Not-for-Publication Appendix to

Has the Information Channel of Monetary Policy Disappeared? Revisiting the Empirical Evidence

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Contents

I. Additional Results on the Information Advantage

I.A Information Advantage Coefficients

We report the coefficient $\beta_{GB,t}$ in the Information Advantage Fluctuation test in Figures 1-2.

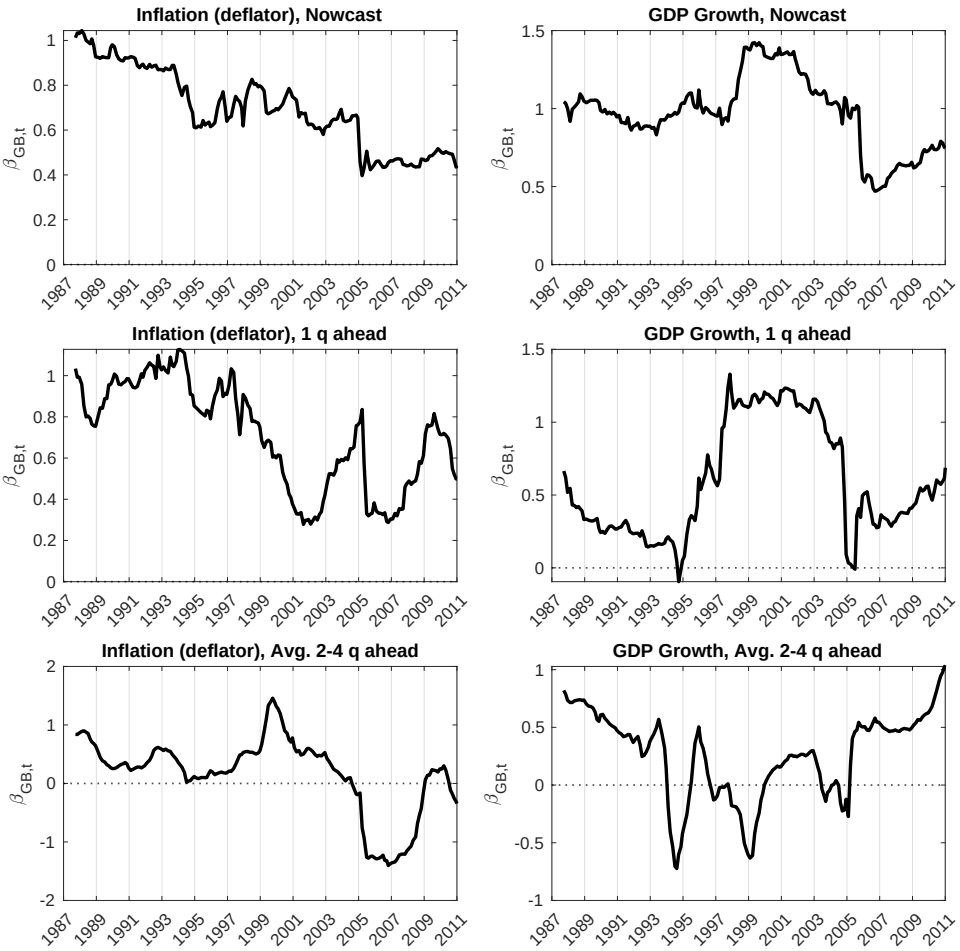

FIGURE 1: INFORMATION ADVANTAGE: $\beta_{GB,t}$ COEFFICIENTS

Note: The picture plots the $\beta_{GB,t}$ coefficient in eq. (1) based on 60 meetings rolling windows. Horizontal axes correspond to mid-window dates.

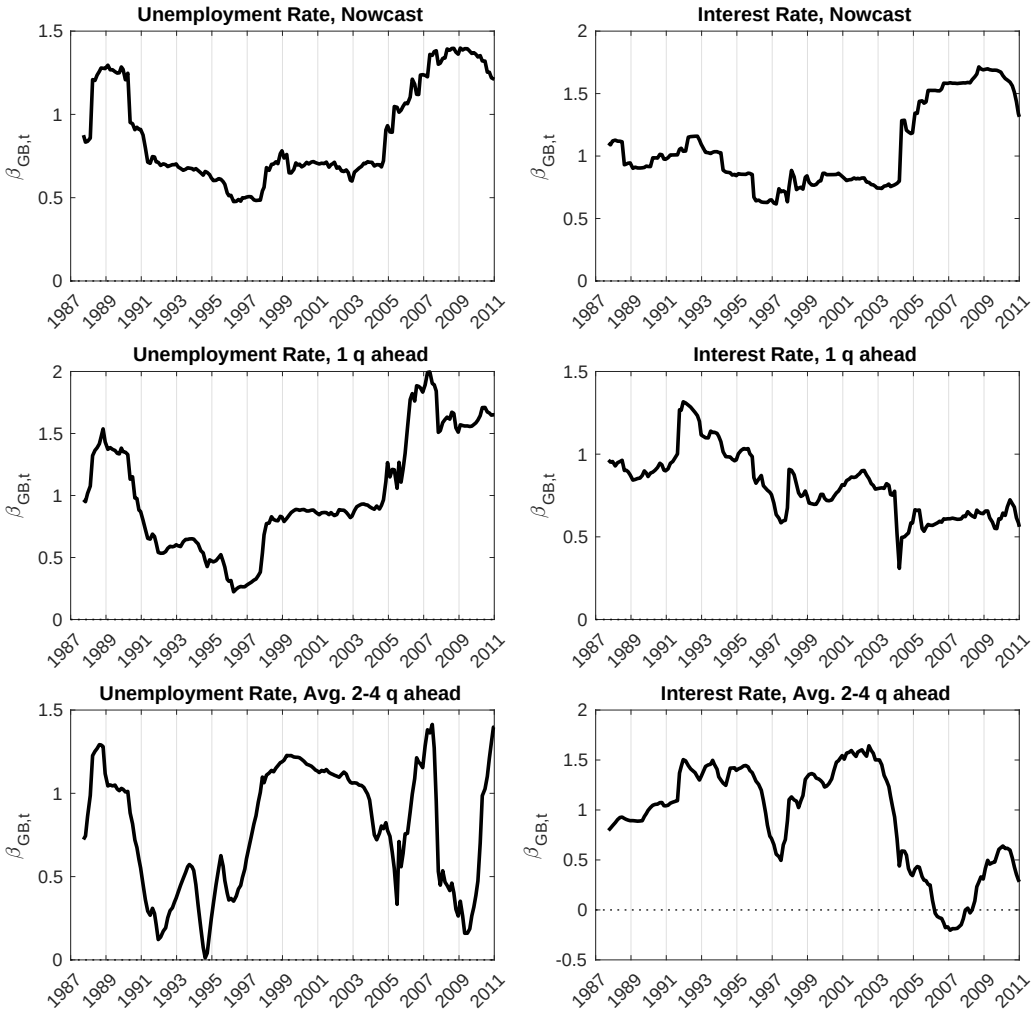

FIGURE 2: INFORMATION ADVANTAGE: $\beta_{GB,t}$ COEFFICIENTS

Note: The picture plots the $\beta_{GB,t}$ coefficient in eq. (1) based on 60 meetings rolling windows. Horizontal axes correspond to mid-window dates.

I.B Robustness to the Rolling Window Size

We explore the robustness of the Information-Advantage Fluctuation test to different window sizes in Figures 3-4.

