Deep Learning Bank Distress from News and Numerical Financial Data

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A Discussion and Application to Monetary Policy

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Overview of Cerchiello et al. (2018)

Agenda

Cerchiello et al. (2018) is part of a larger agenda to understand and measure the stability of the banking system (linkages, fragility).

Methodological Contribution

Combine "traditional" (financial) and "non-traditional" (text) data via

- Dimension reduction of bank-related news via doc2vec
- Neural network to combine data and predict bank failures

Question

Can this methodology allow us to use non-traditional data for causal inference?

Application: The Effects of Monetary Policy

What are the effects of monetary (interest rate) policy?

$$y_t = \alpha + \beta \text{ Federal Funds Rate}_t + \varepsilon_t$$

Why can't we run this regression? Endogeneity, e.g., other economic factors may drive both y_t and the Fed's policy.

Romer and Romer (2004) (R&R)
Only study effects of changes in interest rates that are deviations from systematic responses to economic variables.

Problem
Controlling for only a handful of variables may not remove all of the endogenous variation in interest rates (see Ramey (2016))

Controlling for More

Potential Solution

Let policymakers tell us what they're responding to. Incorporate

- **Numerical data** Fed forecasts of macroeconomic variables (R&R Greenbook variables)
- **Text data** Fed discussions of monetary policy decisions (FOMC transcripts using doc2vec)

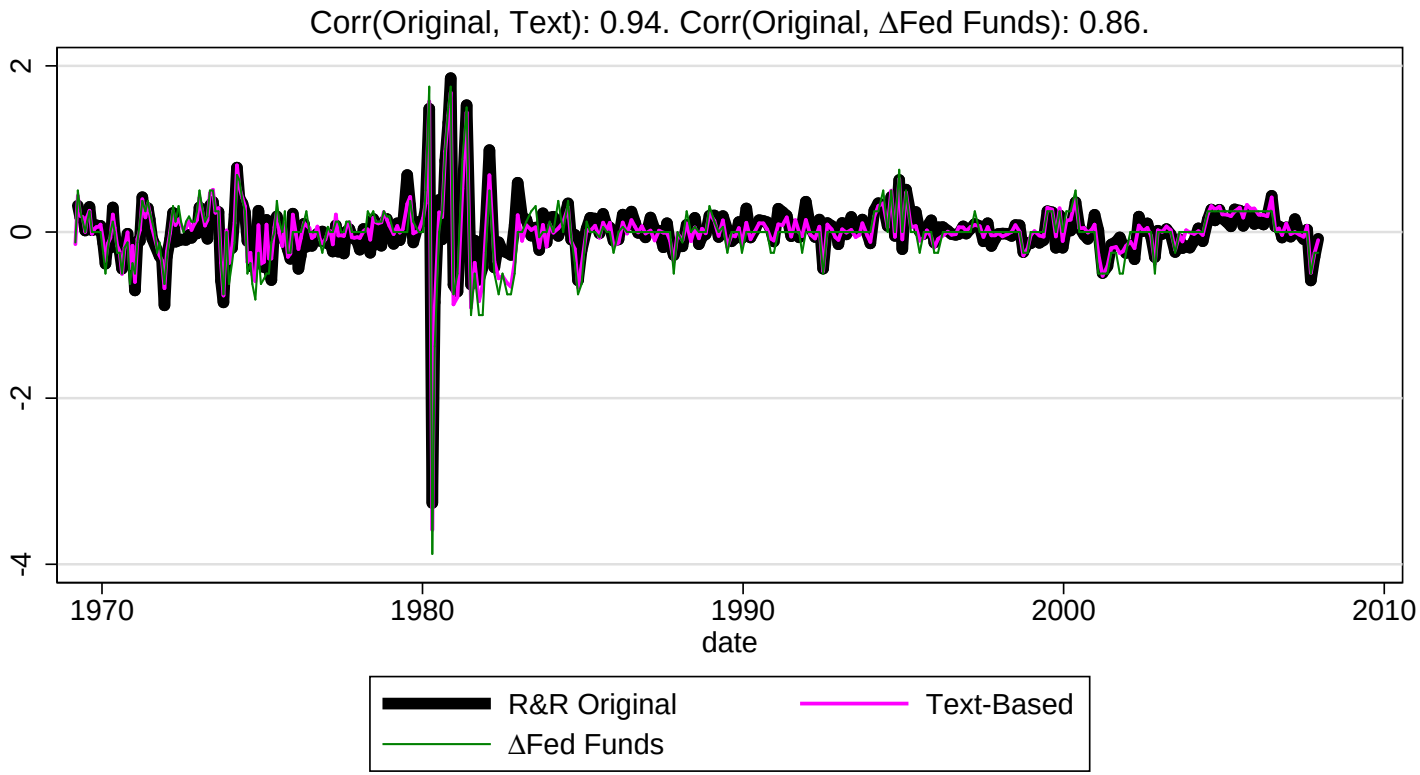
Use a neural network or LASSO, together with numerical and text data, to predict interest rate at each meeting; use residual as "Romer & Romer text-based monetary shock"

▸ Details

The Shocks

Monetary policy shocks are the residuals from the following regression (estimated via LASSO):

$$\Delta\text{Fed Funds Target}_t = \alpha + \beta'[\text{Fed Forecasts}]_t + \epsilon_t + \phi'[\text{Doc2Vec Transcripts}]_t + \epsilon_t$$

