



FEDERAL RESERVE BANK *of* NEW YORK

# (Again) Weaker Oil Prices: Demand, Supply, or Neither?

Jan J. J. Groen, Officer,  
Research and Statistics Group, FRBNY

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# Disclaimer

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The views expressed in this presentation and the underlying analysis are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.



# Introduction

Oil prices have plunged since the Summer of 2014. Why?

- Demand shocks? This suggests further slowdown of global economic activity.
- Supply shocks? Cheaper oil might indicate boost in household and firm spending is forthcoming due to lower energy costs.
- Findings:
  - 2014: Oversupply drove cheaper oil.
  - 2015-2016: Oil price weakness until early 2016 due to a mixed bag of weak demand and continued oversupply, with improving demand being the overall driver in oil price rebound since early 2016.



# Identifying oil demand and supply shocks: Part I

Using correlations of oil price changes with a broad array of financial variables:

- **Sparse PLS:** Summarizes the correlations by small number of factors from the relevant subset of financial variables.
  - **PLS Regression:** construct linear combinations of the variables in our financial market dataset (“**factors**”) that have maximum explanatory content for oil price changes.
  - **Sparse PLS:** filter out those financial variables that only contribute minimally to the factors and re-estimate factors based on retained subset of financial series.
  - **3 factors** based on **60 series** out of the overall 85 financial variables is currently used to summarize the correlation structure.



# Identifying oil demand and supply shocks: Part II

Using correlations of oil price changes with a broad array of financial variables:

- **Sparse PLS:** Summarizes the correlations by small number of factors from the relevant subset of financial variables.
- **Identification:** Examine the estimated factors to determine how they reflect demand or supply dynamics.
  - Assess the correlations of the factors with the data to see if they match the expected patterns.



# Identifying oil demand and supply shocks: Part II

## Expected signs of correlations with oil prices

	Demand	Supply
National equity markets		
Oil exporters	+	+
Oil importers	+	-
Exchange rates (Dollar versus )		
Oil exporters	+	+
Oil importers	-/+	-
“Safe Haven”	-	-/+
Equity sectors		
Oil and Gas Related	+	+
Non-Cyclical (Health, Biochemical, etc.)	-/+	-
Cyclical	+	-
Commodities		
Energy	+	+
Gold	+	+
Industrial metals	+	-/+
Agricultural	-/+	-
Baltic Dry Cargo Shipping Rates Index	+	-/+
Non-commercial net longs	+	+
10 Year U.S. Treasury Bond Yield	+	-/+
VIX	-	+
Corp AAA Spread	-	+
Corp BAA Spread	-	+
Corporate Spread	-	+
Financial Paper Spread	-	+
U.S. Oil Rigs Count	-/+	-

+ indicates a positive relationship

- indicates a negative relationship

-/+ indicates unrestricted relationship



# Identifying oil demand and supply shocks: Part II

Using correlations of oil price changes with a broad array of financial variables:

- **Sparse PLS:** Summarizes the correlations by small number of factors from the relevant subset of financial variables.
- **Identification:** Examine the estimated factors to determine how they reflect demand or supply dynamics.
  - Assess the correlations of the factors with the data to see if they match the expected patterns.
  - Factors 1 and 3 reflect demand shocks, factor 2 reflects supply developments.
  - On a monthly basis:
    - Demand factors relate to G7 and China OECD leading indicators
    - Supply factor relates to OPEC spare capacity data.



# Identifying oil demand and supply shocks: Part III

Using correlations of oil price changes with a broad array of financial variables:

- **Sparse PLS:** Summarizes the correlations by small number of factors from the relevant subset of financial variables.
- **Identification:** Examine the estimated factors to determine how they reflect demand or supply dynamics.
- **Decompose weekly oil price changes:**

$$\begin{aligned} \text{Oil Price Change} = & b_0 + b_1 * (\text{Demand Factors}) \\ & + b_2 * (\text{Supply Factors}) + \text{Residual} \end{aligned}$$

We update this every week using weekly data from January 1986 through the close of business of the Friday of the most recent week (contact me if interested at [jan.groen@ny.frb.org](mailto:jan.groen@ny.frb.org)).



