Online Supplement to "Monetary Policy Transmission in the United Kingdom: A High-Frequency Identification Approach"

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This Supplement reports the results from some additional exercises that we run to check the robustness of the main findings in Cesa-Bianchi, Thwaites, and Vicondoa (2020).

First, Section A presents descriptive statistics about the series of instruments used in the analysis. Section B displays the baseline IRFs with the confidence intervals computed with additional procedures. Section C displays the IRFs for alternative specifications of the baseline VAR. Finally, Section D presents additional results of the overidentification test.

A Instruments

This Section describes the time series properties of the external instrument, i.e. the monetary policy surprises aggregated at monthly frequency.

Table S1 reports the list of largest surprises in our sample.

Table S1 List Of Largest Monetary Policy Surprises

Ranking	Date	Surprise	Event	Description
1	06-Nov-2008	-0.44	MPC rate decision	Bank Rate reduced by 1.5% due to "a sharp slowdown in economic activity"
2	02-Aug-2001	-0.26	MPC rate decision	Bank Rate reduced by 0.25% due to "inflation was below target for the whole of the two-year forecast period" and " risk of output were on the downside"
3	06-Feb-2003	-0.24	MPC rate decision	Bank Rate reduced by 0.25% due to "weaker output than expected"
4	04-Jun-1998	0.22	MPC rate decision	Bank Rate increased by 0.25% "markets and commentators generally appeared to be expecting no further rise in rates and indeed, a gradual decline over the next two years"
5	08-Sep-1999	0.22	MPC rate decision	Bank Rate increased by 0.25% due to "Since the August meeting, new data showed that the pace of final domestic demand growth in 1999 Q2 was faster than expected"
6	04-Dec-2008	0.19	MPC rate decision	Bank Rate reduced by 1% due to "significant probability of undershooting the inflation target in the medium term"
7	04-Feb-1999	-0.18	MPC rate decision	Bank Rate reduced by 0.5% to "provide a degree of insurance against some of the downward risks" from the international outlook

Note. Ranking of the largest monetary policy daily surprises computed using the second front contract of 3-month Sterling future, i.e. the 3-to-6-month ahead expectation about the 3-month Libor.

Figure S1 reports the monetary policy surprises using different contracts, *FSScm1*, *FSScm2*, *FSScm3*, and *FSScm4*, and *GBP3M*. Finally note also that we need to aggregate

the daily monetary policy surprises into a monthly series. To aggregate the surprises from daily to monthly frequency we follow the procedure employed by Gertler and Karadi (2015). We stress here that results do not change when simply summing the surprises within the month, as shown by the robustness exercises reported in Figure S14 included in this Supplement.

All the monetary policy surprises display a similar behavior. The largest surprises are concentrated around three events: 1998, 2002 and 2008. Also, the series display higher volatility in the pre-crisis sample, reflecting the fact that monetary policy was constrained by the zero lower bound in the second part of the sample period. The monetary policy surprises, however, display significant variation even in this part of the sample. The

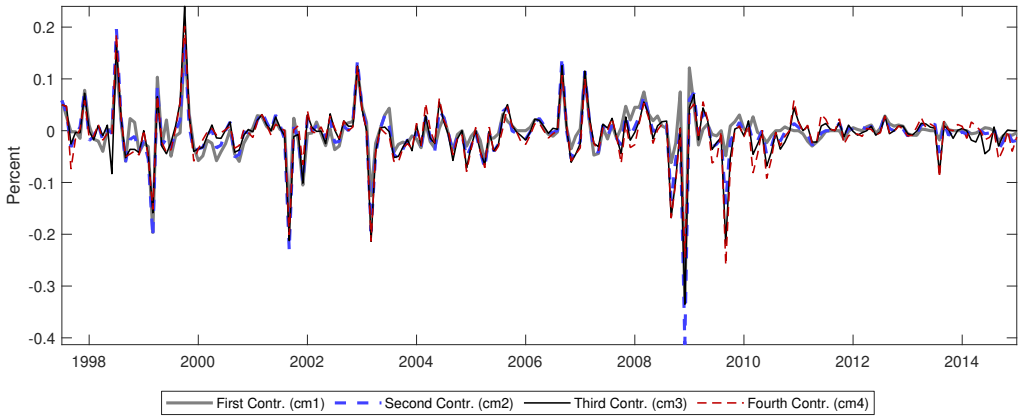

Figure S1 MONETARY POLICY SURPRISES. *Note.* Each line represent a monetary policy surprise computed with a different contract as explained in Section 2 in the main text.

similarity between the different monetary policy surprises plotted in Figure S1 is reflected in their correlation. Among all pairs, correlation ranges from a minimum of 0.77 (between *FSScm1* and *FSScm4*) to a maximum of 0.97 (between *FSScm3* and *FSScm4*). The average pairwise correlation (i.e., the average correlation across all pairs) is 0.89. Table S2 reports the summary statistics for the monetary policy surprises. All series have near-zero mean and a relatively high standard deviation (between 4 and 5 basis points); they display a very high excess kurtosis; and display a small serial correlation that is either positive or negative depending on the monetary policy surprise considered. This is a particularly undesirable feature for a series of arguably 'exogenous' shocks, since any persistence would suggest that the shocks are somewhat predictable. We therefore investigate the statistical significance of those autocorrelation coefficients.