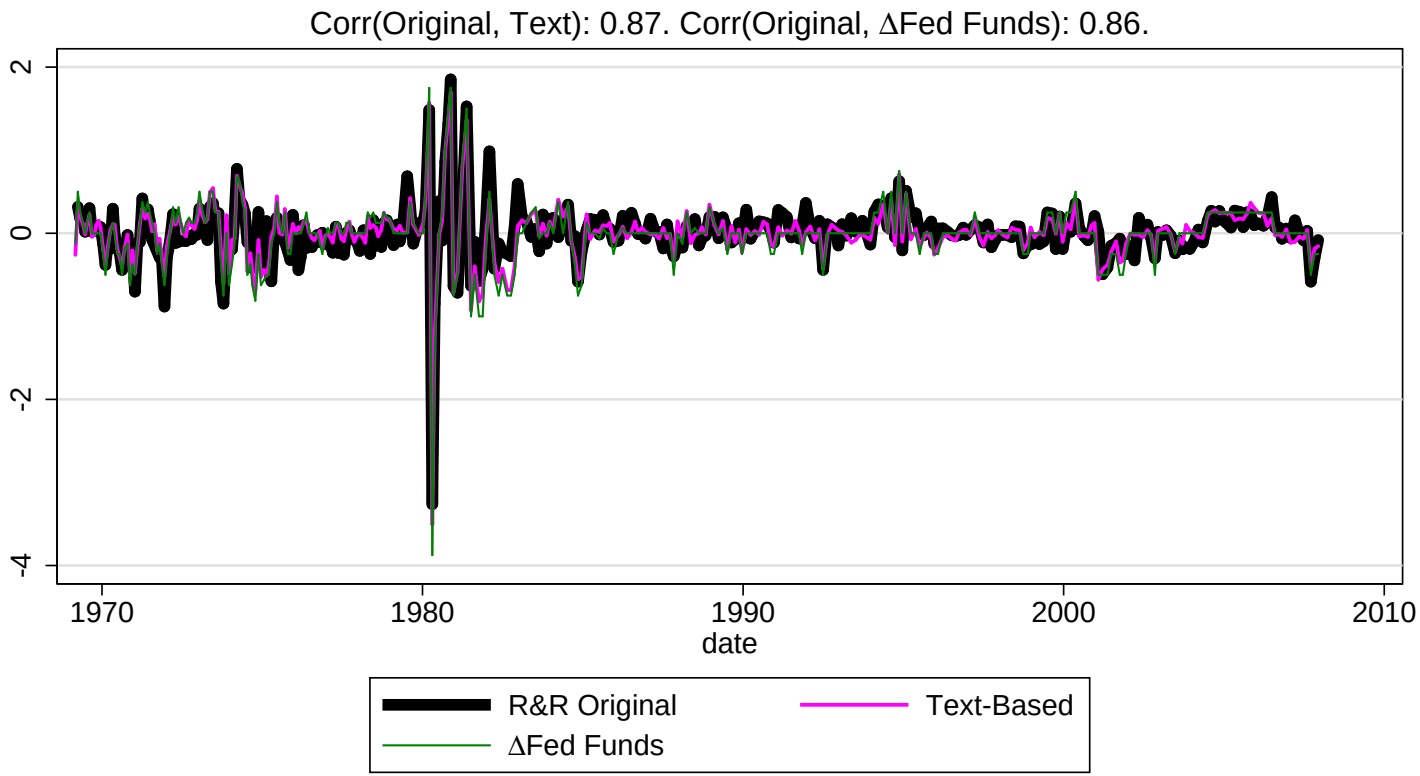


▸ 69–96 ▸ 83–07

Do we Need the Greenbook?