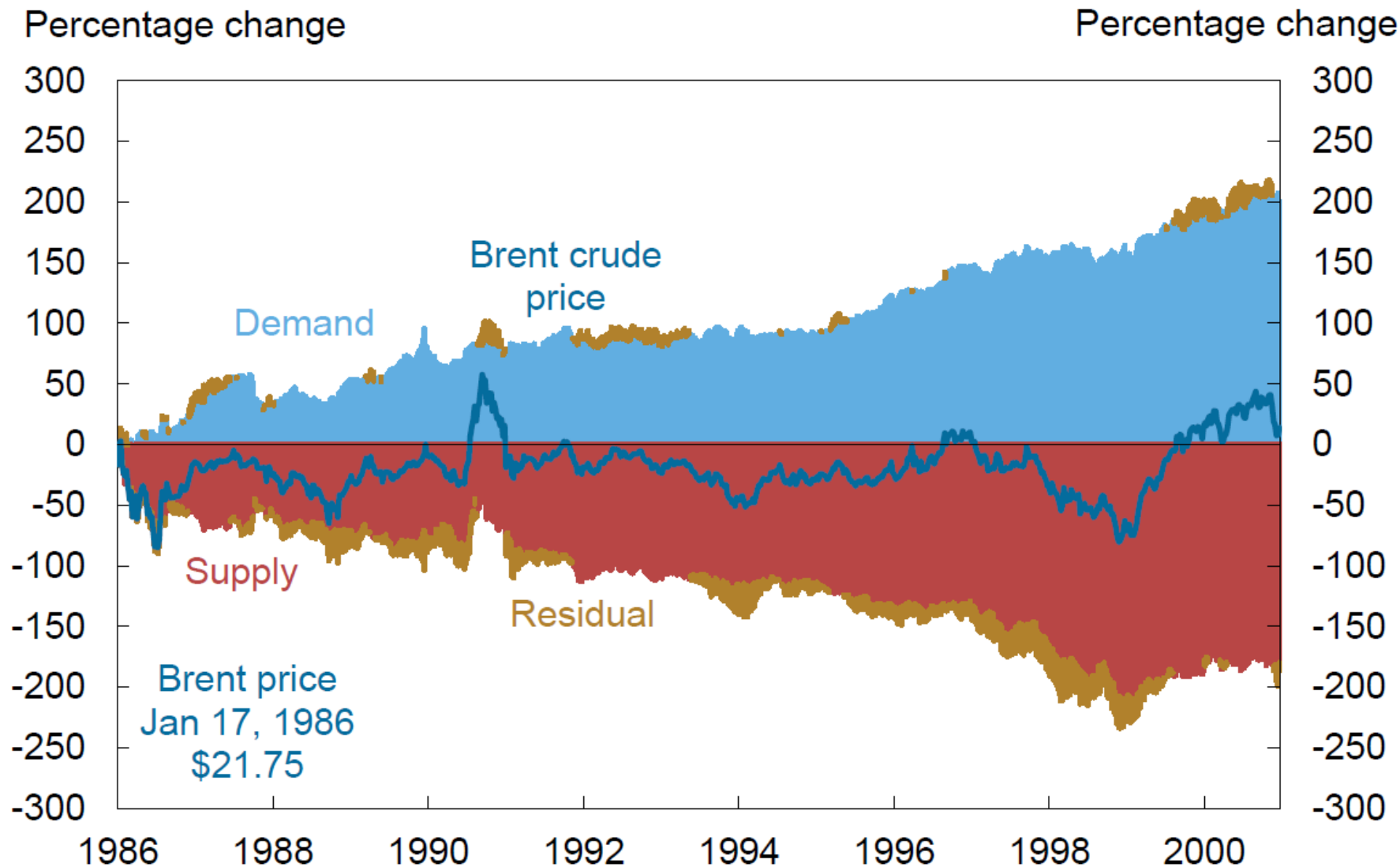


# Historical Performance

- The estimated demand and supply factors explain about 60% of historical, weekly oil price changes.
- The decomposition has supply side shocks driving the drop in oil price in the late 1980s and late 1990s as OPEC members, in particular Saudi Arabia, aggressively expanded their oil production.
- In the 2001-2009 period, weaker demand drove oil prices downward during the 2000-2001 U.S. recession and the 2007-2009 Great Recession, and pushed prices higher during the subsequent recoveries.
  - Tighter global oil supply put persistent upward pressure on prices over this period.



# Cumulative Weekly Decomposition 1986-2000

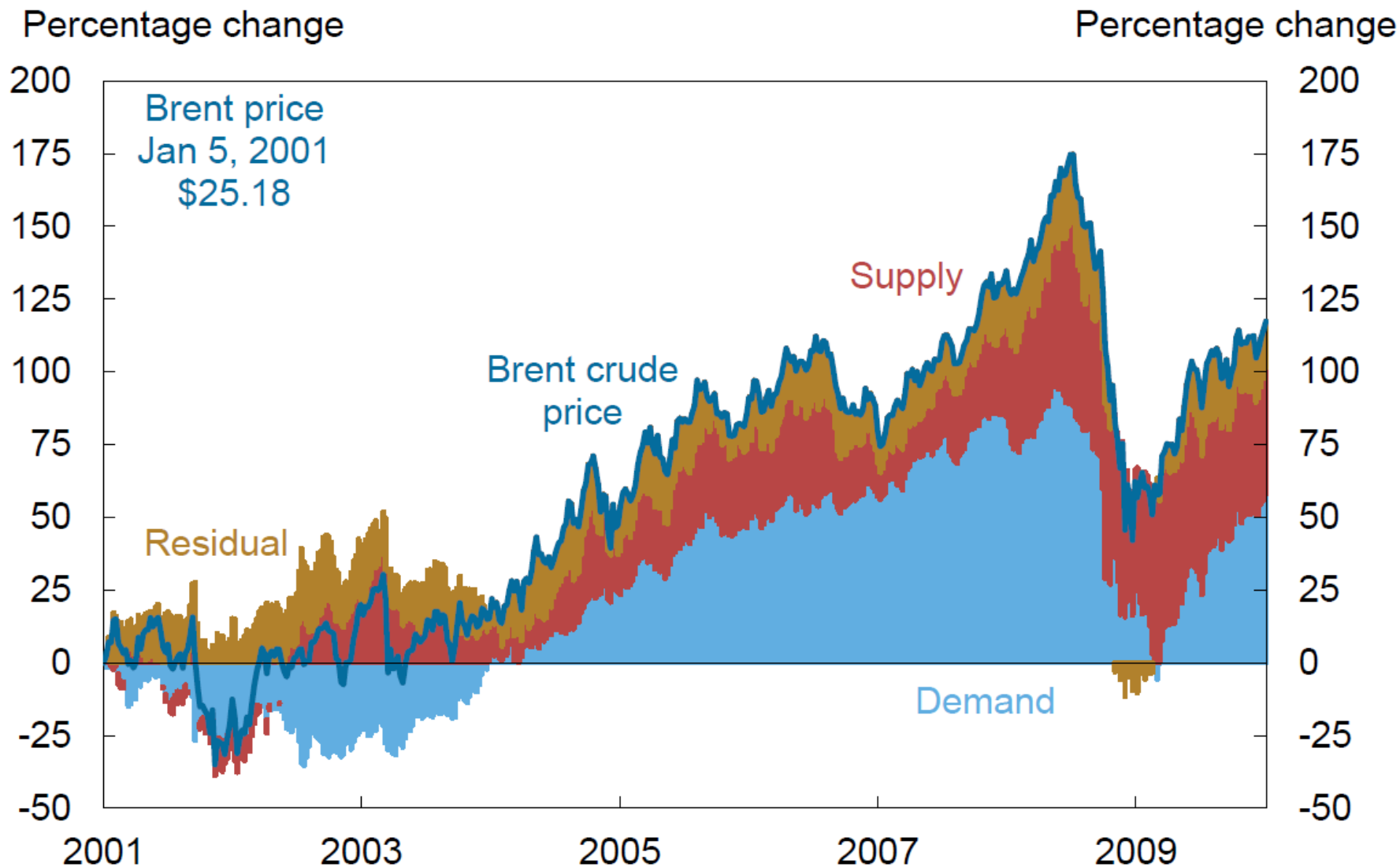


Sources: Authors' calculations; Haver Analytics; Thomson Reuters; Bloomberg.

Notes: Residual reflects price movements unexplained by supply and demand factors.

Supply, demand, and residual sum to Brent crude price.

# Cumulative Weekly Decomposition 2001-2010



Sources: Authors' calculations; Haver Analytics; Thomson Reuters; Bloomberg.