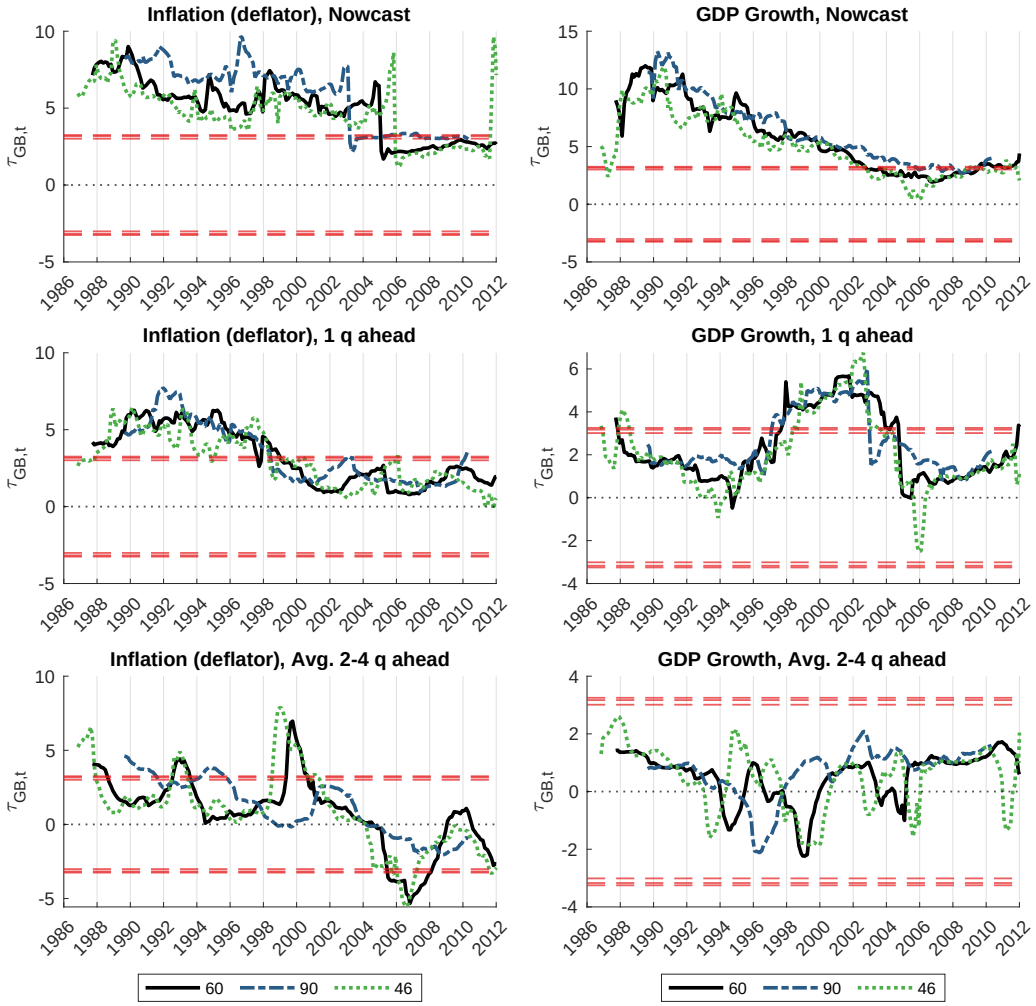

FIGURE 3: INFORMATION ADVANTAGE WINDOW SIZE: GDP GROWTH AND INFLATION

Note: The figure shows $\tau_{GB,t}$ from eq. (2) based on: $m = 60$ (black solid line), $m = 90$ (blue dash-dotted line) and $m = 46$ (green dotted line) meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. Dashed (red) lines denote 5% critical value lines based on Rossi and Sekhposyan (2016)'s two-sided Fluctuation test.

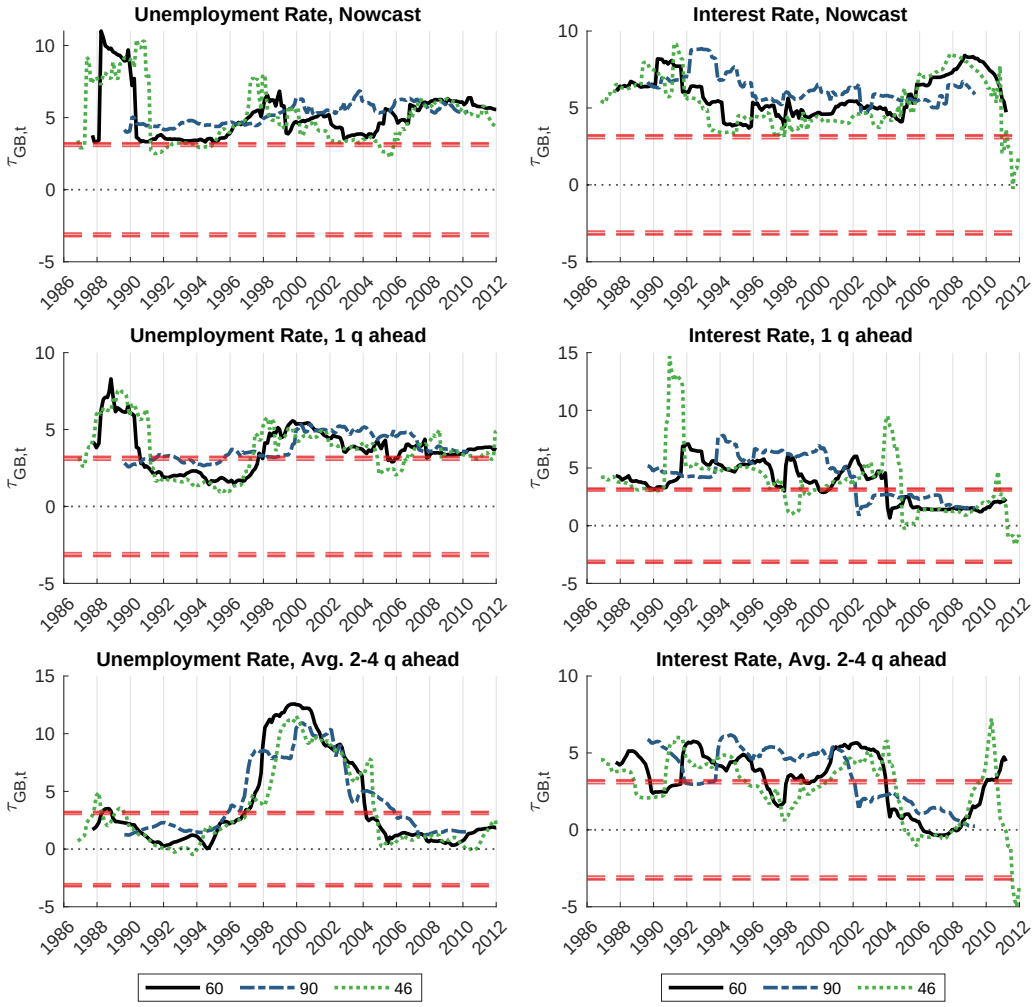

FIGURE 4: INFORMATION ADVANTAGE WINDOW SIZE: UNEMPLOYMENT AND INTEREST RATES

Note: The figure shows $\tau_{GB,t}$ from eq. (2) based on: $m = 60$ (black solid line), $m = 90$ (blue dash-dotted line) and $m = 46$ (green dotted line) meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. Dashed (red) lines denote 5% critical value lines based on Rossi and Sekhposyan (2016)'s two-sided Fluctuation test.

I.C Robustness to the Real-time Vintages

Figure 5 shows the Information-Advantage Fluctuation test when using different vintages (first, second and the third releases) for the realizations of the target variable.

II. Forecast Accuracy and Information Advantage

II.A Insights from Forecast Combination Literature

In this section, we address the relationship between the weights β_{GB} and β_{BCEI} in the information advantage regressions and the accuracy of the forecasts x_{t+h}^{GB} and x_{t+h}^{BCEI}, as measured by mean squared forecast error (MSFE).

The intuition for the null hypothesis $\beta_{GB} = 0$ in our information advantage regressions is that, given two forecasts x_{t+h}^{GB} and x_{t+h}^{BCEI} for the same target variable x_{t+h}, the best forecast should put all the weight on x_{t+h}^{BCEI} and zero weight on x_{t+h}^{GB}. In fact, this is evident by rewriting eq. (1) in the main paper as:

$$x_{t+h} = \delta + \beta_{GB} x_{t+h}^{GB} + \widetilde{\beta}_{BCEI} x_{t+h}^{BCEI} + \eta_{t+h}, \tag{A.1}$$

where $\widetilde{\beta}_{BCEI} = 1 + \beta_{BCEI}$.

Thus, one would expect that the magnitude of the coefficients β_{GB} and β_{BCEI} corresponds to the accuracy of the Greenbook/Tealbook and BCEI forecasts, respectively. However, that is not always the case when the two forecasts are not unbiased and uncorrelated.

More specifically, although typically the most accurate forecasts (in terms of the MSFE) get higher weight in the information advantage regression, it is also possible that forecasts with equal accuracy may have different information advantage coefficients. For example, when the forecasts are highly correlated, the coefficients in the information advantage regression could be large and different from

each other, thus not reflecting their relative forecasting accuracy. Here below, we further provide a detailed discussion of the relationship between information advantage regression coefficients and their relative forecast accuracy.