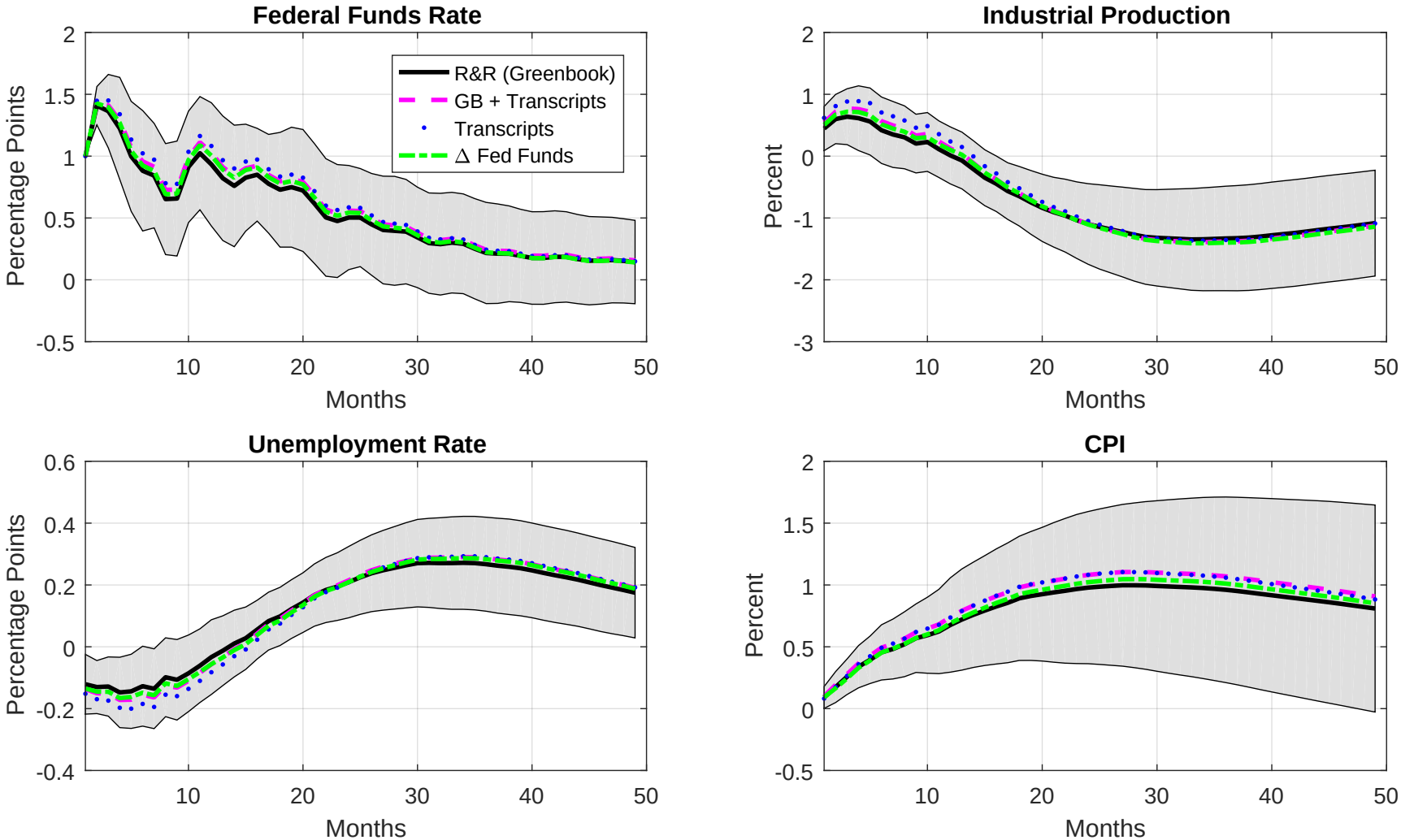
Suppose we were instead to condition on the FOMC's information set using only its discussions:

$$\Delta\text{Fed Funds Target}_t = \alpha + \phi'[\text{Doc2Vec Transcripts}]_t + \epsilon_t$$



▸ 69–96 ▸ 83–07

Response to a 1pp Increase in FFR



Impulse response to a monetary policy shock that raises the Fed Funds Rate by 1p.p. on impact. VAR(12) in Fed Funds rate, log industrial production, log oil prices, log CPI, using monetary policy shock as an external instrument (as in Ramey (2016)). Sample period: March 1969–December 2007. 90% asymptotic standard errors for the R&R shock are in gray.

▸ 69–96 ▸ 83–07

Conclusions

The innovative methodology of Cerchiello et al. (2018) allows for a new analysis of the effects of monetary policy.

- Incorporating additional data changes estimated responses to monetary policy by very little.
- "Price puzzle" remains—do the transcripts add more information? They seem to effectively add as much as traditional (Greenbook) variables.
- Might the transcripts also add too much information (we don't want to remove variation resulting from policymaker preferences)

End. Thanks!

Supplemental Slides

References I

Ahrens, Achim, Christian B Hansen, and Mark E Schaffer, "lassopack: Model selection and prediction with regularized regression in Stata," *arXiv preprint arXiv:1901.05397*, 2019.

Cerchiello, Paola, Giancarlo Nicola, Samuel Rönnqvist, and Peter Sarlin, "Deep learning bank distress from news and numerical financial data," *arXiv preprint arXiv:1706.09627*, 2018.

Le, Quoc and Tomas Mikolov, "Distributed representations of sentences and documents," in "International conference on machine learning" 2014, pp. 1188–1196.

Montiel Olea, José Luis, James H Stock, and Mark W Watson, "Inference in structural VARs with external instruments," Working Paper 2018.

Ramey, Valerie A, "Macroeconomic shocks and their propagation," in "Handbook of macroeconomics," Vol. 2, Elsevier, 2016, pp. 71–162.

References II

Řehůřek, Radim and Petr Sojka, "Software Framework for Topic Modelling with Large Corpora," in "Proceedings of the LREC 2010 Workshop on New Challenges for NLP Frameworks" ELRA Valletta, Malta May 2010, pp. 45–50. http://is.muni.cz/publication/884893/en.

Romer, Christina D. and David H. Romer, "A New Measure of Monetary Shocks: Derivation and Implications," *American Economic Review*, 2004, *94* (4), 1055–1084.

Details on Implementation

- For the shocks estimated using textual input, the model was selected using LASSO as implemented in Stata by Ahrens et al. (2019). I perform a 10-fold cross-validation to select the shrinkage parameter that gives the smallest mean-squared prediction error, $\lambda \approx 24$. Working with a 1-layer neural network produced similar results, so the LASSO framework was retained for its simplicity.
- **Text processing.** I estimate the transcript embeddings using the doc2vec algorithm of Le and Mikolov (2014), as implemented in Python's gensim package (Řehůřek and Sojka, 2010), with 500 dimensions, 40 epochs of training, and a minimum word occurrence of 2.
- The external-instruments SVAR was implemented using the code from Montiel Olea et al. (2018), with asymptotic standard errors reported.
- **Data.** Greenbook data is from the Philadelphia Fed's website. Transcripts are from all regularly-scheduled FOMC meetings, from the Federal Reserve Board's website. Macroeconomic data are from the St. Louis Fed's FRED portal (the mnemonics used are DFEDTAR, DFEDTARL, DFEDTARU, FEDFUNDS, INDPRO, UNRATE, WTISPLC, and CPIAUCSL).