We plot in Figure S2 the sample autocorrelation function of the monetary policy surprise that we consider in our baseline estimation (*FSScm2*) together with its 95 percent confidence bands (left panel) and its ergodic distribution (right panel). Figure S2 shows that there is no statistically significant serial correlation in our series of monetary policy surprises.[1]

[1]We also checked the monetary policy surprises computed with different contracts. There is no sta-

Table S2 Monetary Policy Surprises - Summary Statistics

	cm1	cm2	cm3	cm4
Obs	217	217	217	217
Mean	-0.01	-0.01	- 0.01	-0.01
Max	0.17	0.19	0.24	0.2
Min	-0.33	-0.41	-0.34	-0.26
St. Dev.	0.04	0.05	0.05	0.05
Auto Corr.	-0.06	0.04	0.09	0.13
Skew.	-1.82	-2.4	-1.39	-1.07
Kurt.	19.52	23.15	14.82	10.88

Note. Summary statistics of the monetary policy surprise (computed with a different contract. *Obs* is the number of observations; *Mean* is the sample mean; *Max* is the maximum value; *Min* is the minimum value; *St. Dev.* is the standard deviation; *Auto Corr.* is the first lag autocorrelation coefficient; *Skew* is skewness; *Kurt* is kurtosis.

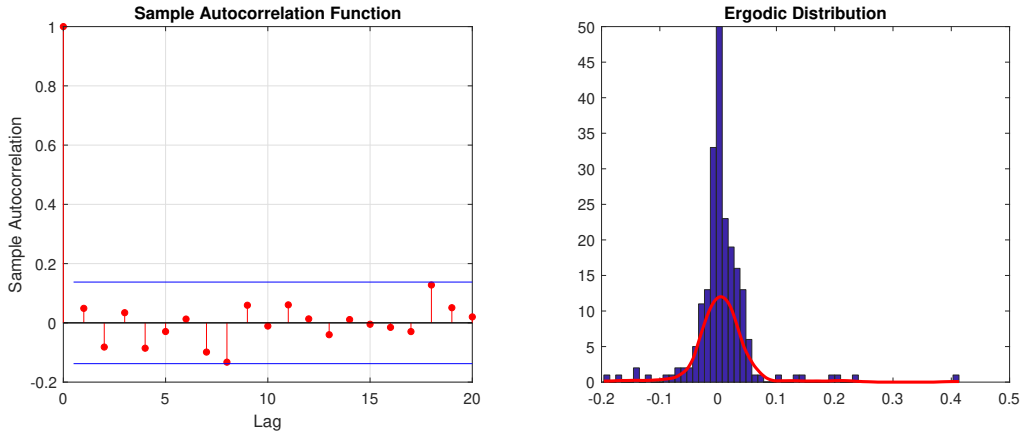

Figure S2 Monetary Policy Surprise (cm2) - Sample Autocorrelation And Ergodic Distribution. *Note.* The left panel reports the sample autocorrelation function for the monetary policy surprise compute with the second front contract (cm2), together with 95 percent confidence bands; the right panel plots its ergodic distribution.

Finally, we compare our series of monetary policy surprises with the one constructed by Cloyne and Hurtgen (2016). The sample period over which we can compare the two series of monetary policy surprises goes from 1997:6 to 2009:02—the latest observation of the updated series of Cloyne and Hurtgen (2016). The two series display quite different behavior. Indeed the correlation coefficient between the two is extremely low, at 0.16. As shown in Section 5, this somewhat puzzling low correlation simply reflects the fact that our series of shocks and Cloyne and Hurtgen (2016)'s capture different information about monetary policy news.

tistically significant association at the 90 percent confidence level.

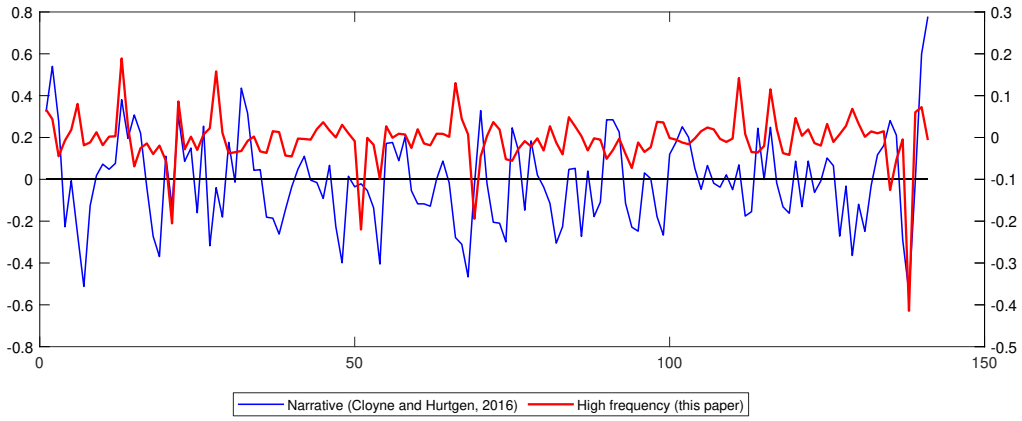

Figure S3 Instruments For Monetary Policy Shock: Narrative And High-Frequency Measures (Overlapping Sample Period). *Note.* The red line displays the updated Cloyne and Hurtgen (2016)'s instrument for monetary policy shocks (right axis). The blue solid line displays the high-frequency instrument developed in this paper (left axis).

B Additional IRFs - Inference

The confidence bands of the IRFs presented in Sections 4.1 and 4.2 were computed using wild bootstrap and moving block bootstrap. While wild bootstrap is the most popular one in the Proxy-SVAR literature, (Jentsch and Lunsford, 2019a) and (Jentsch and Lunsford, 2019b) show that this method is inappropriate since it fails to replicate the covariance matrix of the VAR innovations identified with a proxy variables. In order to assess the robustness of the previous results, we compute the confidence intervals using two different methods: the Delta method (see, for example, Montiel Olea, Stock, and Watson, 2018), and the parametric bootstrap (see, for example, Montiel Olea, Stock, and Watson, 2018). Figure S4 and S5 display the IRFs to an instrumented 25 basis points increase in the 1-year gilt rate with 68% and 90% confidence bands. The main findings of the paper are robust to using the different methods for computing the confidence bands.