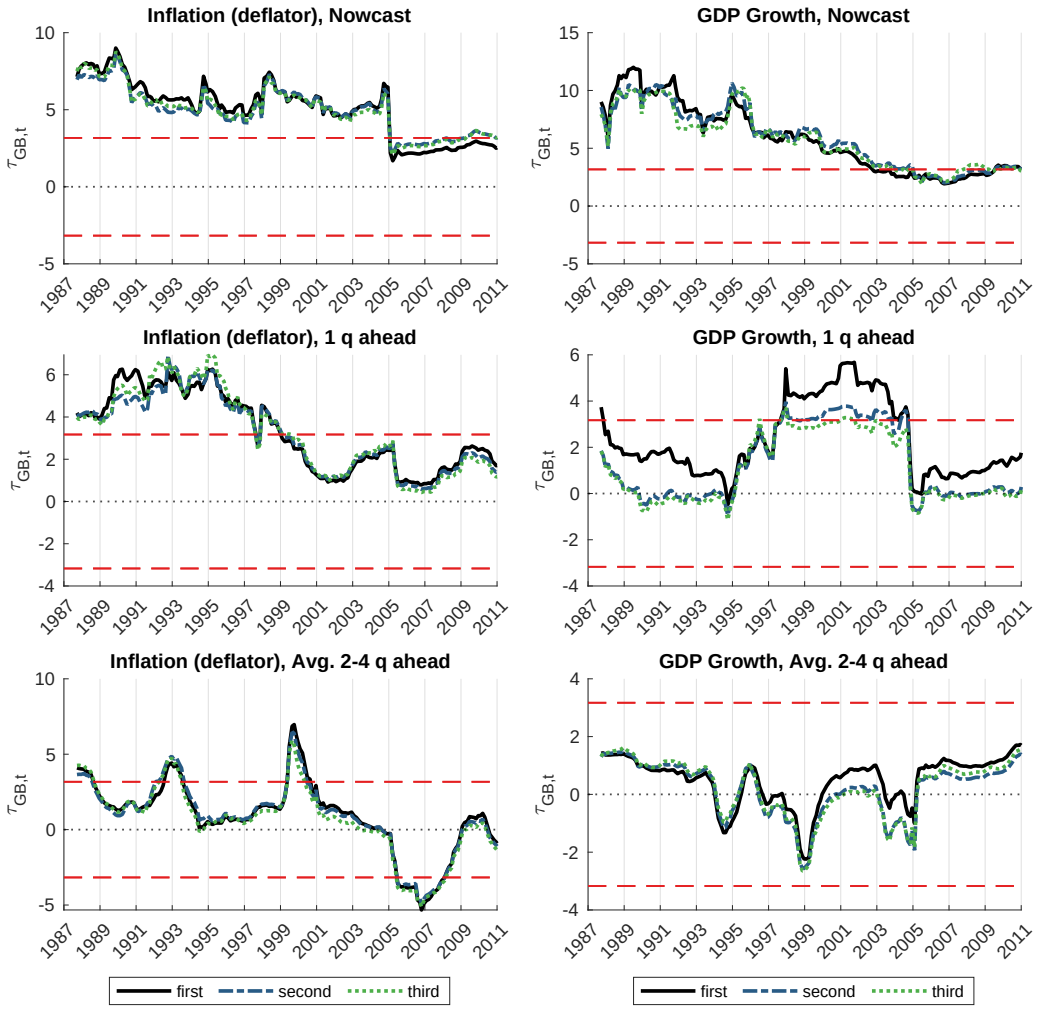

Figure 5: Information Advantage Vintages: GDP Growth and Inflation

Note: The figure shows $\tau_{GB,t}$ from eq. (2) based on $m = 60$ meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$ for different real-time realizations: first release (black solid line), second release (blue dash-dotted line) and third release (green dotted line). Horizontal axes correspond to mid-window dates. Dashed (red) lines denote 5% critical value lines based on Rossi and Sekhposyan (2016)'s two-sided Fluctuation test.

For analytical convenience, it is easier to work with a restricted specification of eq. (A.1), where the constant $\delta = 0$ and the weights β_{GB} and $\tilde{\beta}_{BCEI}$ sum to one, i.e. $\beta_{GB} + \tilde{\beta_{BCEI}} = 1$.[1] Let $fe^{GB}_{t+h} = y_t - x^{GB}_{t+h}$ and $fe^{BCEI}_{t+h} = y_t - x^{BCEI}_{t+h}$. The MSFE of the combined forecast can be written as

$$MSFE = E[w(y_t - x^{GB}_{t+h}) + (1-w)(y_t - x^{BCEI}_{t+h})]^2, \tag{A.2}$$

where w is the weight on the Greenbook/Tealbook forecasts, which we refer to as the forecast "one" in what follows. Moreover, let $s_1^2 = E(fe^{GB})^2$ be the MSFE of the Greenbook/Tealbook forecast, while the $s_2^2 = E(fe^{BCEI})^2$ be that of the BCEI forecast and $s_{12} = E(fe^{BCEI}_{t+h} fe^{GB}_{t+h})$. Further, let ρ define the cross correlations of the two forecasts. Minimizing the MSFE in eq. (A.2) results in the optimal weight w^* on the Greenbook/Tealbook forecast:

$$w^* = \frac{s_2^2 - s_{12}}{s_1^2 + s_2^2 - 2s_{12}} = \frac{1 - \rho\frac{s_1}{s2} - \frac{E(fe^{GB}_{t+h})E(fe^{BCEI}_{t+h})}{s_2^2}}{1 + \frac{s_1{}^2}{s2^2} - 2\rho\frac{s_1}{s2}}. \tag{A.3}$$

This equation shows that the optimal weights summarize a variety of information about individual forecasts, i.e. their MSFEs (s_1^2 and s_2^2), their cross correlations (ρ) as well as their respective biases ($E(fe^{GB}_{t+h})$ and $E(fe^{BCEI}_{t+h})$). In fact, the numerator of w^* is the moment condition typically tested against zero in encompassing regressions.

In the simplest possible case, when the bias is zero and the forecasts are uncorrelated, the optimal weights simplify and are proportional to the MSFEs, such

[1] As suggested in Granger and Ramanathan (1984), when the weights sum to one and each forecast is unbiased then their combination is an unbiased forecast. In general, however, Granger and Ramanathan (1984) argue that the unrestricted specification in eq. (A.1) should be preferred, at least on a theoretical basis, since it results in an unbiased forecast combination with a smaller average squared error even when the individual forecasts are biased. Though the theory gives strict preference to the unrestricted specification, in practice the gains might not be very large as the empirical application in Granger and Ramanathan (1984) shows.

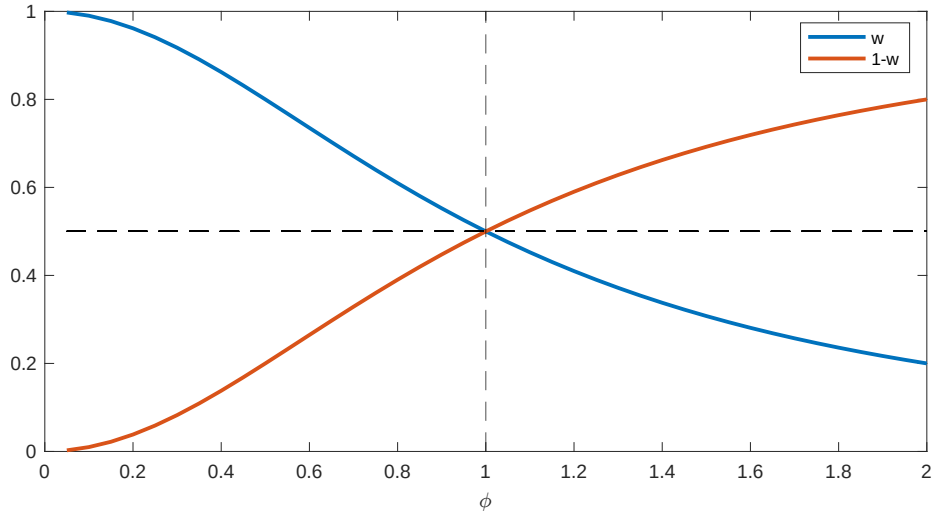

FIGURE 6: BENCHMARK COMBINATION WEIGHTS

Note: w is the weight on forecast 1, while $1-w$ is the weight on forecast 2, $\phi < 1$ showcases the situation where the first forecast (Greenbook/Tealbook) is more accurate than the second one (BCEI).

that the more accurate model gets more weight:

$$w^* = \frac{s_2^2}{s_1^2 + s_2^2} \tag{A.4}$$

Motivated by the empirical observation that our forecasts exhibit time-varying cross-correlations (see Figure 10) and are biased, at least at some points in time (see Figures 11 and 12), below we study the behavior of the optimal weights resorting to a graphical implementation.

Let $s_1/s_2 = \phi$, where s_2 equals 1.[2] ϕ measures the relative forecast accuracy: $\phi < 1$ refers to the situation where the first forecast (Greenbook/Tealbook) is more accurate than the second (BCEI), while $\phi > 1$ indicates the opposite. First, we establish a benchmark case where the individual forecasts are unbiased and uncorrelated. Subsequently, we consider the cases of cross-correlated and biased forecasts. In all the cases, we consider $\phi \in [0.05 : 0.05 : 2]$.

[2]In fact, the exact value is irrelevant.