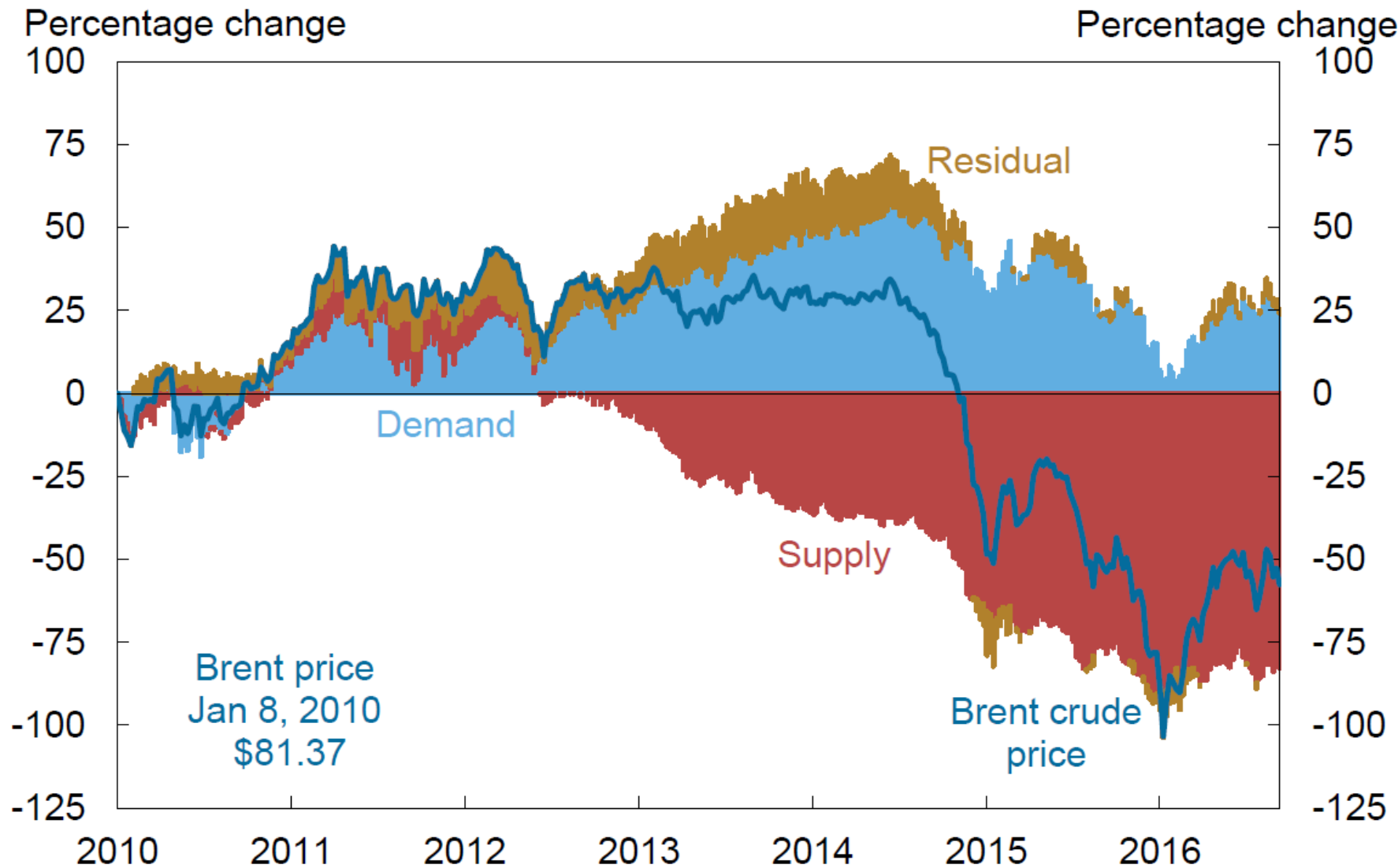
Notes: Residual reflects price movements unexplained by supply and demand factors.  
Supply, demand, and residual sum to Brent crude price.

# Historical Performance

- From 2010 to the present: rising global demand and some supply side pressures pushed oil prices higher until 2012.
- Between 2012 and mid-2014: expanding oil supply resulted in downward pressure on oil prices, counterbalanced by increasing global oil demand.
- From mid-2014: Saudi Arabia announced that it would no longer cut production to prop up prices and this supply shock pulled down oil prices in the second half of 2014.



# Cumulative Weekly Decomposition since January 8, 2010



Sources: Authors' calculations; Haver Analytics; Thomson Reuters; Bloomberg.

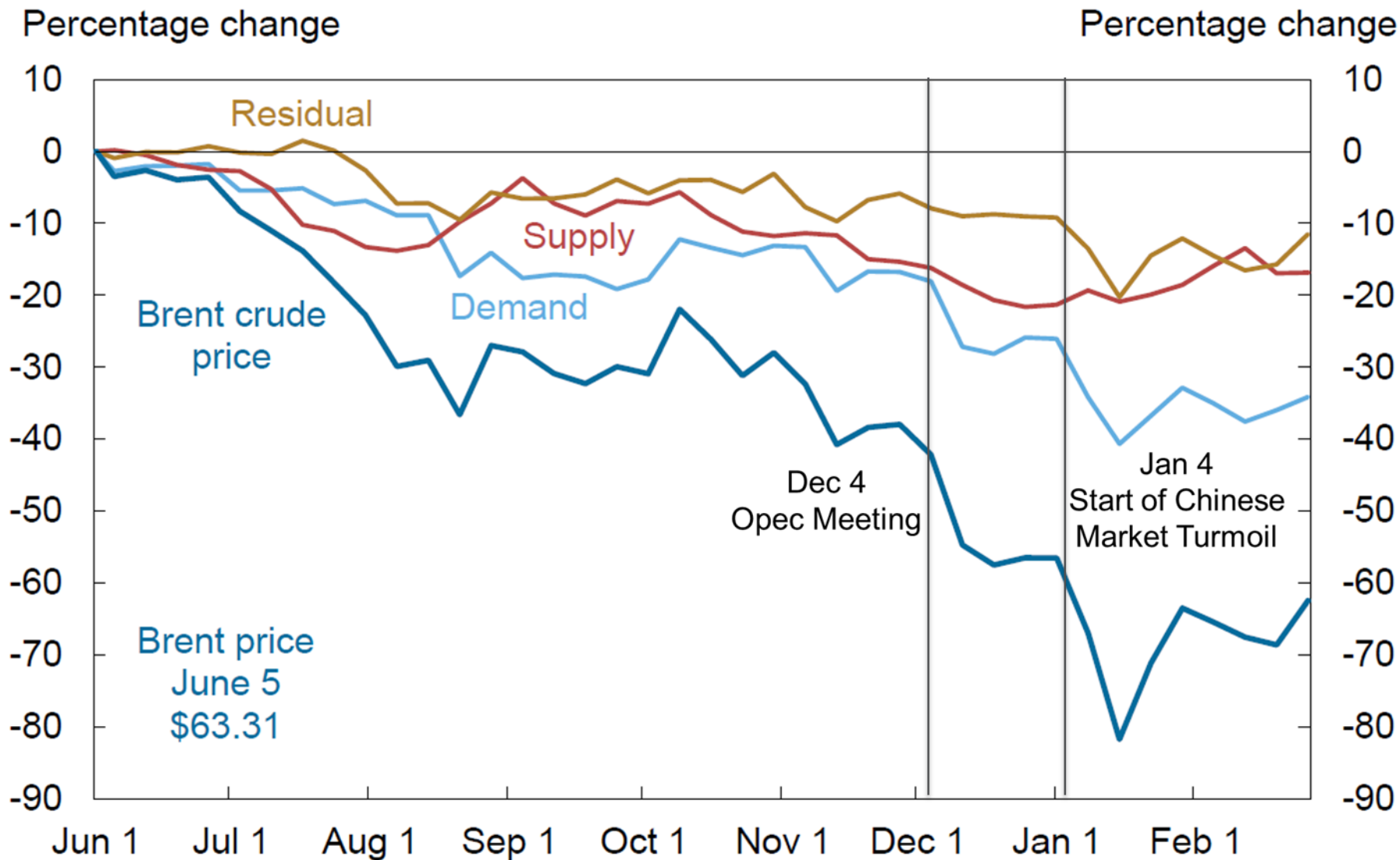
Notes: Residual reflects price movements unexplained by supply and demand factors.  
Supply, demand, and residual sum to Brent crude price.