C Alternative Specifications

This section presents the impulse responses for the following alternative specifications of the baseline VAR: excluding US EBP (Figure S6), adding VIX to the baseline specification (Figure S7), using the 2-year interest rate as the policy indicator (Figure S8), including exports and imports (Figure S9), and considering 6 lags instead of 2 lags (Figure S10).

Section C.1 displays the impulse responses for the baseline VAR estimated using an extended sample (1982:1-2015:1) (Figure S11), a common sample between macroeconomic variables and the monetary policy surprises (1997:6-2015:1) (Figure S12), and a Pre-ZLB sample (1992:1-2009:02) (Figure S13).

Section C.2 contains the impulse responses of the baseline VAR identified using the

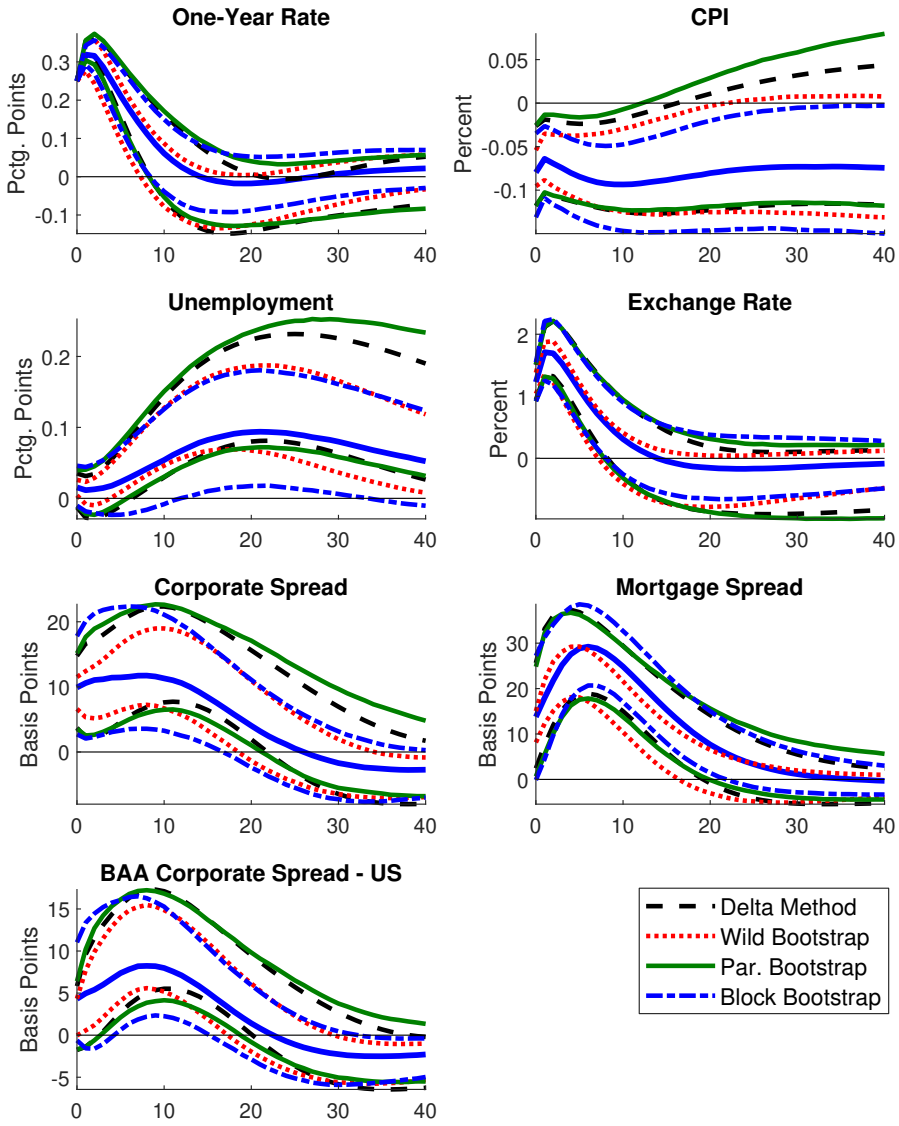

Figure S4 IRFs To A Monetary Policy Shock - Robustness. *Note.* VAR estimated in log levels, with 2 lags, and a constant over the period 1992:1-2015:1. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 41.4 and $R^2 = 0.08$. The lines report the mean, using the moving block bootstrap, and the 68% confidence intervals computed using delta method, wild bootstrap, parametric bootstrap and moving block bootstrap with 5,000 replications.

following alternative series of surprises as instruments: aggregated using a simple sum for each month (Figure S14), the fourth front Sterling future contract (Figure S15) , excluding the extraordinary MPC meetings from the set of events (Figure S16), and excluding the