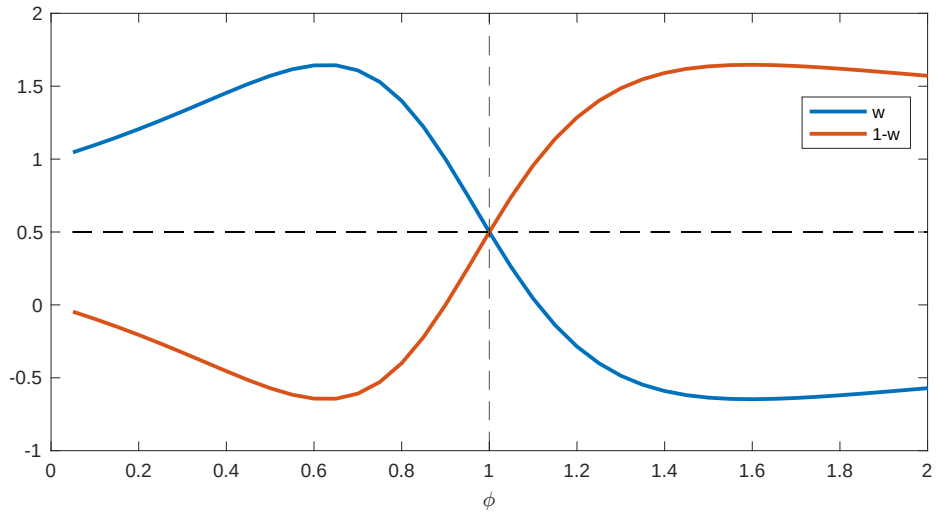

FIGURE 7: COMBINATION WEIGHTS WITH CORRELATED FORECASTS: EXAMPLE

Note: w is the weight on forecast 1, while $1-w$ is the weight on forecast 2, $\phi < 1$ showcases the situation where the first forecast (Greenbook/Tealbook) is more accurate than the second one (BCEI).

Benchmark: Uncorrelated and Unbiased Forecasts: Figure 6 shows that, when the forecasts' relative accuracy is equal (i.e. when $\phi = 1$), then the forecasts get equal weight (0.5). Otherwise, the more accurate forecast gets a higher weight. The weights are determined by eq. (A.4).

Unbiased and cross-correlated forecasts: Let $\rho = 0.9$, a reasonable value for the real GDP growth nowcast across most of the considered sample period based on Figure 10.

Figure 7 shows that the presence of non-zero correlation can lead to weights that are negative and greater than 1 (in absolute value). In this case, the weights on each individual forecast reflect not only their respective accuracy, but also their correlation. In fact, $\frac{\delta w}{\delta \rho} = \frac{\phi - \phi^3}{(1+\phi^2-2\rho\phi)^2}$. This suggests that, when the forecasts are equally accurate, their correlation is irrelevant and the weights are equal. On

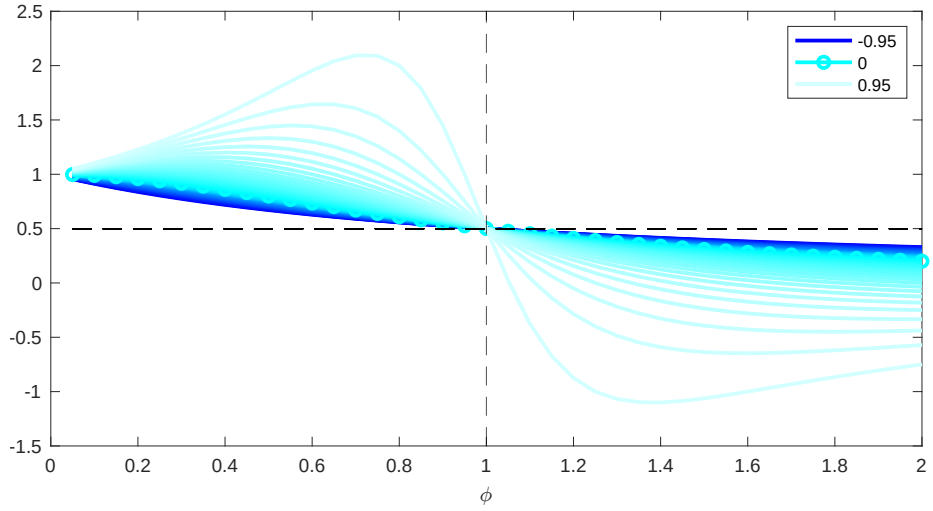

FIGURE 8: COMBINATION WEIGHTS WITH CORRELATED FORECASTS

Note: The figure plots the weight on the first forecast (w) as a function of ϕ. $\phi < 1$ showcases the situation where the first forecast (Greenbook/Tealbook) is more accurate than the second one (BCEI). Each line in the figure corresponds to a different correlation value, which ranges from -0.95 to 0.95, with a step size of 0.05.

the other hand, the weight on the first forecast is inversely proportional to the squared correlation. Figure 7 shows that when $\phi < 1$, i.e. the first forecast is more accurate, the increase in the correlation implies assigning a larger weight on the most accurate forecast. In fact, the ranking of the forecasts stays the same, the most accurate forecast gets a larger weight, but the value of the weight itself does not correspond to the MSFE, as it is "distorted" by the cross-correlations. Figure 8 demonstrates this point for various values of ρ, i.e. allowing for different cross-correlation patterns.

Biased and uncorrelated forecasts: Figure 9 shows the optimal weight on the first forecast when the forecasts are biased and uncorrelated. Each line in the figure corresponds to a different bias value of the first forecast, which ranges from -1 to 1, with a step size of 0.1; the bias of the second forecast is always 0.5. Eq.

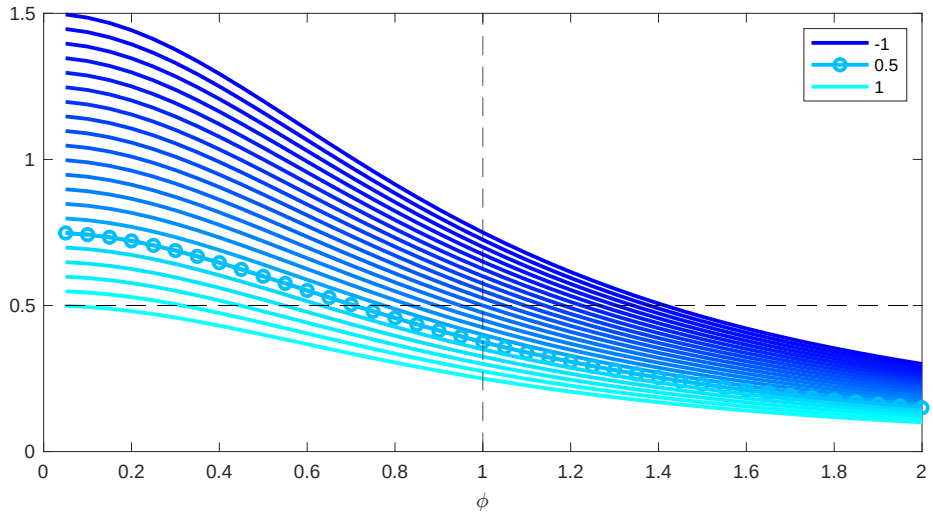

FIGURE 9: COMBINATION WEIGHTS WITH BIASED FORECASTS

Note: The picture plots the weight on the first forecast (w) as a function of ϕ. $\phi < 1$ showcases the situation where the first forecast (Greenbook/Tealbook) is more accurate than the second one (BCEI). Each line in the figure corresponds to a specific value of the bias of the first forecast, which ranges from -1 to 1, with a step-size of 0.1. The bias of the second forecast is always 0.5.

(A.3) suggests that the product of the biases plays a key role in determining the weights. The bias distorts the mapping between the weights in the information advantage regressions and relative forecast accuracy. In fact, it is possible that the first model is better than the second one in terms of relative forecast accuracy, i.e. $\phi < 1$, yet the weight associated with the more accurate forecast in the information advantage regression is lower than that on the less accurate one. The existence of the bias not only "distorts" the magnitude of the weights, but it also does not preserve the ranking. In other words, the most accurate model does not always get the highest weight.

