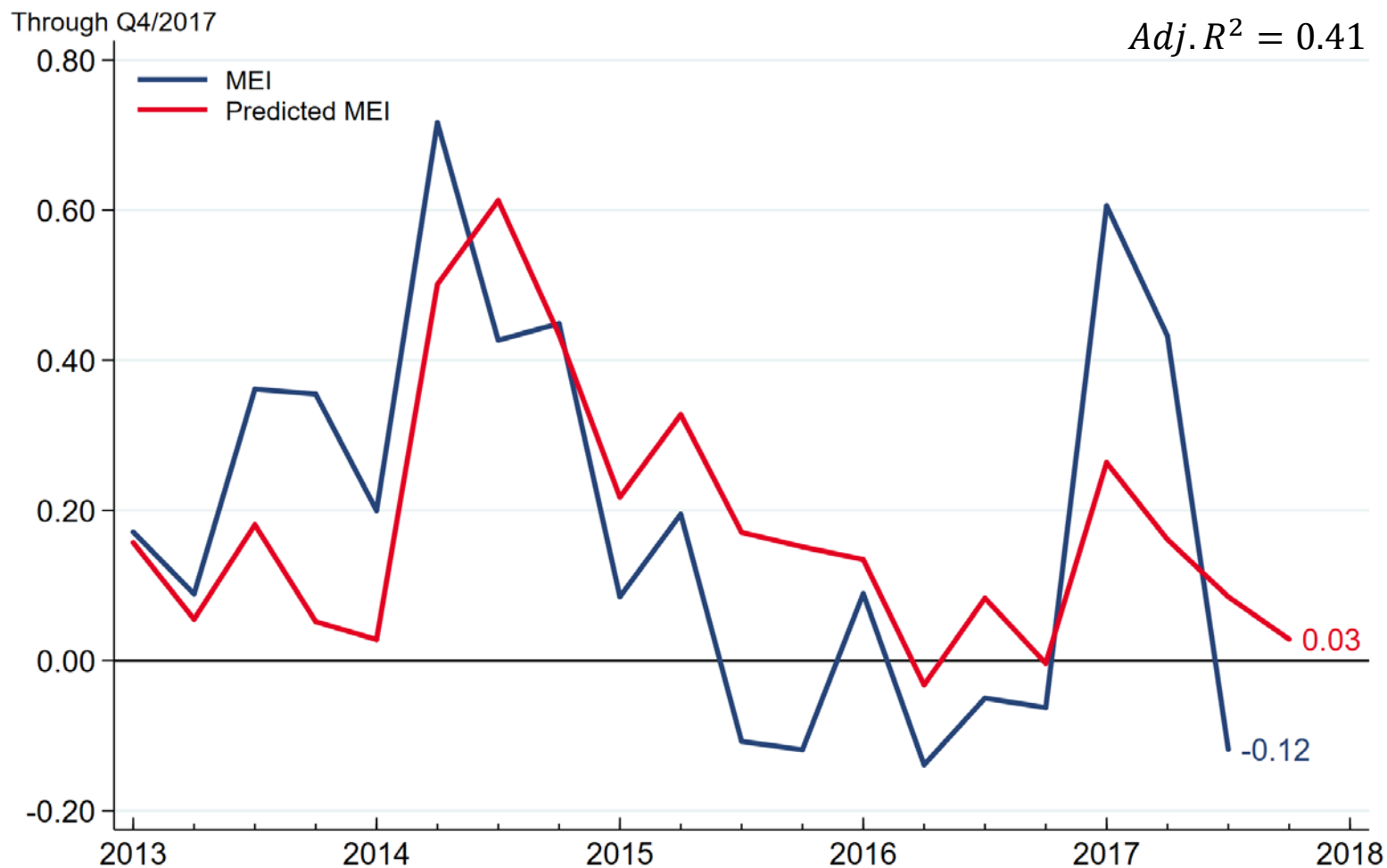
The CFSBC Activity Index has tracked US real GDP growth well until recently

Through Q4/2017

$Adj. R^2 = 0.25$



The CFSBC Activity Index has tracked the Chicago Fed's Midwest Economy Index quite well



Summary

- We calculate our diffusion indexes based on respondents' average responses
 - The indexes are centered at zero
 - They're subject to revisions (small)
 - They're dependent on repeat responders (working so far)
- The index seems to track best our Midwest Economy Index
- Future work
 - Seasonally adjust the indexes
 - Investigate further indexes based on
 - An ordered logit model
 - The first principal component of all our indexes