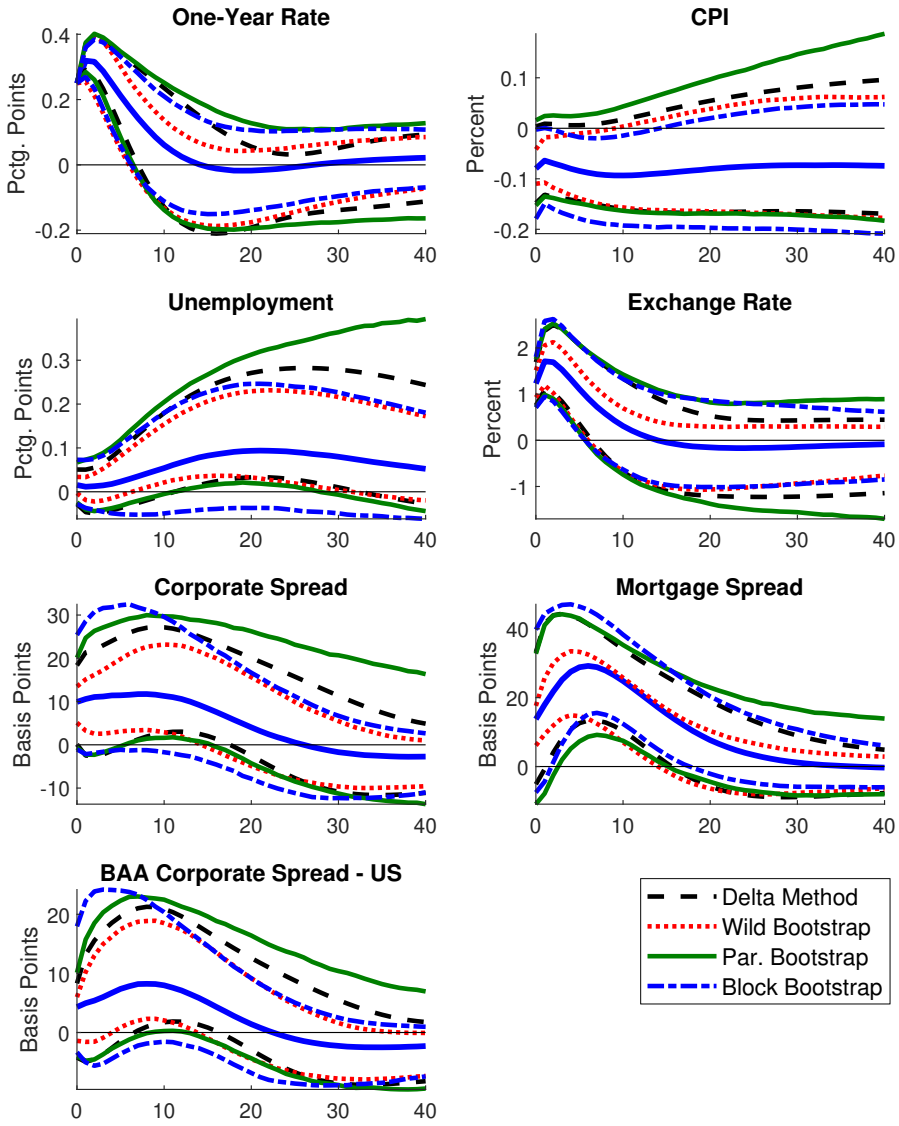

Figure S5 IRFs To A Monetary Policy Shock - Robustness. *Note.* VAR estimated in log levels, with 2 lags, and a constant over the period 1992:1-2015:1. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 41.4 and $R^2 = 0.13$. The lines report the mean, using the moving block bootstrap, and the 90% confidence intervals computed using delta method, wild bootstrap, parametric bootstrap and moving block bootstrap with 5,000 replications.

releases of the Inflation Report from the set of events (Figure S17).[2]

[2]During the sample, there were two unscheduled MPC meetings on September 18, 2001 and October 8, 2008.