II.B Time-varying Forecast Correlations

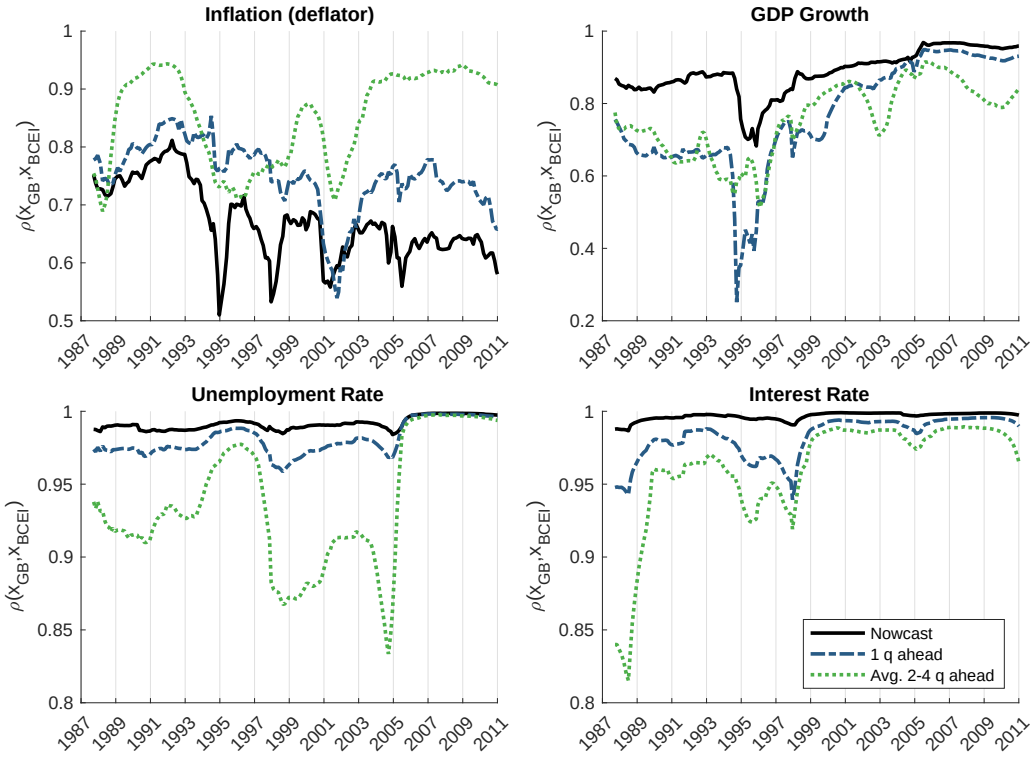

FIGURE 10: CORRELATIONS BETWEEN GREENBOOK/TEALBOOK AND BCEI CONSENSUS FORECASTS

Note: Correlation between Greenbook/Tealbook and Blue-Chip forecasts based on 60 meetings rolling windows. Sample: Feb 1984 - Dec 2015. Horizontal axes correspond to mid-window dates.

II.C Forecast Unbiasedness Tests

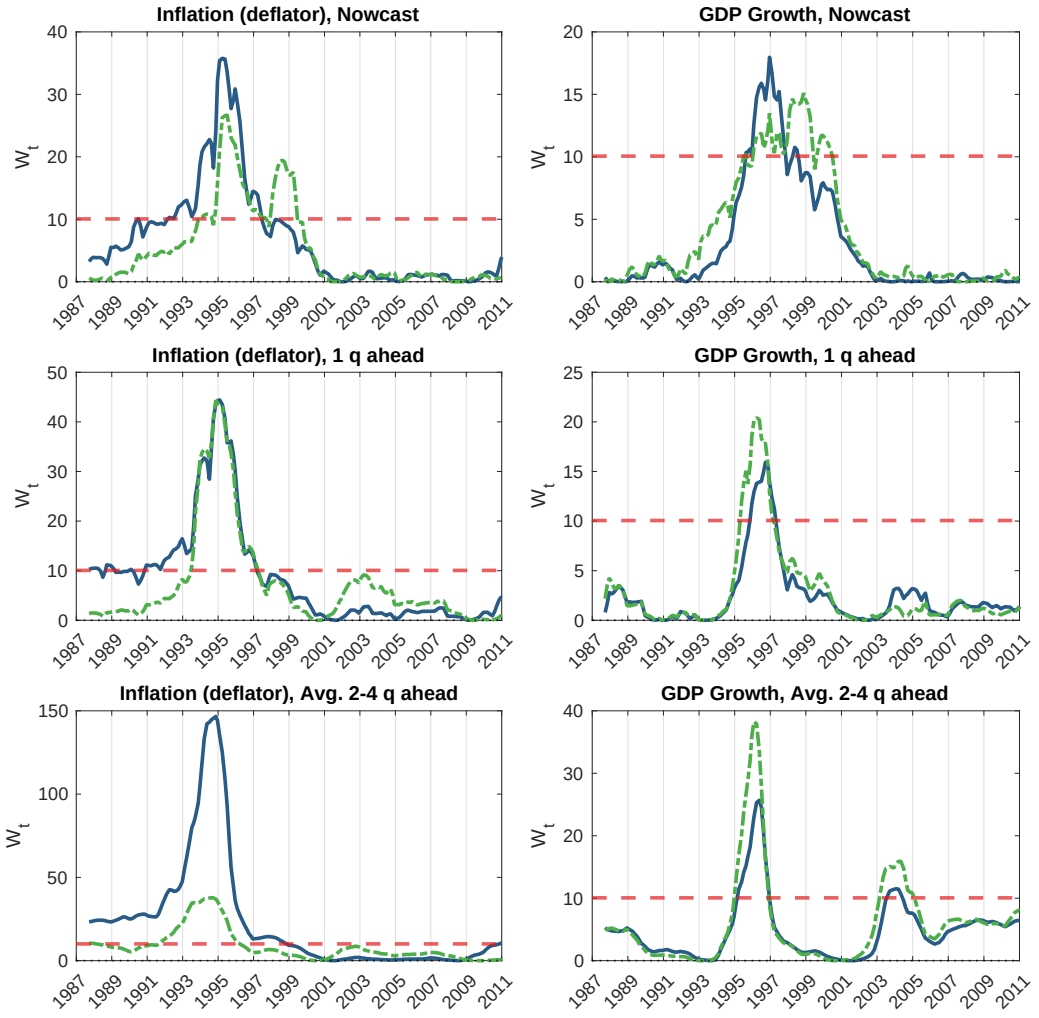

FIGURE 11: FORECAST UNBIASEDNESS FLUCTUATION TEST: GDP GROWTH AND INFLATION

Note: Rossi and Sekhposyan (2016) forecast unbiasedness W_t-test based on $m = 60$ meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. The dashed (red) line denotes the 5% critical value based on Rossi and Sekhposyan (2016)'s Fluctuation test. The sample is: Feb 1984 - Dec 2015.

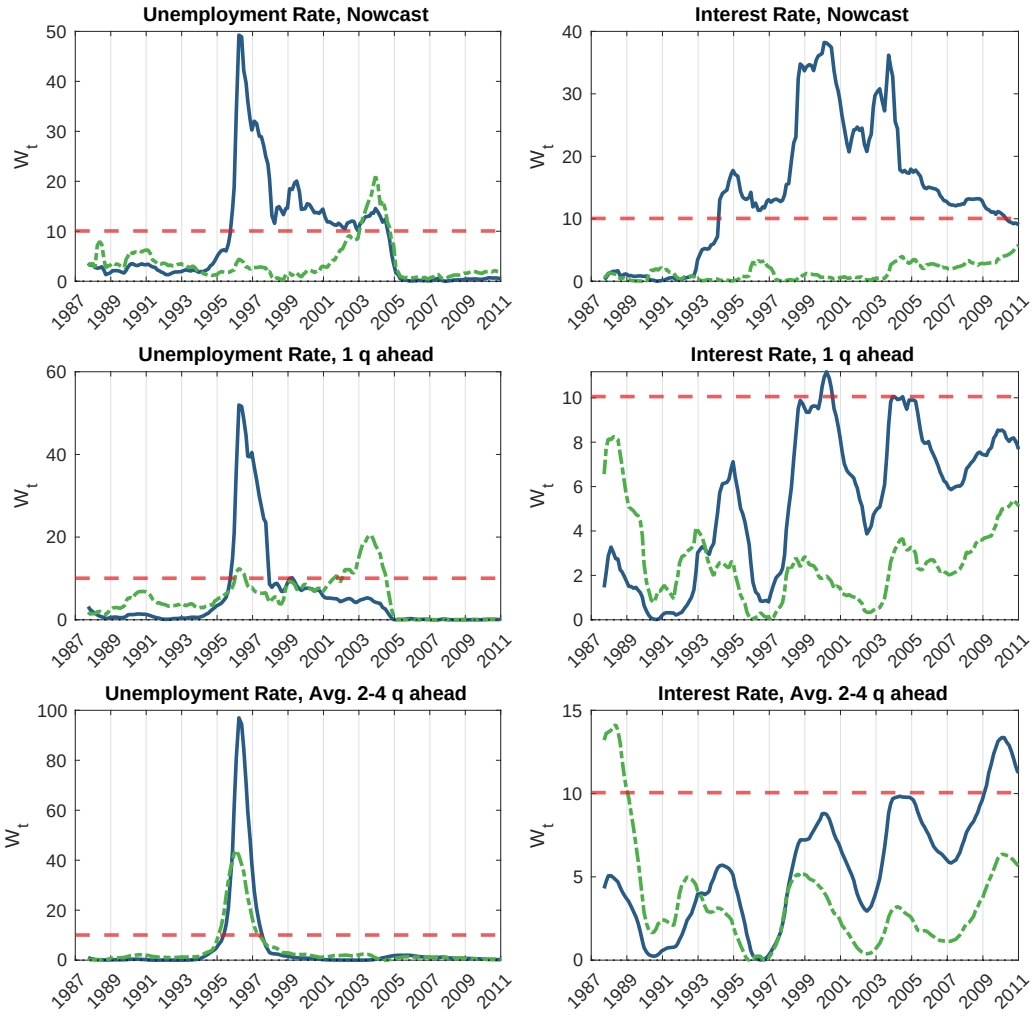

FIGURE 12: FORECAST UNBIASEDNESS FLUCTUATION TEST: UNEMPLOYMENT AND THE INTEREST RATE

Note: Rossi and Sekhposyan (2016) forecast unbiasedness W_t-test based on $m = 60$ meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. The dashed (red) line denotes the 5% critical value based on Rossi and Sekhposyan (2016)'s Fluctuation test. The sample is: Feb 1984 - Dec 2015.