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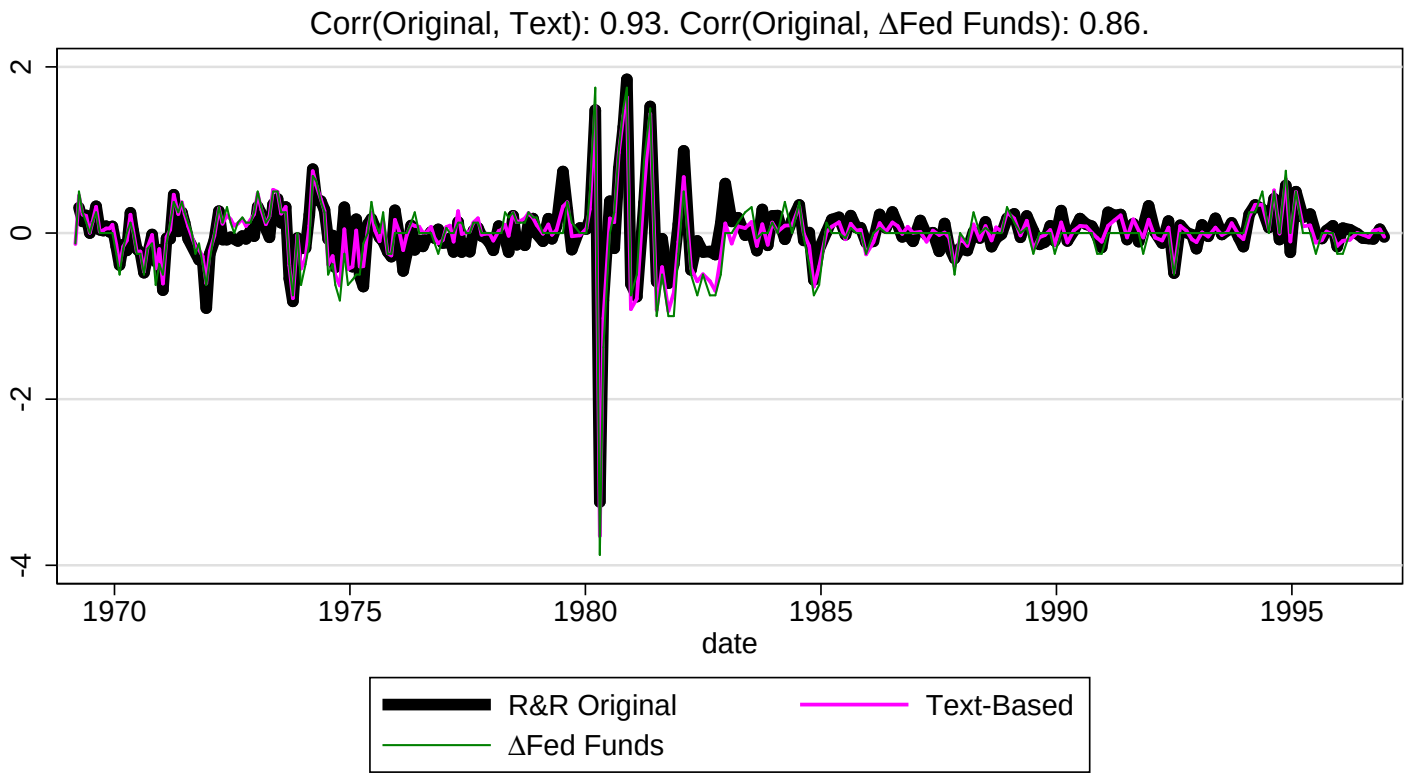
GB + Text, 1969–1996 (Original R&R Sample)