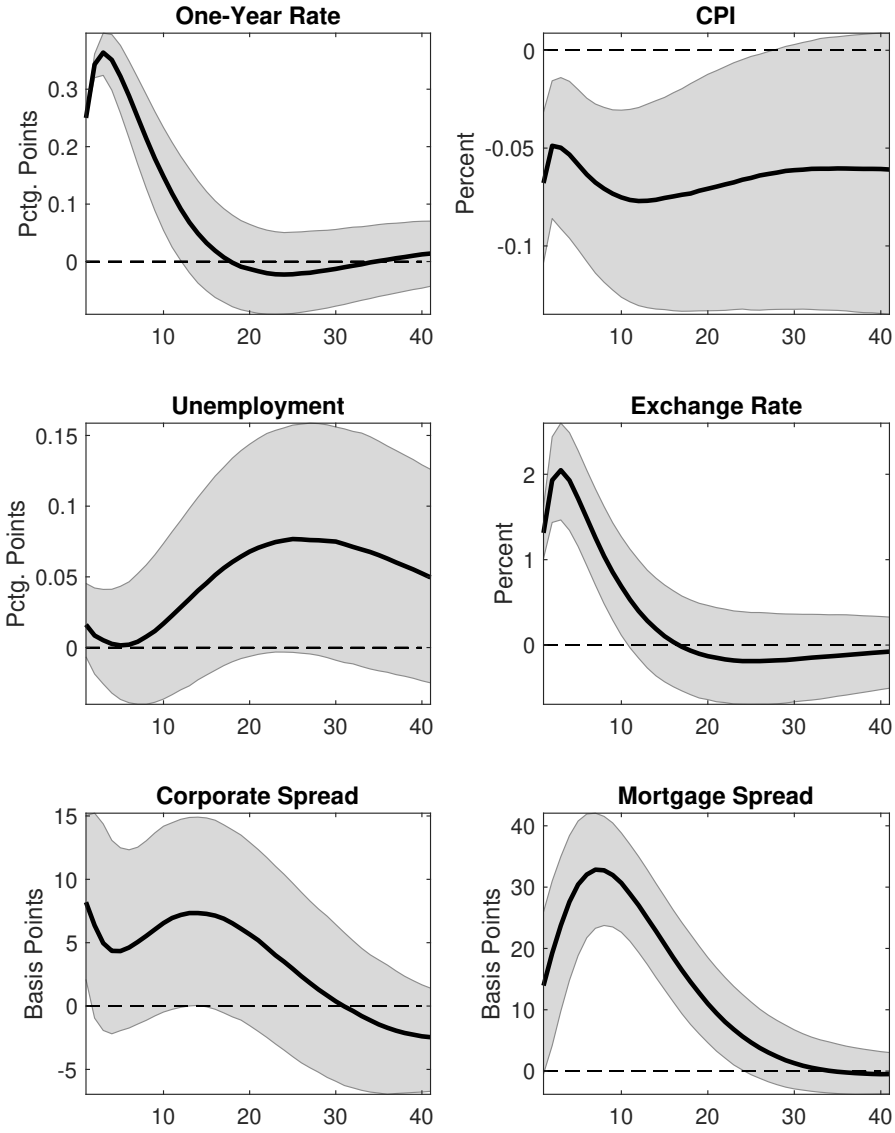

Figure S6 IRFs To A Monetary Policy Shock - Baseline Specification Excluding the US BAA corporate spread. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 31.8 and $R^2 = 0.15$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

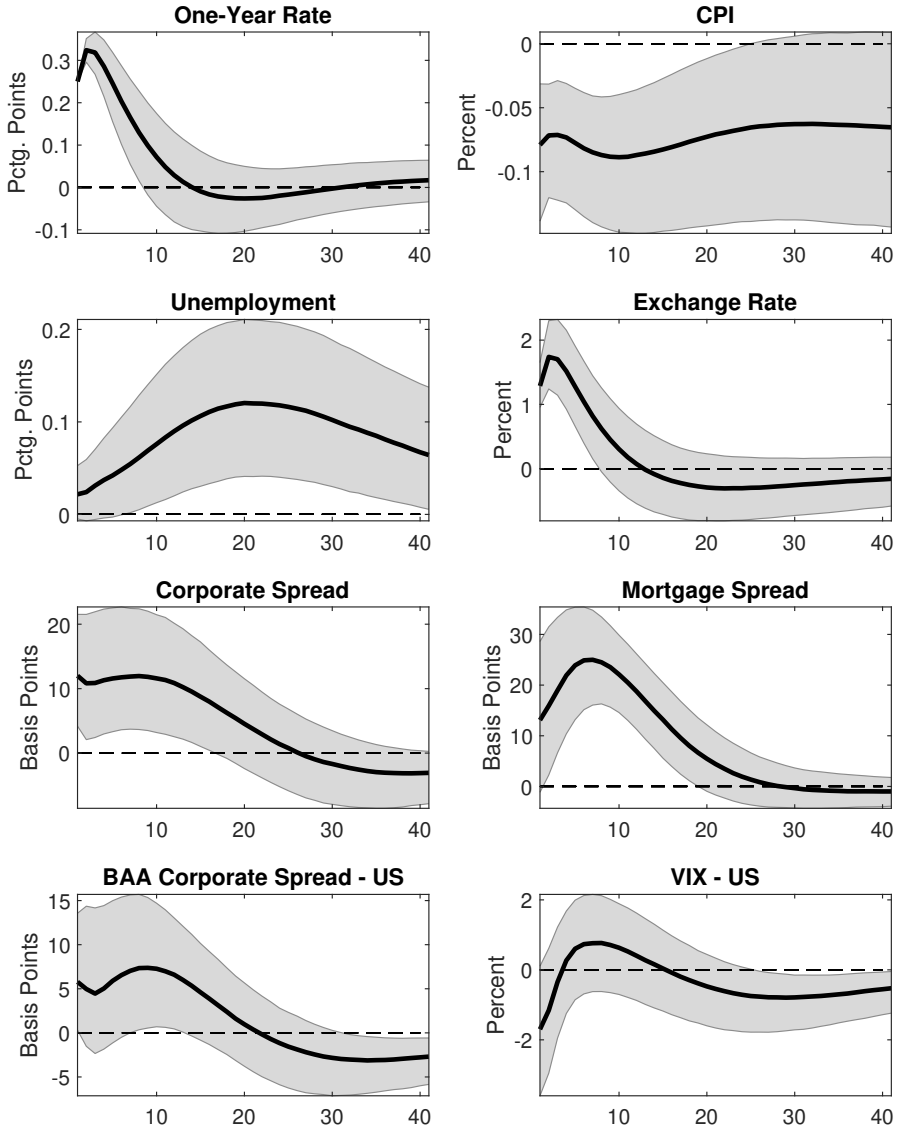

Figure S7 IRFs To A Monetary Policy Shock - Baseline Specification Including VIX. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 33.0 and $R^2 = 0.11$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