# Oil price moves in the second half of 2015

- Oil price weakness in the second half of 2014 and early 2015 occurred on account of perceived continued excess supply.
- Overall, the oil price declines between mid-2015 and February 2016 appear to have demand side shocks as their main driver.  
**BUT:**
  - **2015Q4:** the observed oil price weakness was also to a large extent due to oversupply concerns.
  - **Jan-Feb 2016:** deteriorating global demand expectations were the prominent drivers of oil price movements, following large price declines on Chinese equity markets.



# Cumulative Weekly Decomposition, Jun 2015 to Feb 2016



Sources: Authors' calculations; Haver Analytics; Thomson Reuters; Bloomberg.

Note: Residual reflects price movements unexplained by supply and demand factors.  
Supply, demand, and residual sum to Brent crude price.

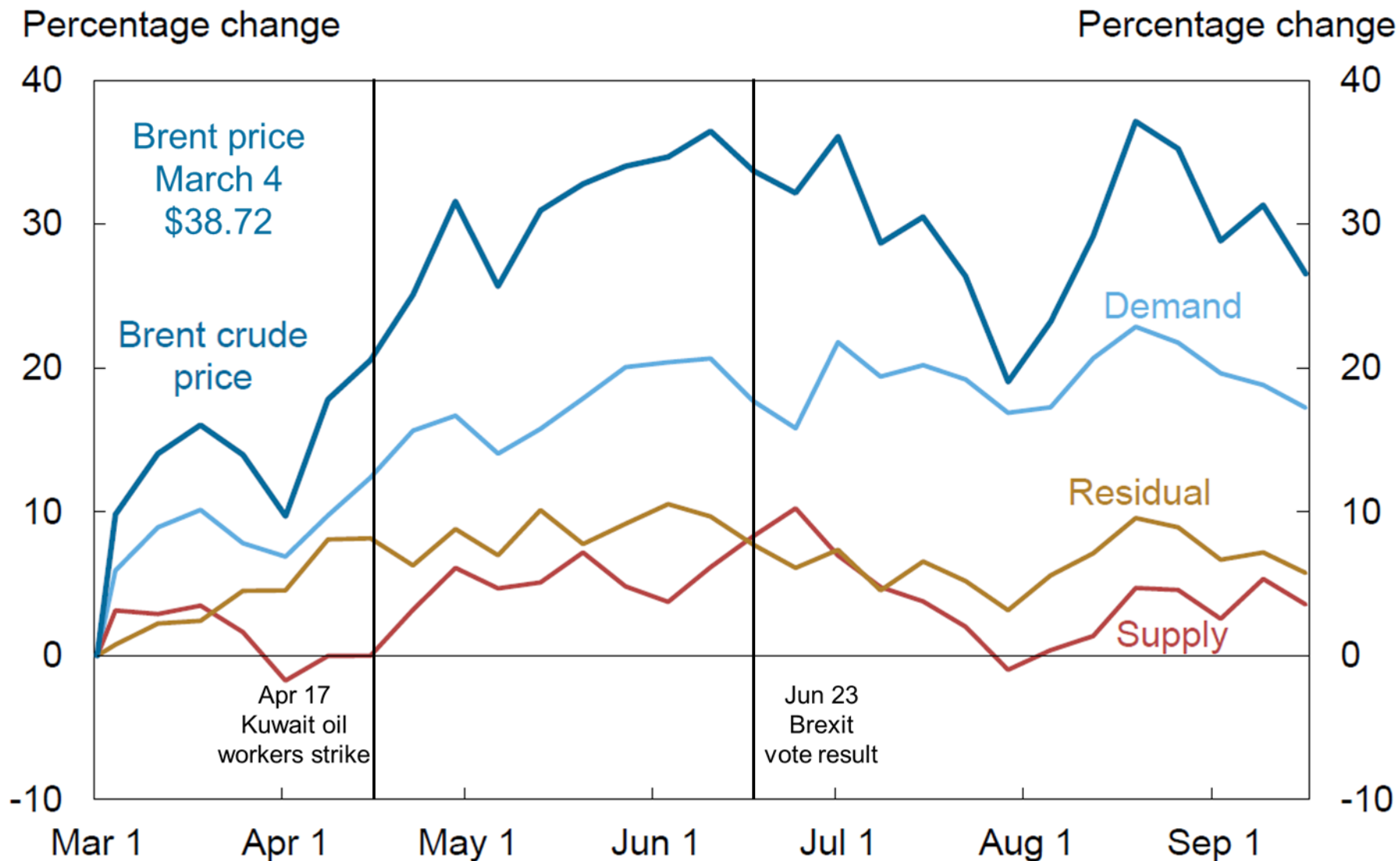
# Oil price dynamics since March

- Since March, oil prices recovered and an improving global demand outlook has been the main force in this development.
  - Fear of supply disruptions, starting with the Kuwaiti oil workers strike, was an additional source of oil price increases during the spring.
- From July onwards, the contribution of global demand expectations to oil price movements remained broadly stable.
  - Perceived supply loosening and tightening more dominantly drove the direction of change in oil prices throughout July and August.
  - Somewhat weaker demand expectations played an increasingly larger role in oil price dynamics in September.