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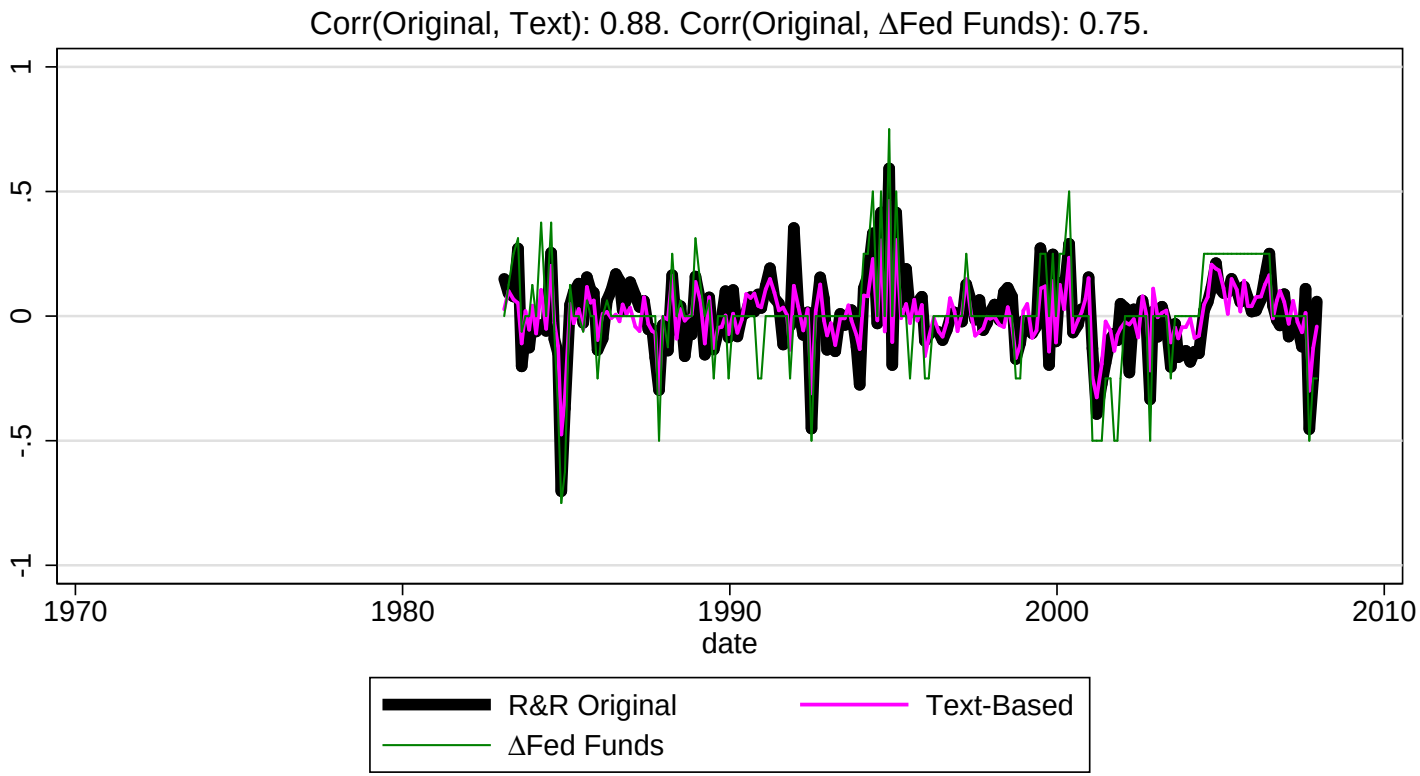
GB + Text, 1983–2007 (following Ramey (2016))



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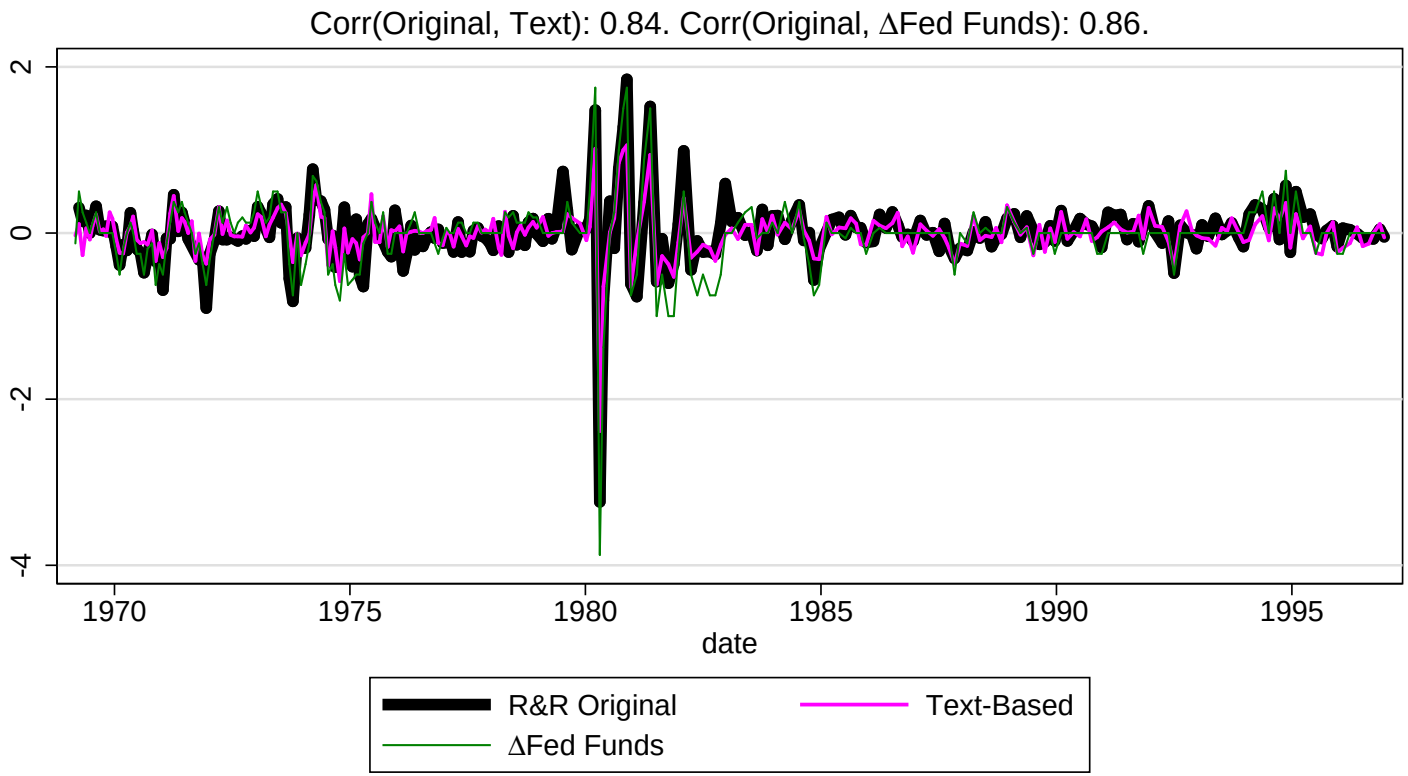
Text Only 1969–1996 (Original R&R Sample)