II.D Forecast Rationality Tests

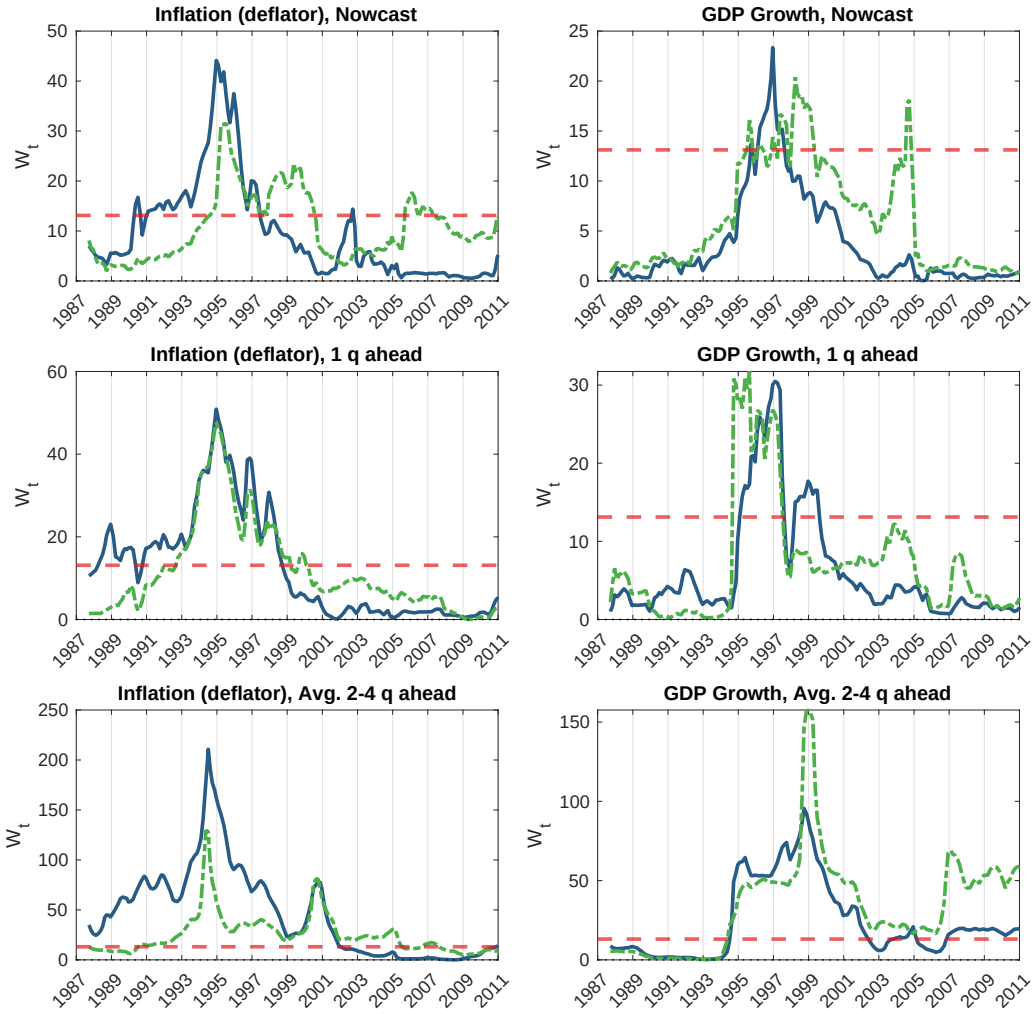

FIGURE 13: FORECAST RATIONALITY FLUCTUATION TEST: GDP GROWTH AND INFLATION

Note: Rossi and Sekhposyan (2016) forecast rationality W_t-test based on $m = 60$ meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. The dashed (red) line denotes the 5% critical value based on Rossi and Sekhposyan (2016)'s Fluctuation test. The sample is: Feb 1984 - Dec 2015.

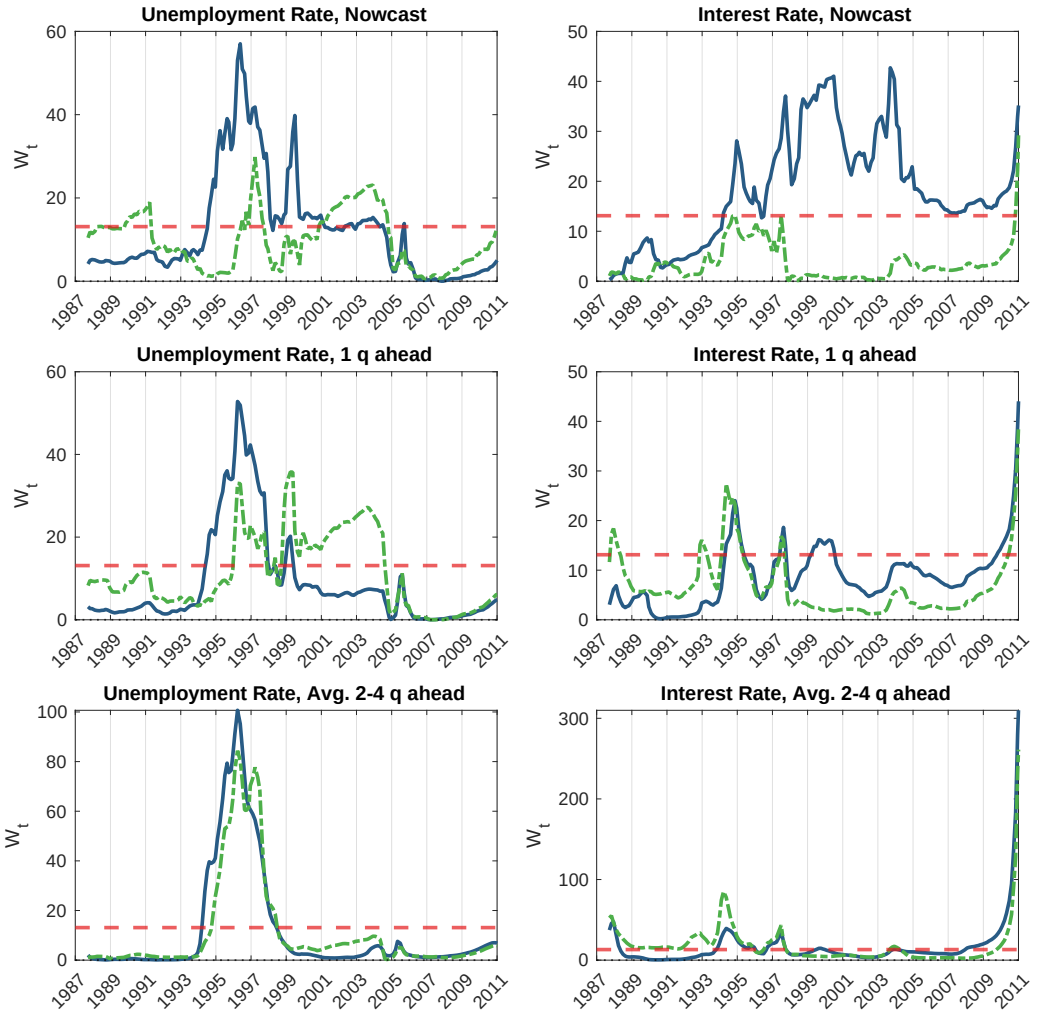

FIGURE 14: FORECAST RATIONALITY FLUCTUATION TEST: UNEMPLOYMENT AND THE INTEREST RATE

Note: Rossi and Sekhposyan (2016) forecast rationality W_t-test based on $m = 60$ meetings rolling windows using a Newey-West covariance estimator with a truncation lag of $m^{1/4}$. Horizontal axes correspond to mid-window dates. The dashed (red) line denotes the 5% critical value based on Rossi and Sekhposyan (2016)'s Fluctuation test. The sample is: Feb 1984 - Dec 2015.