# Cumulative Weekly Decomposition since March 1, 2016

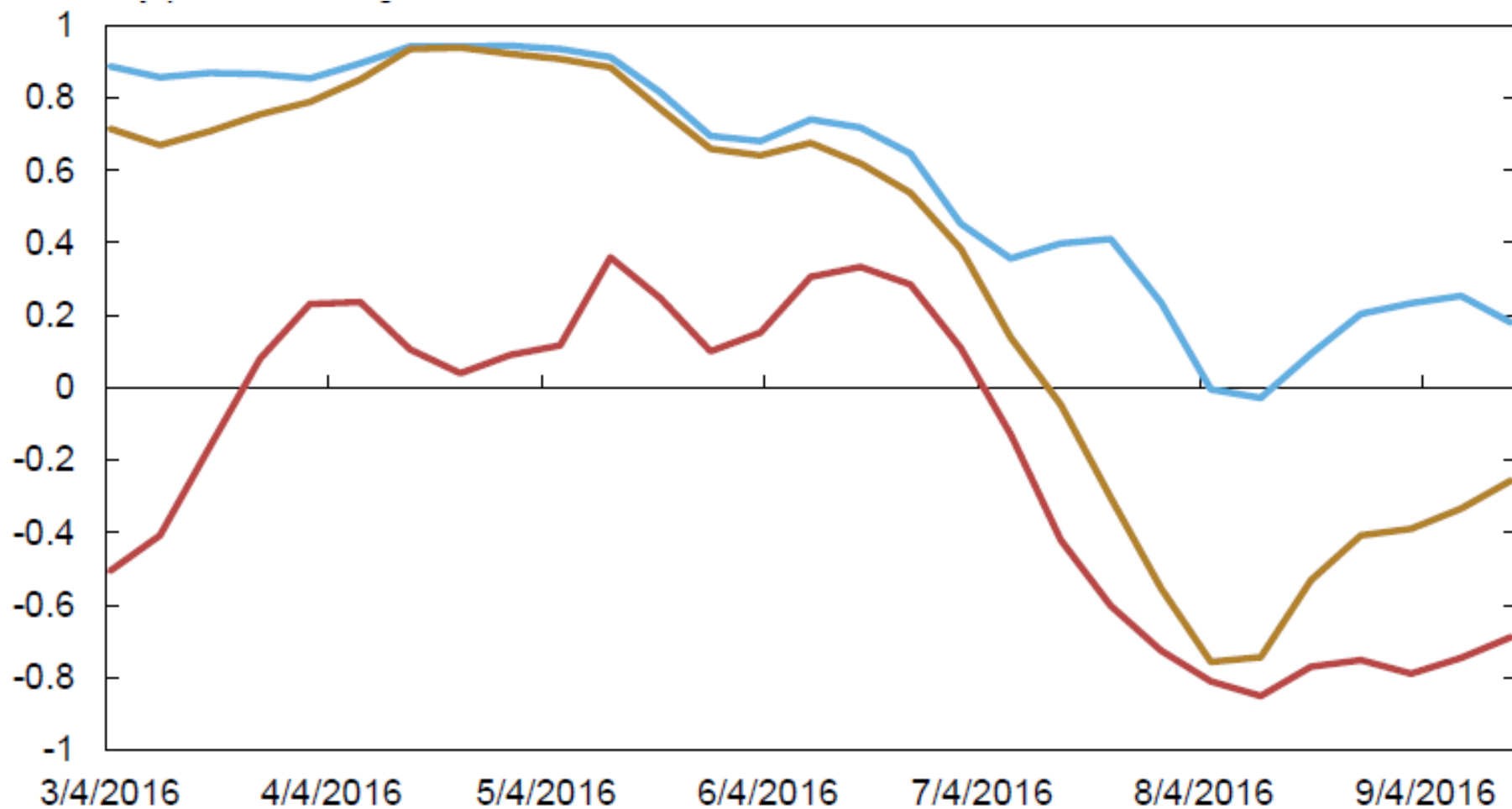


Sources: Authors' calculations; Haver Analytics; Thomson Reuters; Bloomberg.

Note: Residual reflects price movements unexplained by supply and demand factors.  
Supply, demand, and residual sum to Brent crude price.

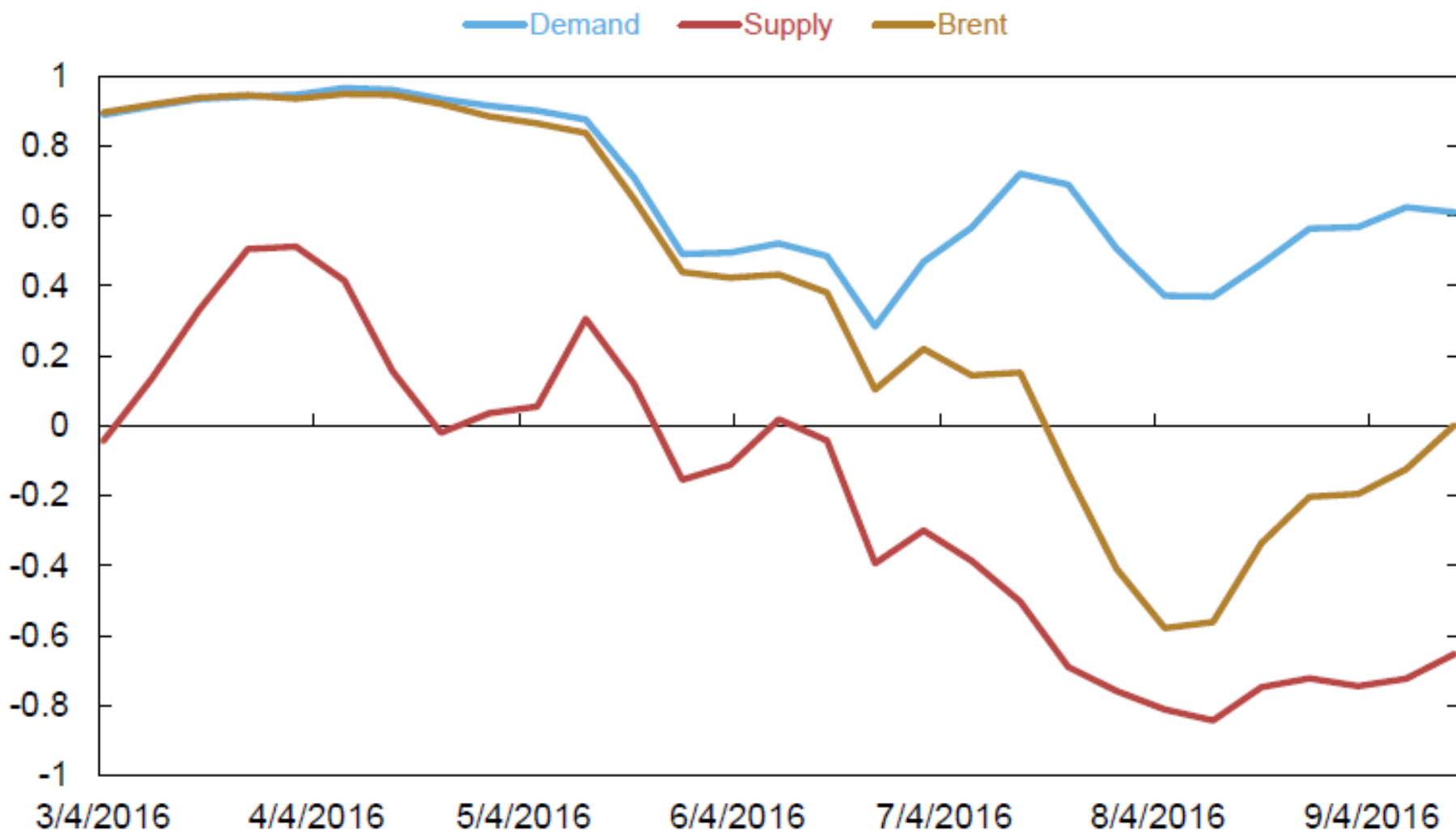
# 13-Week Rolling Correlations with S&P 500