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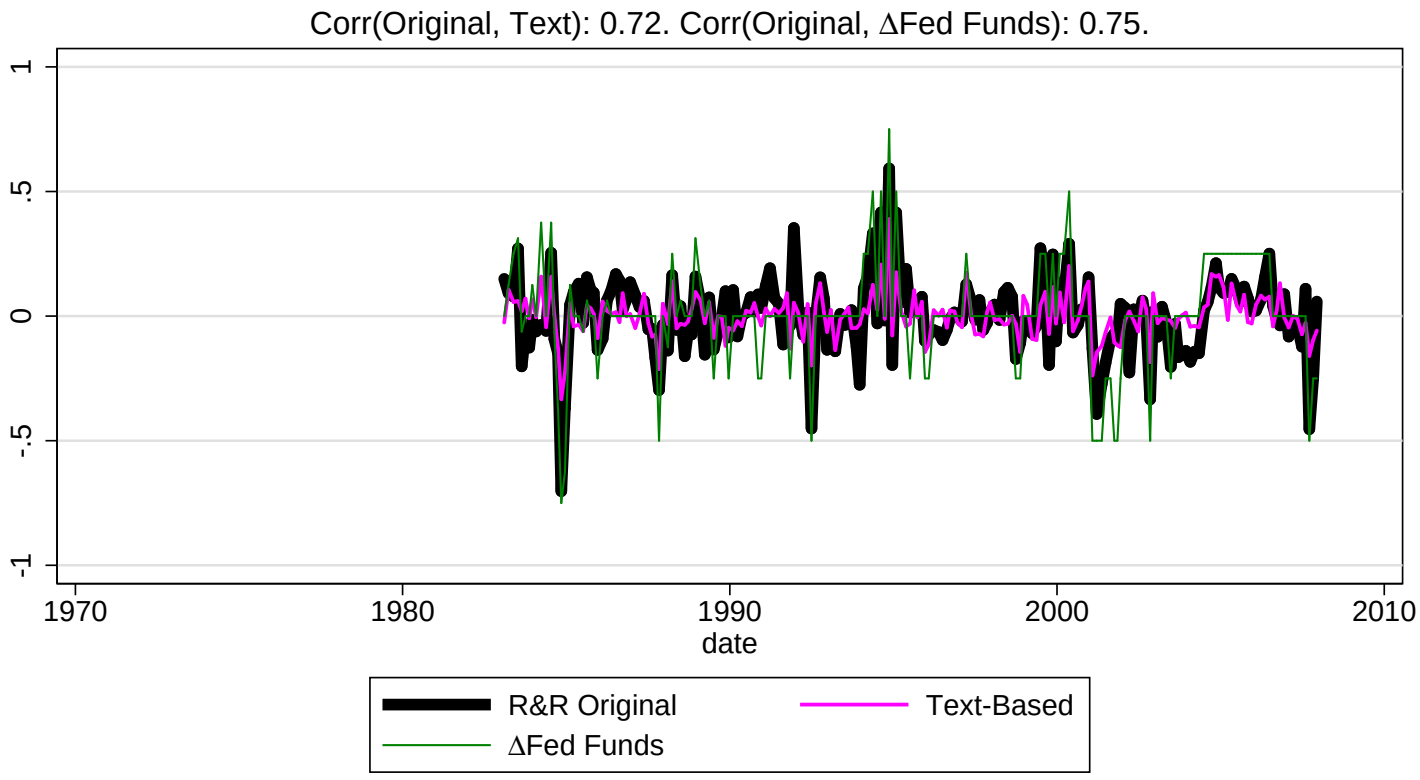
Text Only 1983–2007 (following Ramey (2016))