III. Additional SVAR Evidence

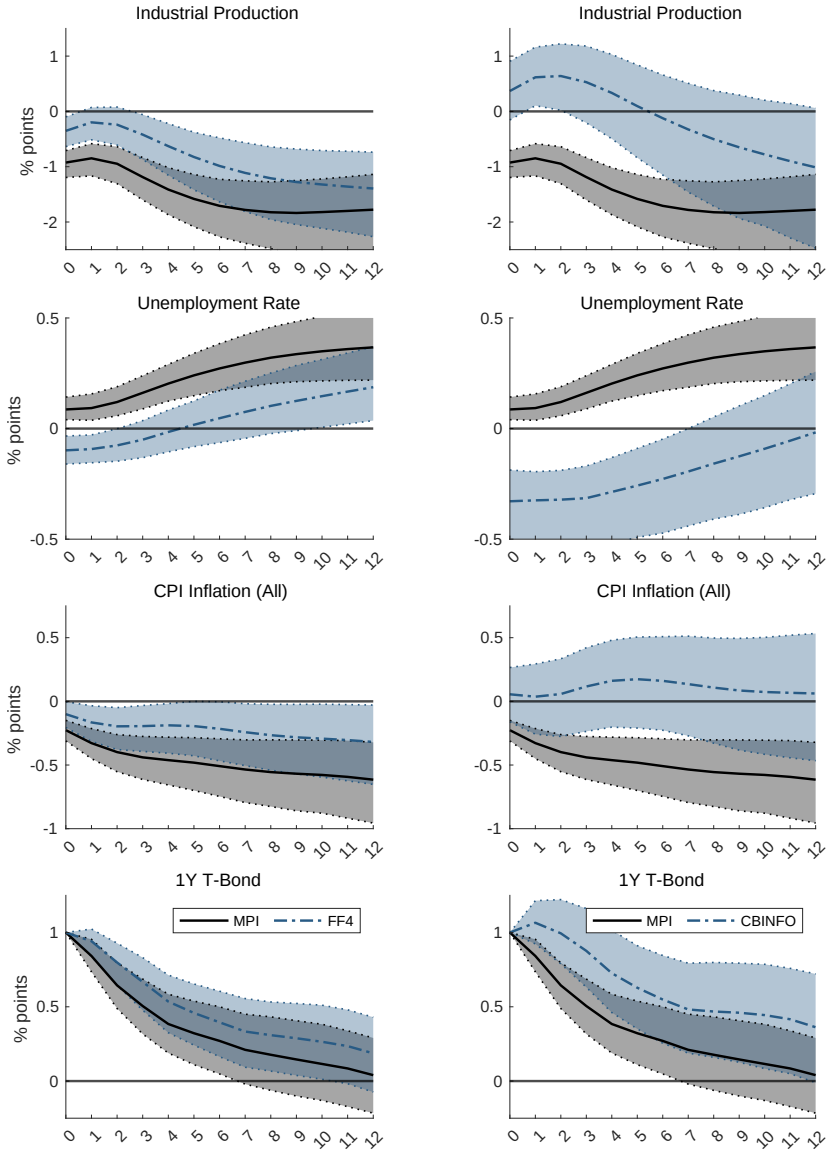

Figure 15: Responses to a monetary shock: Full Sample

Note: Bayesian VAR with standard macroeconomic priors and external instruments identification. VAR sample: January 1979 - December 2019. Instrument samples: February 1990 - July 2003 (left panel) and August 2003 - December 2015 (right panel).

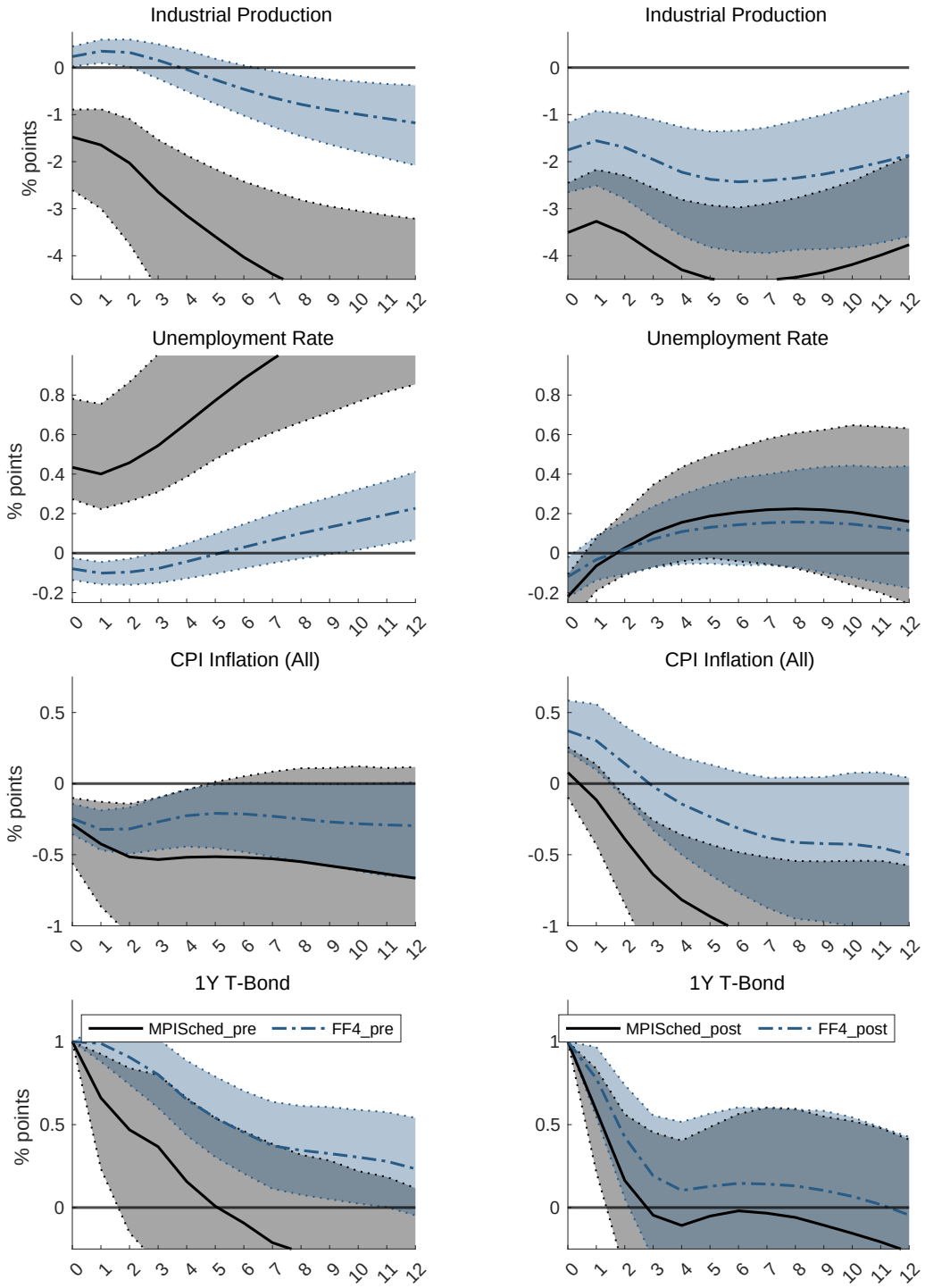

FIGURE 16: RESPONSES TO A MONETARY SHOCK: SCHEDULED ANNOUNCEMENTS ONLY

Note: Bayesian VAR with standard macroeconomic priors and external instruments identification. VAR sample: January 1979 - December 2019. Instrument samples: February 1990 - July 2003 (left panel) and August 2003 - December 2015 (right panel).