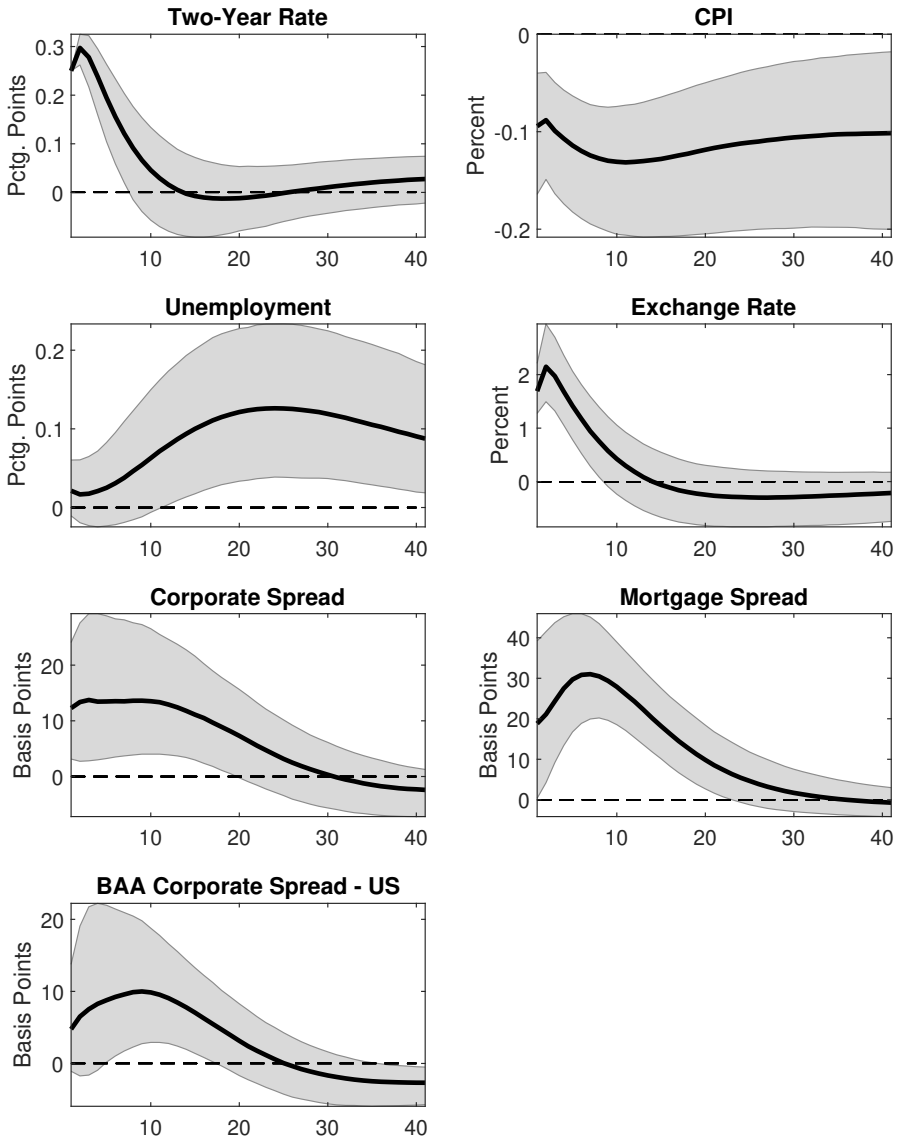

Figure S8 IRFs To A Monetary Policy Shock - Baseline Specification. Alternative interest rate. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 2-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 21.3 and $R^2 = 0.06$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

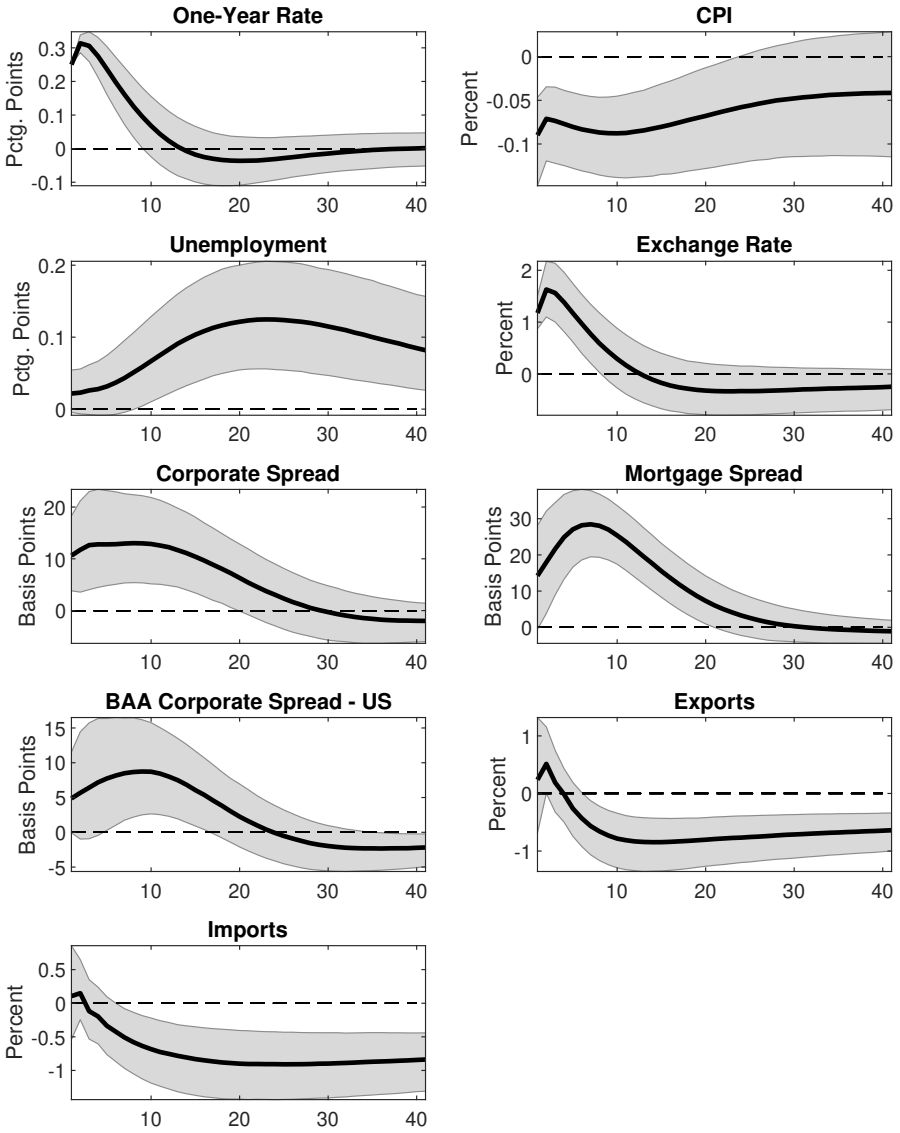

Figure S9 IRFs To A Monetary Policy Shock - Baseline Specification - Exports and Imports. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 38.9 and $R^2 = 0.12$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