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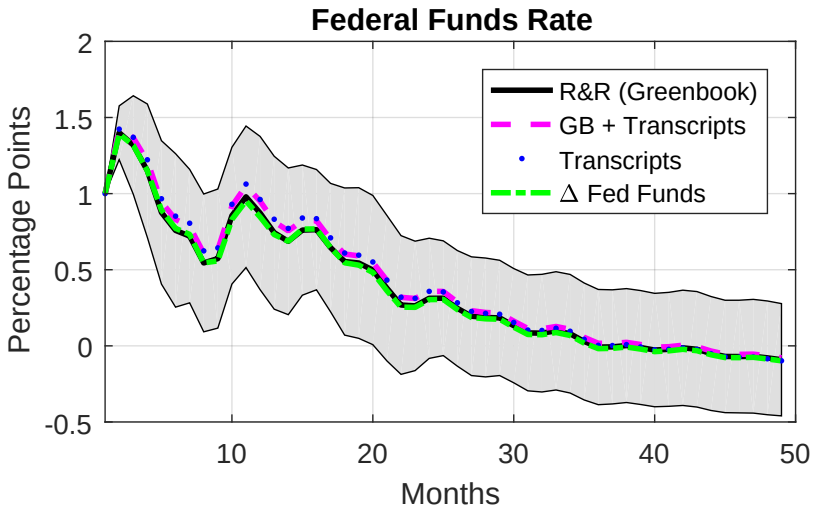
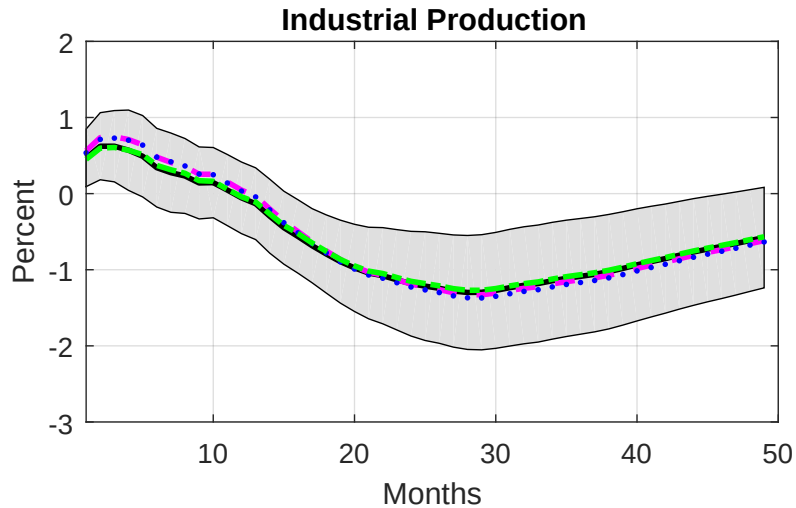
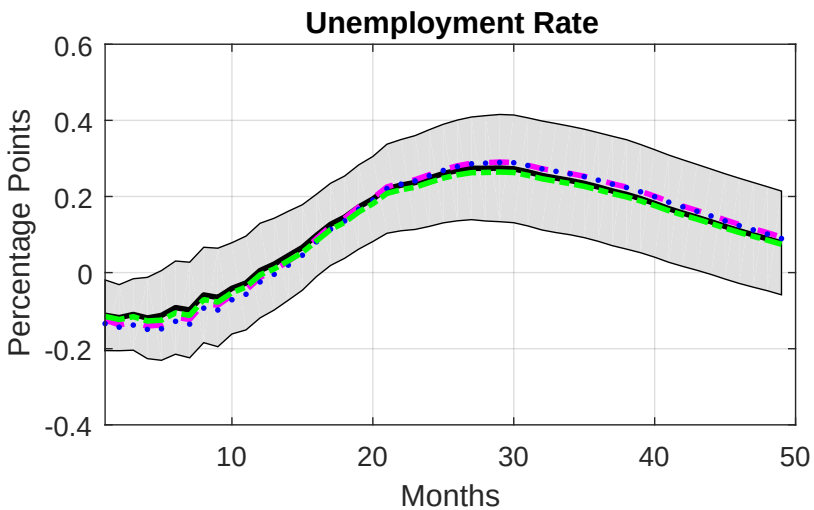
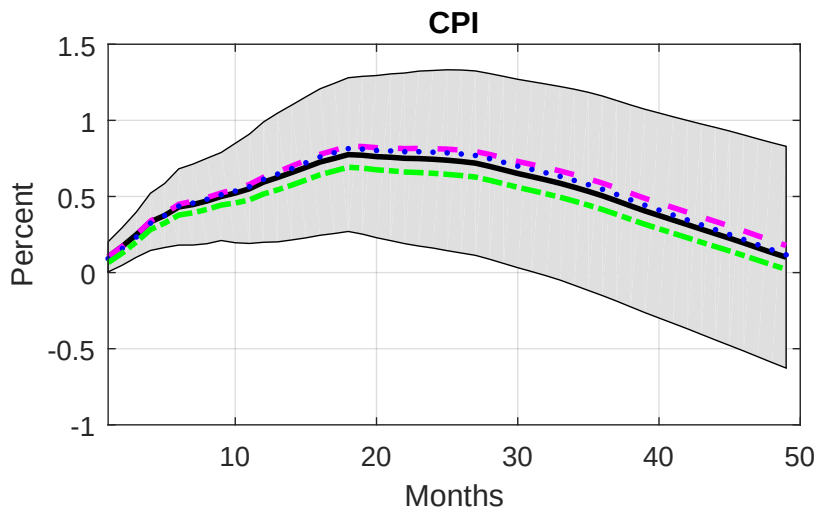
Response to a 1pp Increase in FFR 1969–1996 (Original R&R Sample)