— Demand    — Supply    — Brent



Sources: Authors' calculations; Haver Analytics; Thompson Reuters; Bloomberg

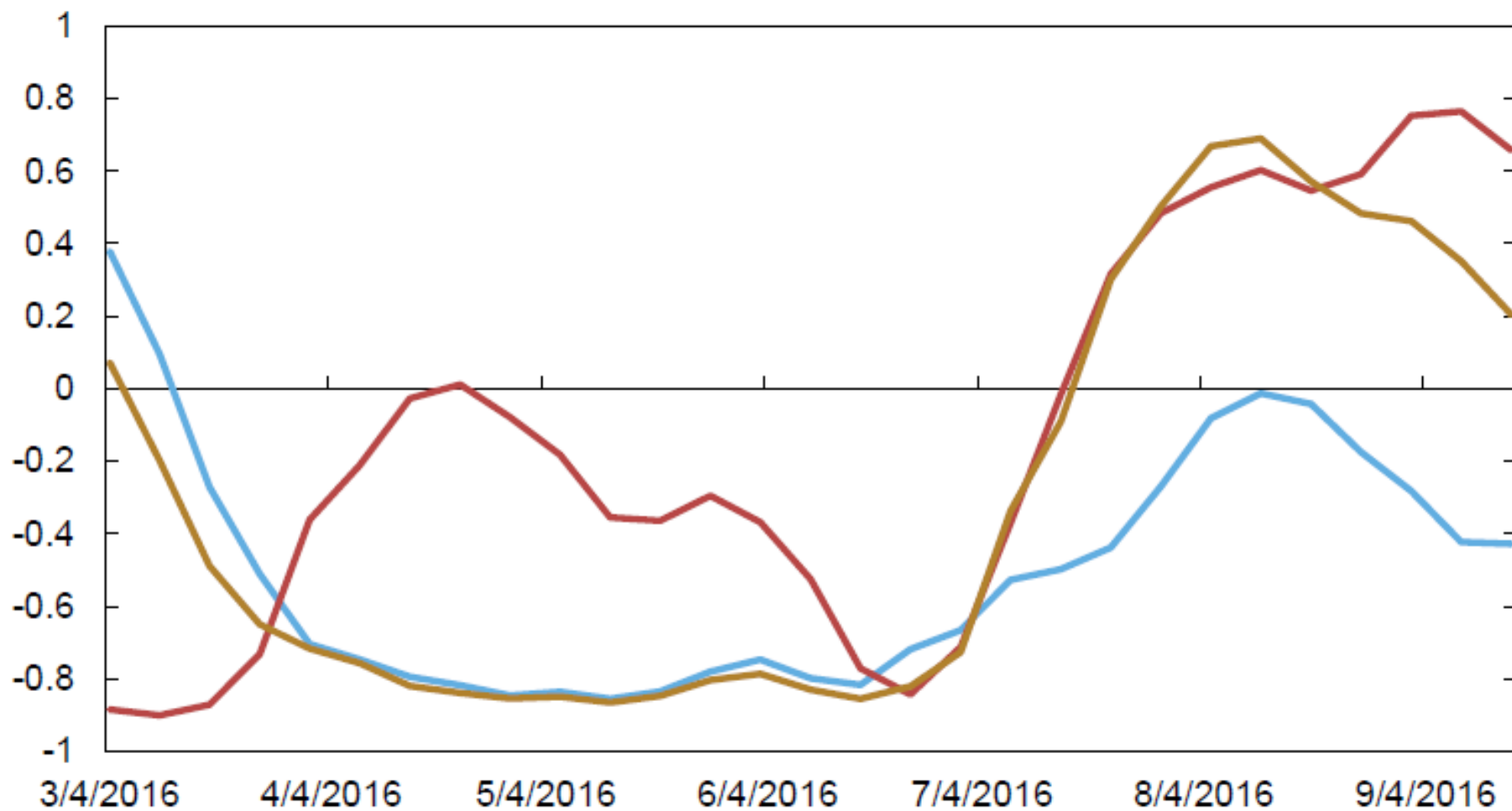
# 13-Week Rolling Correlations with Personal and Household Goods Sector Equity Index



Sources: Authors' calculations; Haver Analytics; Thompson Reuters; Bloomberg

# 13-Week Rolling Correlations with BAA Spread

— Demand    — Supply    — Brent



Sources: Authors' calculations; Haver Analytics; Thompson Reuters; Bloomberg

# References

- For oil demand and supply identification see
  - *Groen, J., and P. Russo. 2015. "Is Cheaper Oil Good News or Bad News for the U.S. Economy?" *Liberty Street Economics*, June 8.*
  - *Groen, J., K. McNeil, and M. Middelдорp. 2013. "A New Approach for Identifying Demand and Supply Shocks in the Oil Market." *Liberty Street Economics*, March 25.*
- See for PLS factor model
  - *Groen, J., and G. Kapetanios. 2016. "Revisiting Useful Approaches to Data-Rich Macroeconomic Forecasting" *Computational Statistics & Data Analysis*, Vol. 100, pages 221-239 (also FRB of New York Staff Report 327)*



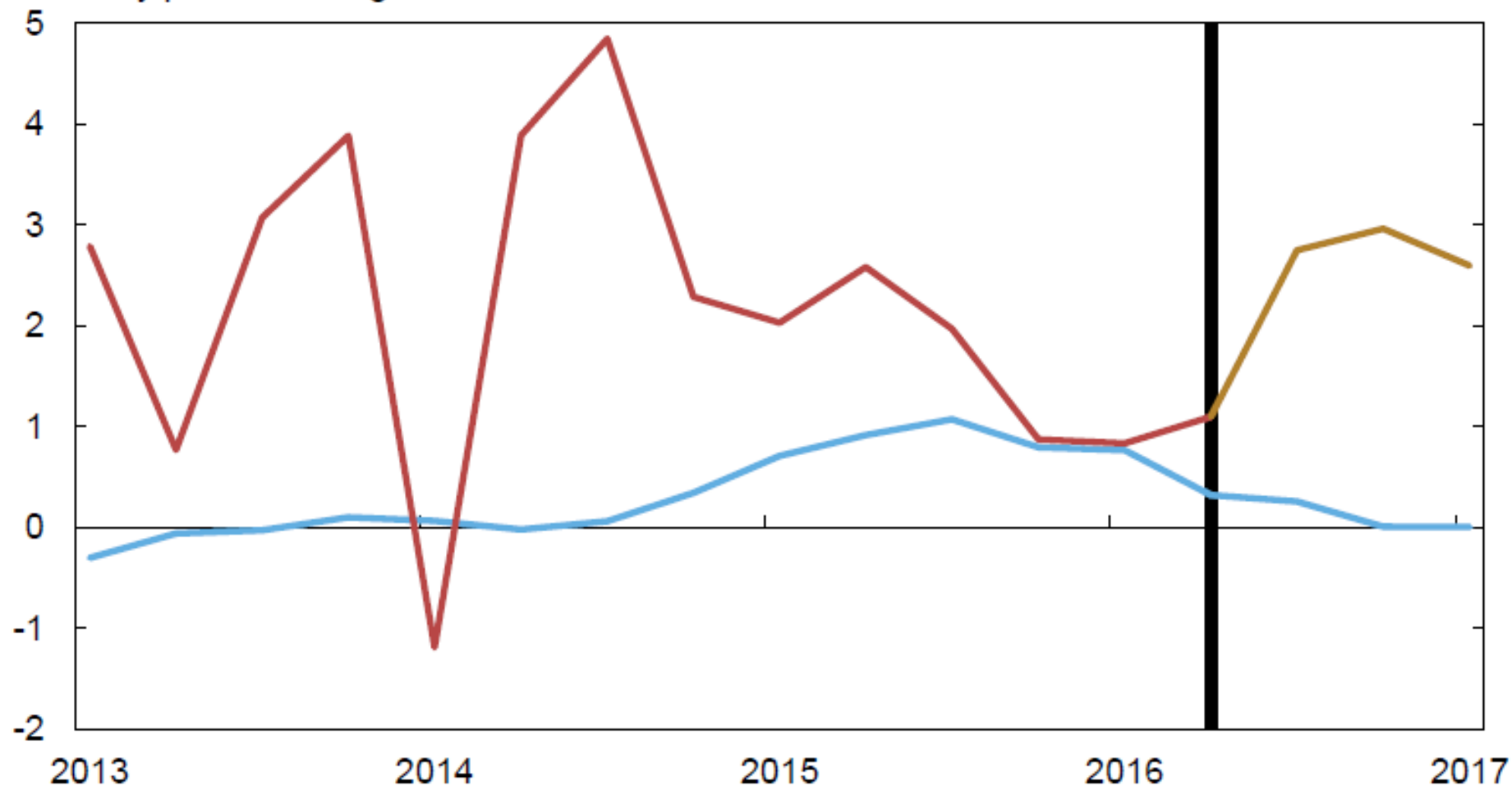
# Appendix: Oil Supply Impact on the U.S. economy