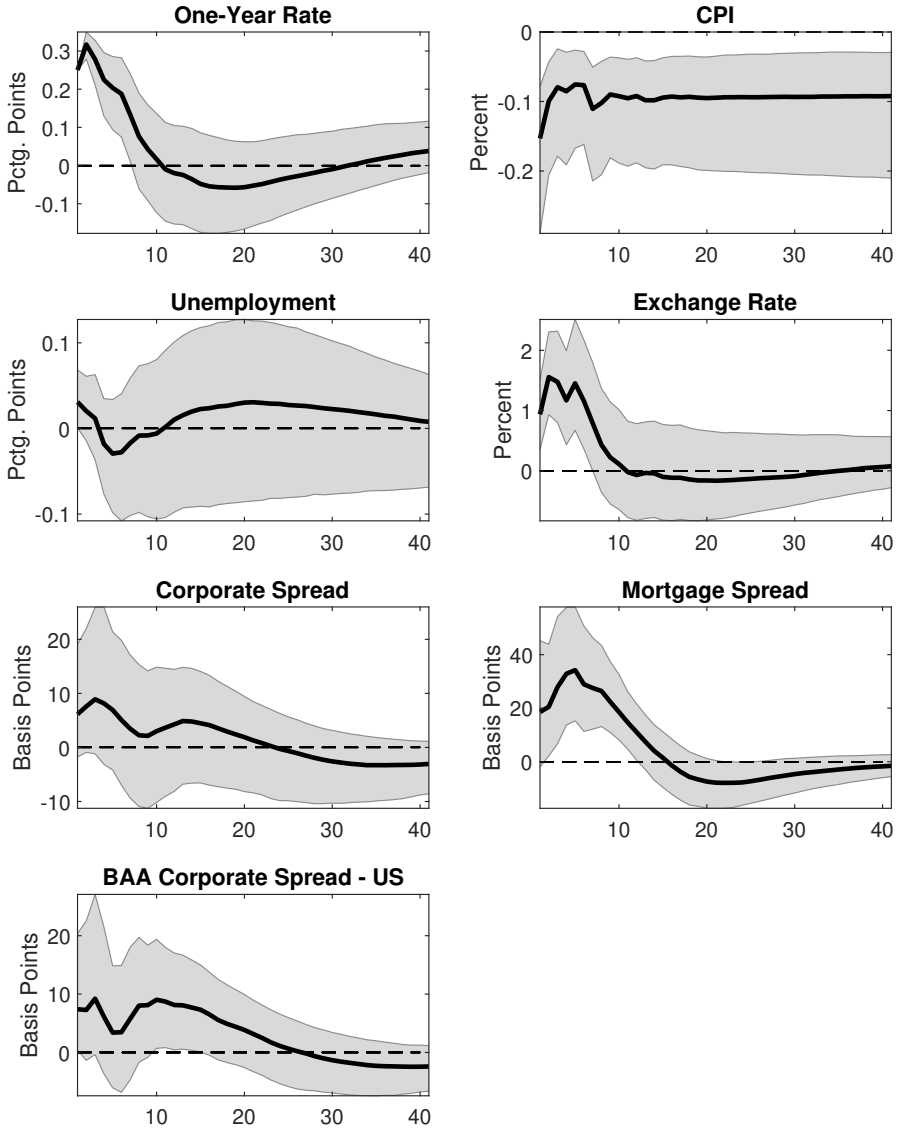

Figure S10 IRFs To A Monetary Policy Shock - Baseline Specification - 6 lags. *Note.* VAR estimated in log levels, with 6 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 10.9 and $R^2 = 0.06$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