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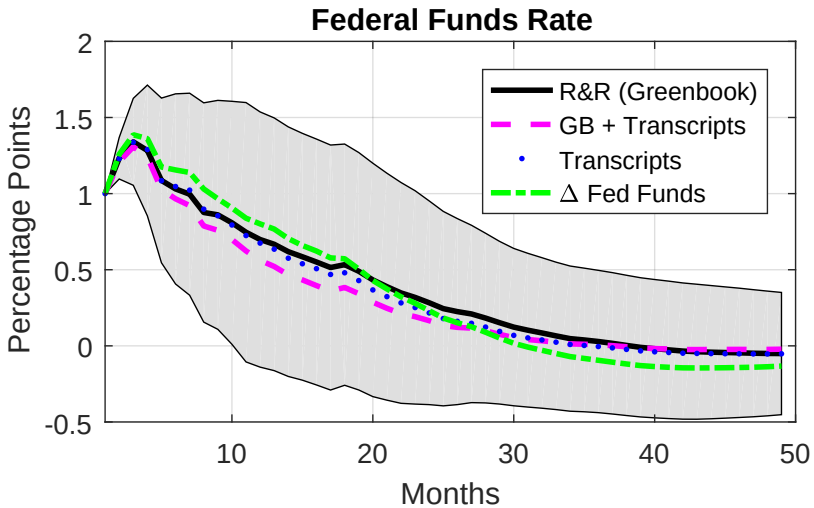
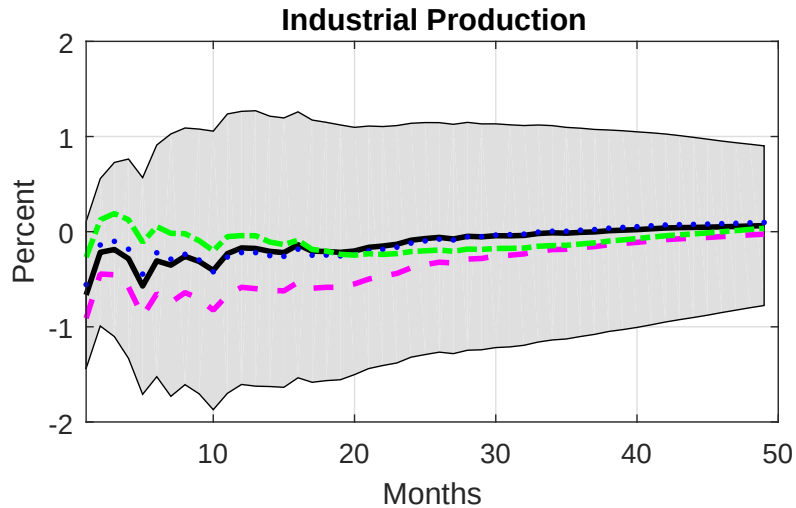
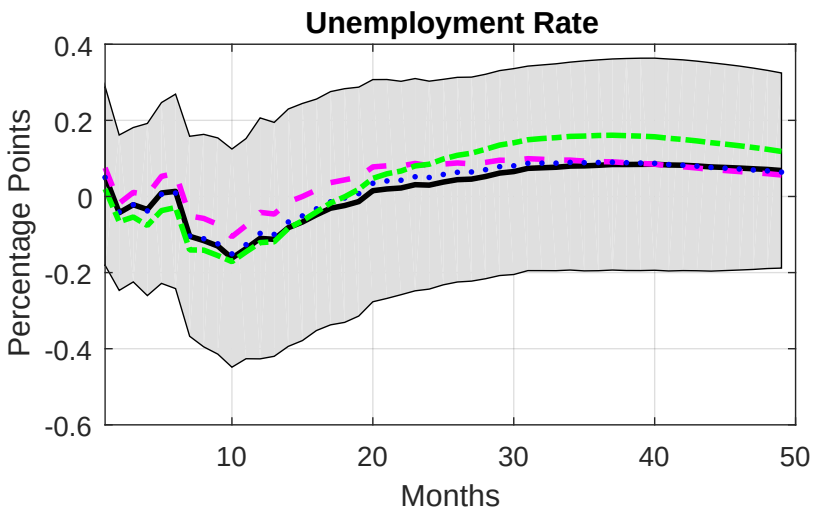
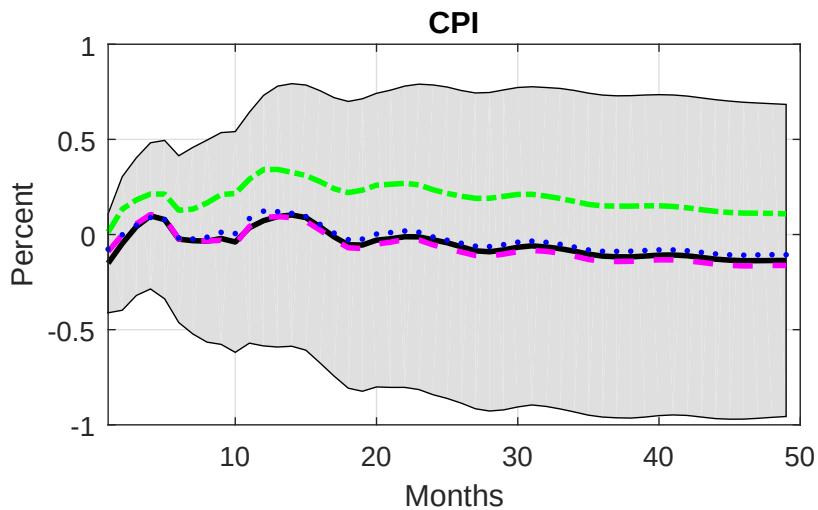
Response to a 1pp Increase in FFR 1983–2007 (following Ramey (2016))









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