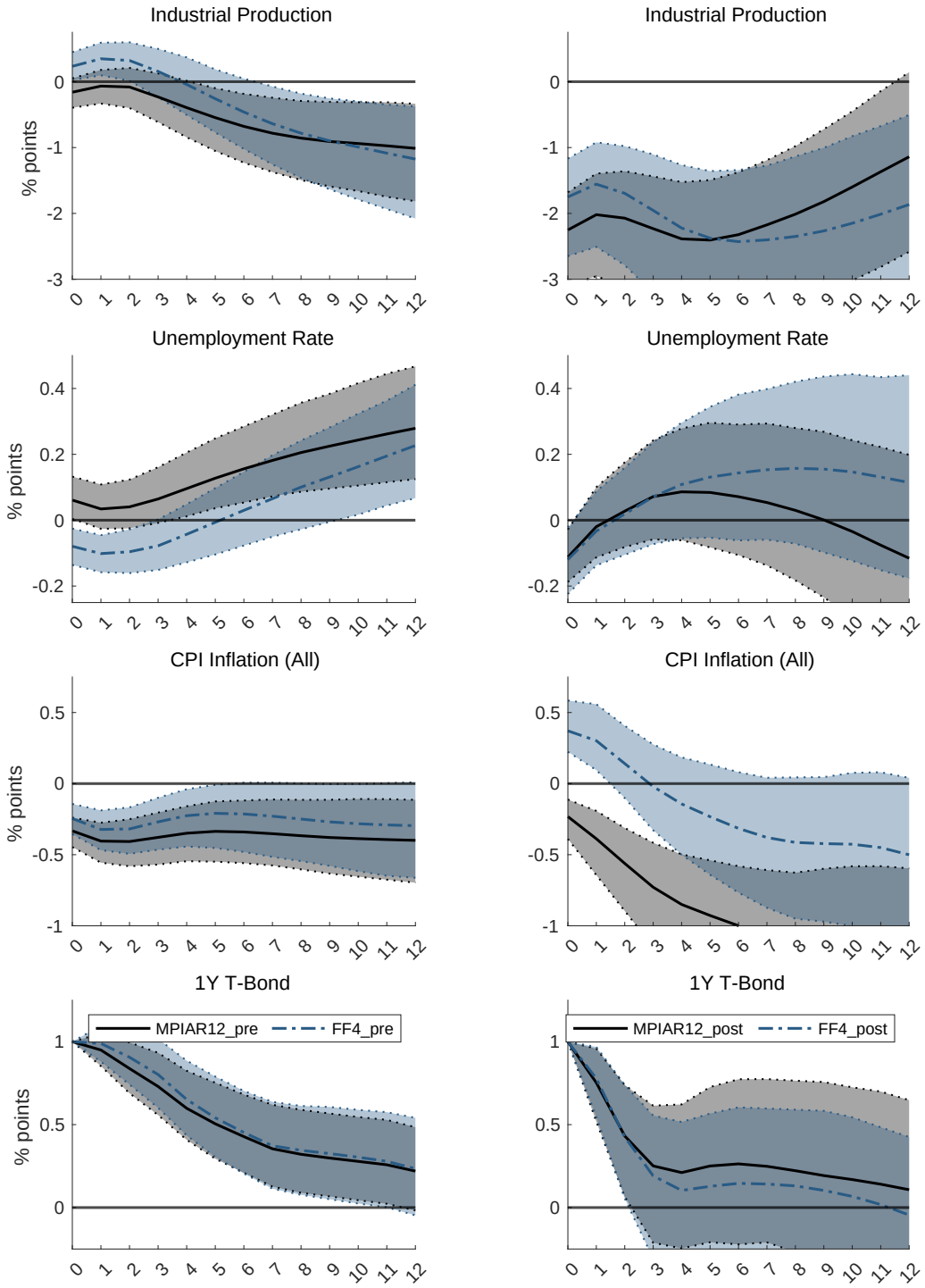

FIGURE 17: RESPONSES TO A MONETARY SHOCK: AR(12) ADJUSTMENT

Note: Bayesian VAR with standard macroeconomic priors and external instruments identification. VAR sample: January 1979 - December 2019. Instrument samples: February 1990 - July 2003 (left panel) and August 2003 - December 2015 (right panel).

IV. Data

This section reports additional details on the data used in our paper. It also describes which data series are publicly available and which data series have restricted access and, as such, cannot be included in the replication files.

IV.A Public Access Data

The following data series are publicly available and can be directly obtained from the sources described in detail below.

IV.A.1 Historical Archive of the FOMC

The dates of Federal Open Market Committee (FOMC) announcements were collected from the Historical Archive of the FOMC which is provided by the Board of Governors of the Federal Reserve System. The set of FOMC announcements includes regular monthly FOMC meetings which have an associated Greenbook/Tealbook, as well as some unscheduled meetings which were followed by a press release. For announcements prior to February 1994, we follow Gürkaynak, Sack and Swanson (2005) and use the dates of open-market operations following an FOMC meeting since the Federal Reserve did not explicitly announce changes in its target for the Federal Funds Rate before that date and market participants had to infer the target change indirectly from the open market operation. The set of dates matches the one in Gürkaynak, Sack and Swanson (2005) and was manually updated beyond the end of their sample until December 2017. The FOMC archive can be accessed here.

IV.A.2 Philadelphia Fed Greenbook/Tealbook Data Set

The Greenbook/Tealbook forecasts of real GDP growth, inflation and the unemployment rate relative to the previous quarter, the current quarter, and up to four

quarters ahead were retrieved from the Federal Reserve Bank of Philadelphia's "Greenbook Data Set" as the following series:

- gRGDP: Real GDP, Q/Q Growth, Annualized Percentage Points
- gPGDP: GDP Price Inflation, Q/Q Growth, Annualized Pct. Points
- UNEMP: Unemployment Rate, Level, Pct. Points

The "Philadelphia Fed's Greenbook Data Set" can be accessed here.

For the Greenbook/Tealbook forecast of the interest rate, we use the historical projections of the three-month Treasury bill rate relative to the current quarter, and up to four quarters ahead. This series can be retrieved from the Federal Reserve Bank of Philadelphia's dataset on "Financial Assumptions: Interest Rates and Equity Pieces". Note that updates to this dataset beyond September 2008 have been discontinued by the Philadelphia Fed. The updated series for the "Historical Projections: 3-month T-Bill Rate" were provided to us by the Board of Governors of the Federal Reserve. The Philadelphia Fed's dataset on "Financial Assumptions: Interest Rates and Equity Pieces" can be accessed here.

IV.A.3 The Philadelphia Fed Real-Time Data Set

The real-time data on realizations for GDP growth, inflation and the unemployment rate can be retrieved from the Philadelphia Fed's "Real-Time Data Set for Macroeconomists". We use the following series from the dataset on first-, second-, and third-release values:

- Real GNP/GDP, Q/Q Growth (Annual Rate, Percentage Points)
- Price Index for GNP/GDP, Q/Q Growth (Annual Rate, Percentage Points)

Where appropriate, we impute any missing values in the first-release series using the second-release values. The dataset on "First-, second- and third-release" values can be accessed here.

For real-time realizations of the unemployment rate, we use the following series from the "Real-Time Data Set: Full-Time Series History".

- Unemployment Rate (RUC), Quarterly Vintages and Monthly Observations, Percentage points, seasonally adjusted

To convert the monthly history into a quarterly series of realizations, we use the quarterly average of the monthly observations (of quarterly vintages). The "Real-Time Data Set: Full-Time Series History" can be accessed here.

IV.A.4 St. Louis Fed FRED Data Service

We obtain the following series from the St. Louis Fed FRED Data Service which can be accessed here.

- 3-Month Treasury Bill: Secondary Market Rate (TB3MS), Monthly, Percent, Not seasonally adjusted, https://fred.stlouisfed.org/series/TB3MS
- 1-Year Treasury Constant Maturity Rate (DGS1), Percent, Monthly, End of Period, Not Seasonally Adjusted, https://fred.stlouisfed.org/series/DGS1

IV.A.5 FRED-MD data

The following data series were retrieved from the FRED-MD Database (McCracken and Ng, 2015) from the 2020-06 vintage (Series ID and Description as in the 2020/06 vintage).

- INDPRO, Industrial Production
- UNRATE, Unemployment Rate

- CPIAUCSL, CPI All Items

The FRED-MD database can be accessed at here.

IV.B Data from other publications

The following data has been obtained from other publications and can be downloaded from the replication codes of the respective articles, the authors' websites or are available on request from the authors.

IV.B.1 High-Frequency Market-Based Monetary Surprises

The meeting-level high-frequency market-based surprises in the three-month Federal Funds Futures Rate (FF4) as well as the high-frequency surprise in the 30-day Federal Funds Futures Rate (MP1) are obtained from Gürkaynak, Sack and Swanson (2005). Updates of these data series up to December 2017 were provided to us by Refet Gürkaynak.

IV.B.2 Excess Bond Premium

The original Excess Bond Premium series is from Gilchrist and Zakrajšek (2012). The updated series was obtained from Zakrajsek, Lewis and Favara (2016) and is available for download here.

IV.C Restricted access data (not distributed)

Access to the following data series is restricted and thus, these series cannot be provided in the public replication files.

IV.C.1 Commodity Price Series

The data for the commodity price index were retrieved from Bloomberg via the ticker *CRB CMDT Index*, Last Price, Monthly (Last Day). This source requires

a subscription to the service.

Note: The Online-Appendix to Miranda-Agrippino and Ricco (2020) provides instructions on how this series can be reconstructed by merging two public sources.

IV.C.2 Blue Chip Economic Indicators Forecasts (BCEI)

The BCEI is a monthly commercial survey-based forecast dataset containing consensus forecasts for 16 macroeconomic variables, collected from approximately 50 business economists. The dataset is published by Wolters Kluwer since August 1976. This data is proprietary and is thus not publicly accessible. An archive file of the forecast history can be acquired from Wolters Kluwer, for more information see here. Note that many university and central bank libraries have subscriptions to the archive publication of these forecasts. We use BCEI forecasts of real GDP growth, inflation, the unemployment rate and the interest rate relative to the current quarter, and up to four quarters ahead. Specifically, we use the consensus forecasts for the following series:

- Real GDP (Real GNP prior to 1992), Percentage Change From Prior Quarter At Annual Rate, Percentage Points
- GDP Price Index (GNP Deflator prior to 1992), Percentage Change From Prior Quarter At Annual Rate, Percentage Points
- Unemployment Rate, Average for Quarter, Percentage Points
- 3-Month Treasury Bills, Average For Quarter, Percentage Points

References

Gilchrist, Simon, and Egon Zakrajšek. 2012. "Credit Spreads and Business Cycle Fluctuations." *American Economic Review*, 102(4): 1692–1720.

Granger, Clive W. J., and Ramu Ramanathan. 1984. "Improved methods of combining forecasts." *Journal of Forecasting*, 3(2): 197–204.

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Miranda-Agrippino, Silvia, and Giovanni Ricco. 2020. "The Transmission of Monetary Policy Shocks." *American Economic Journal: Macroeconomics, forthcoming.*

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