- To identify macroeconomic oil supply shocks the estimated supply component of oil price changes is used as an instrumental variable on the residuals of a VAR model for GDP, consumption, investment (oil vs. non-oil) plus some additional series.
- Expansionary oil supply shocks had a stimulative impact on economic activity in the U.S. in 2015.
- However, as global oil supply expectations have stabilized recently and tightened somewhat in 2016Q2, one should expect less of an expansionary impact on activity in 2016.

# Real GDP

— Contribution of oil supply shocks — Actual — VAR simulation

Quarterly percent change



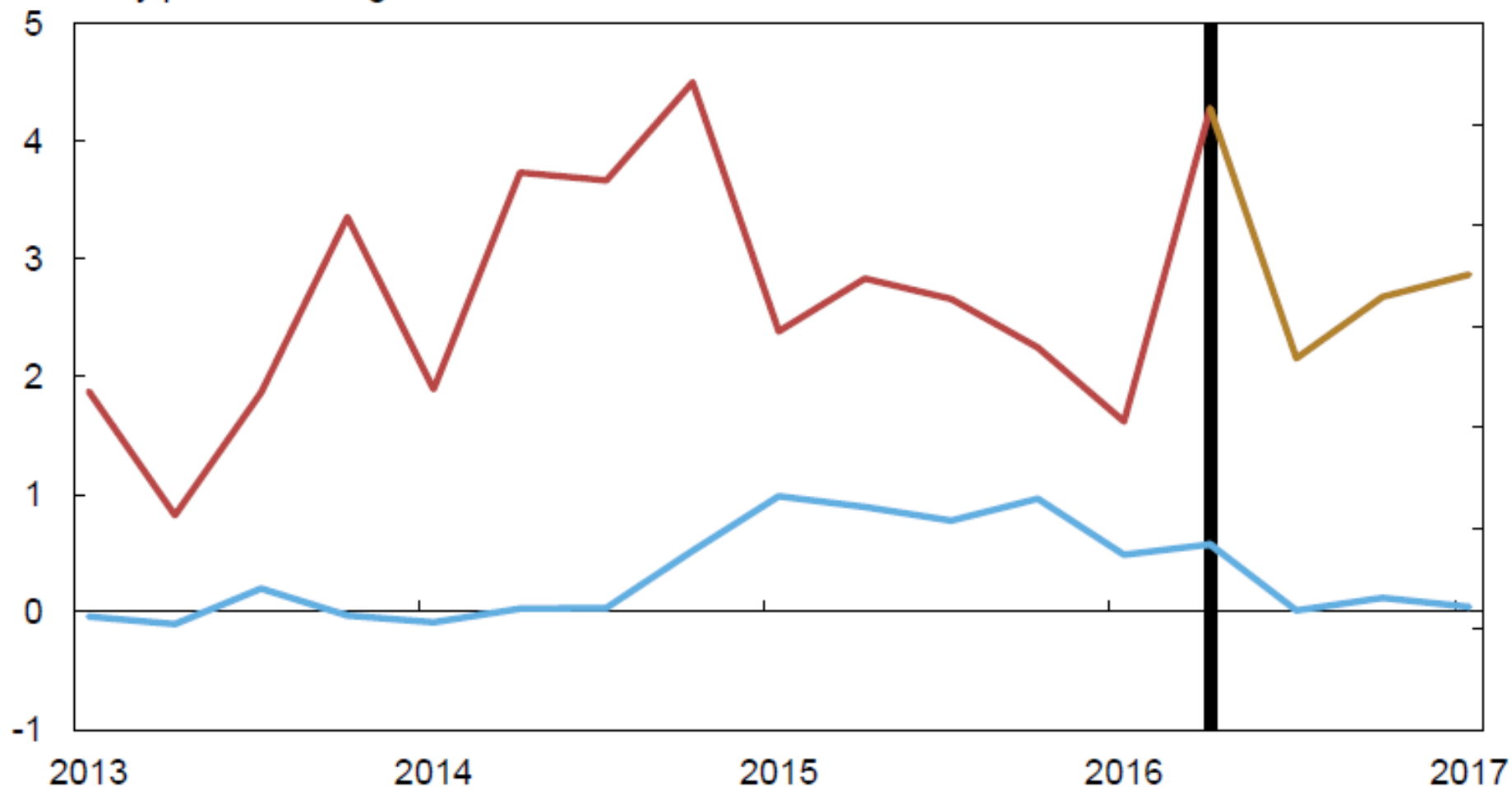
Sources: Authors' calculations, Haver Analytics; Thompson Reuters; Bloomberg

Notes: VAR is vector autoregression. Figures are seasonally adjusted annualized rate.

# Real Personal Consumption Expenditure

— Contribution of oil supply shocks — Actual — VAR simulation

Quarterly percent change



Sources: Authors' calculations, Haver Analytics; Thompson Reuters; Bloomberg

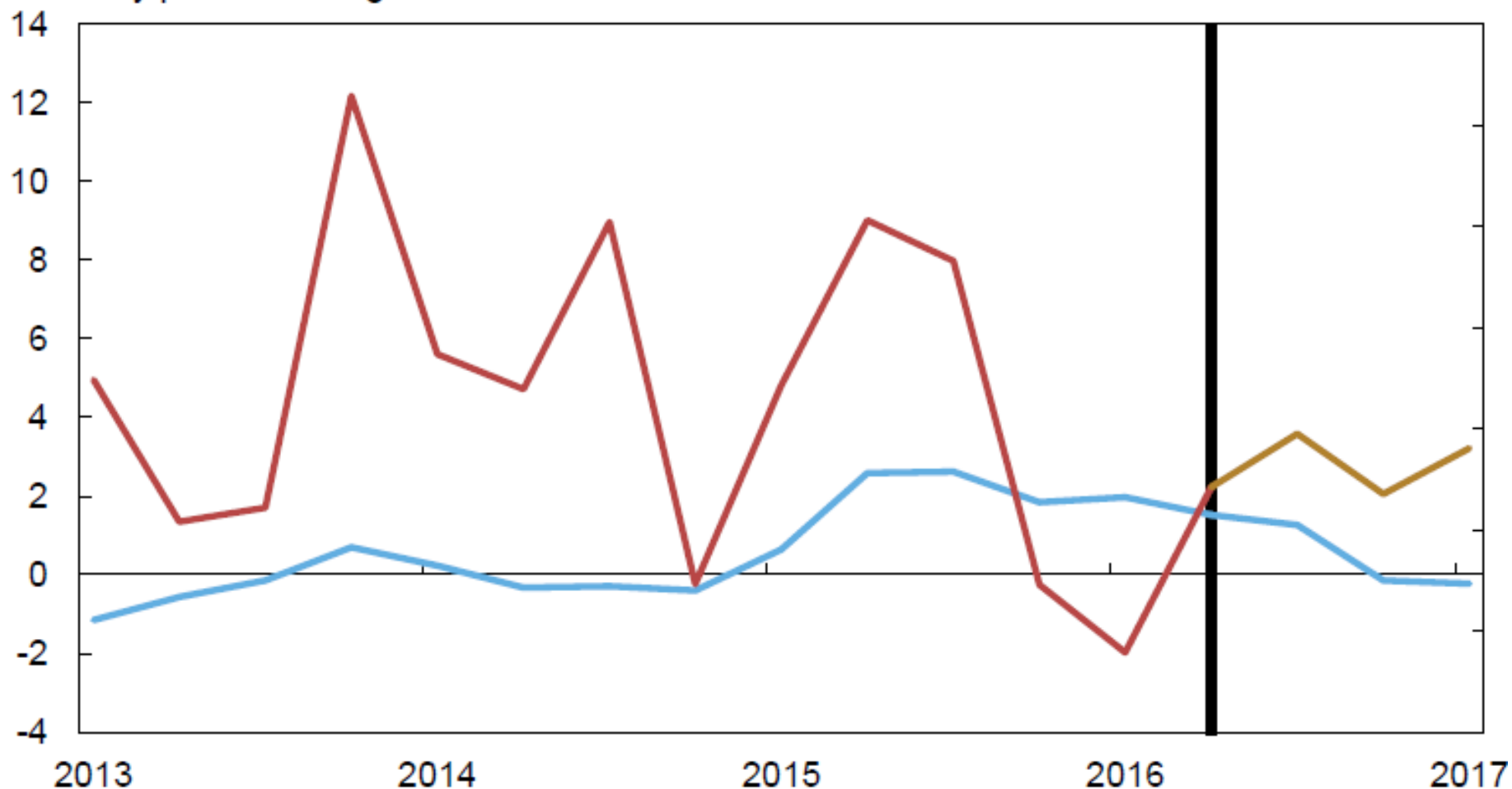
Notes: VAR is vector autoregression. Figures are seasonally adjusted annualized rate.



# Nonresidential Business Fixed Investment

Contribution of oil supply shocks    Actual    VAR simulation

Quarterly percent change



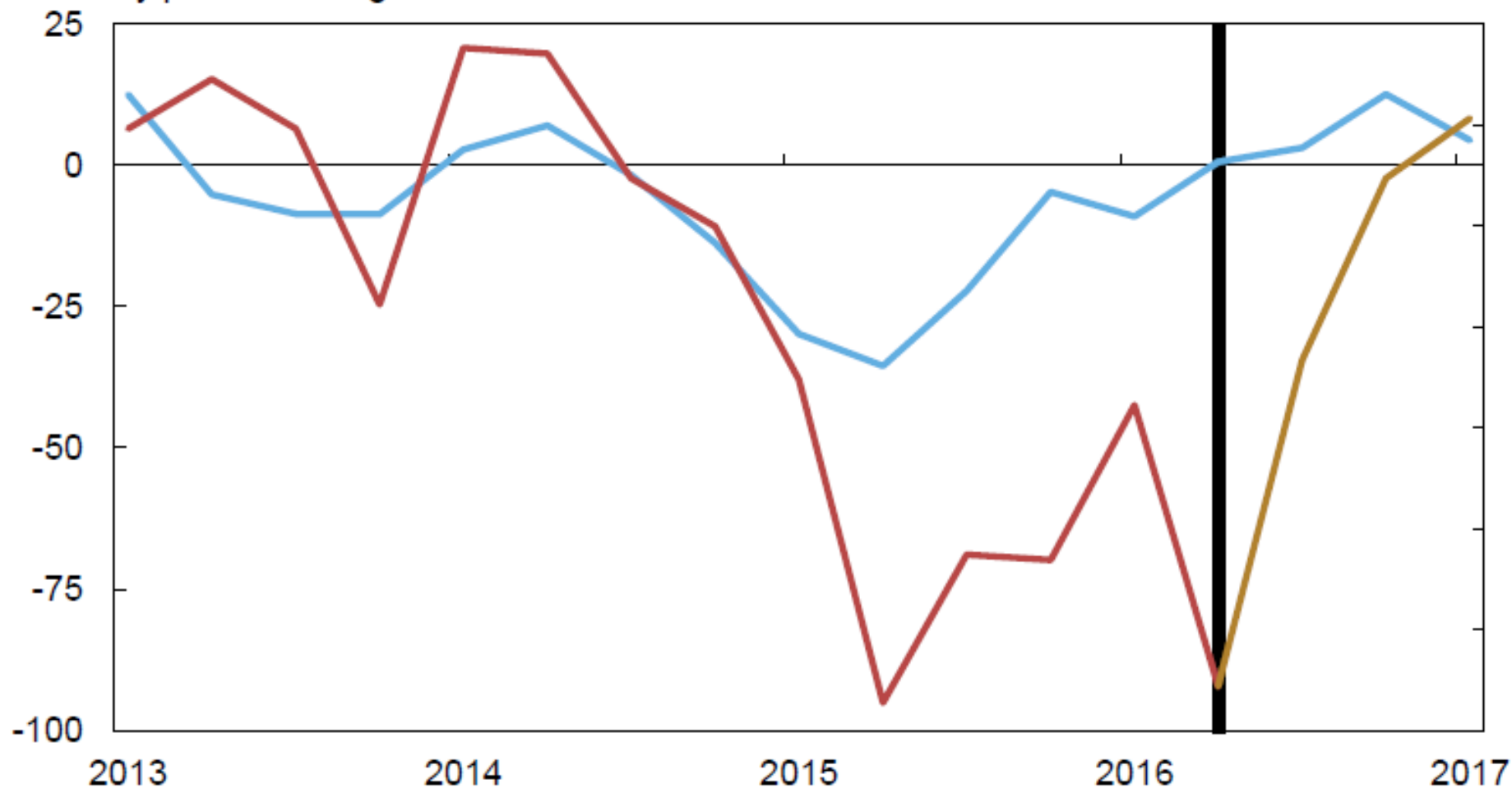
Sources: Authors' calculations, Haver Analytics; Thompson Reuters; Bloomberg

Notes: VAR is vector autoregression. Figures are seasonally adjusted annualized rate.

# Oil/Mining-Related Investment

— Contribution of oil supply shocks — Actual — VAR simulation

Quarterly percent change



Sources: Authors' calculations, Haver Analytics; Thompson Reuters; Bloomberg

Notes: VAR is vector autoregression. Figures are seasonally adjusted annualized rate.