C.1 Alternative Sample Periods

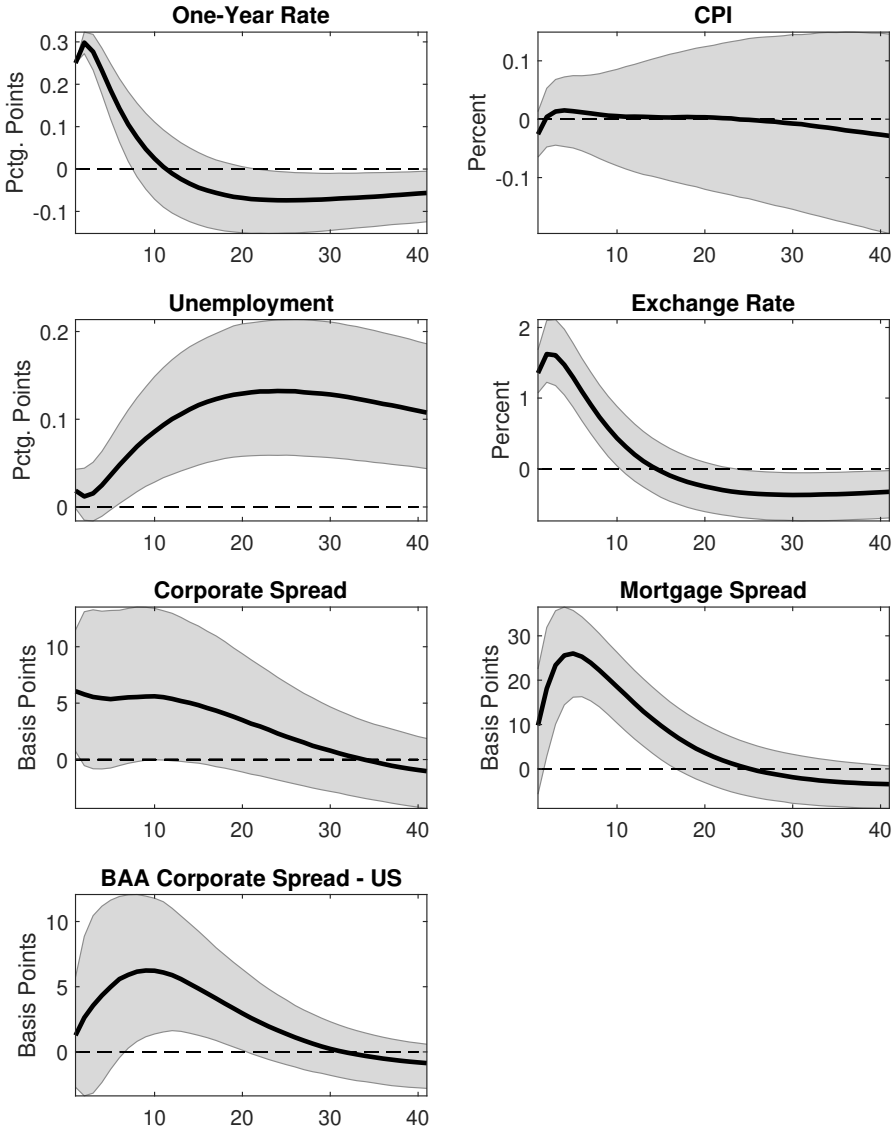

Figure S11 IRFs To A Monetary Policy Shock - Baseline Specification - Extended Sample (1982:1-2015:1). *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1982:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 56.9 and $R^2 = 0.14$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

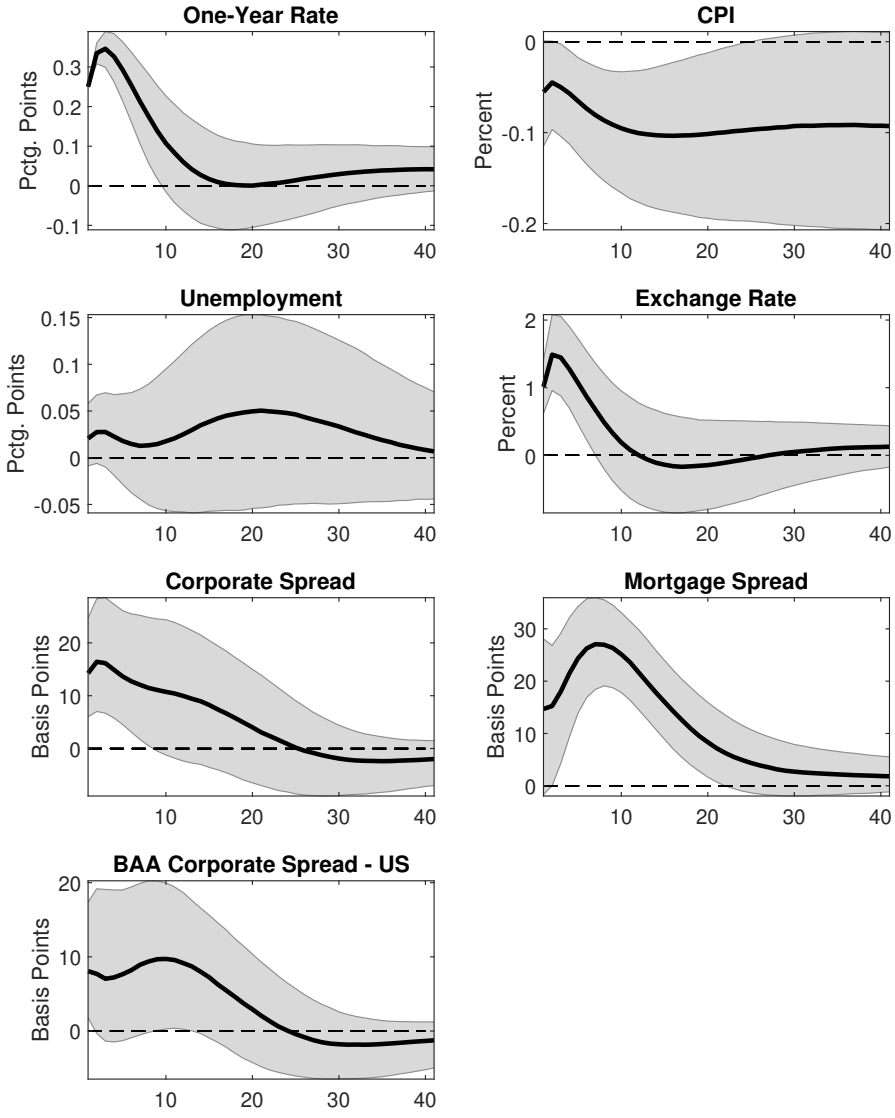

Figure S12 IRFs To A Monetary Policy Shock - Baseline Specification - Sample (1997:6-2015:1). *Note*. VAR estimated in log levels, with 2 lags and a constant over the 1997:6-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 31.3 and $R^2 = 0.10$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

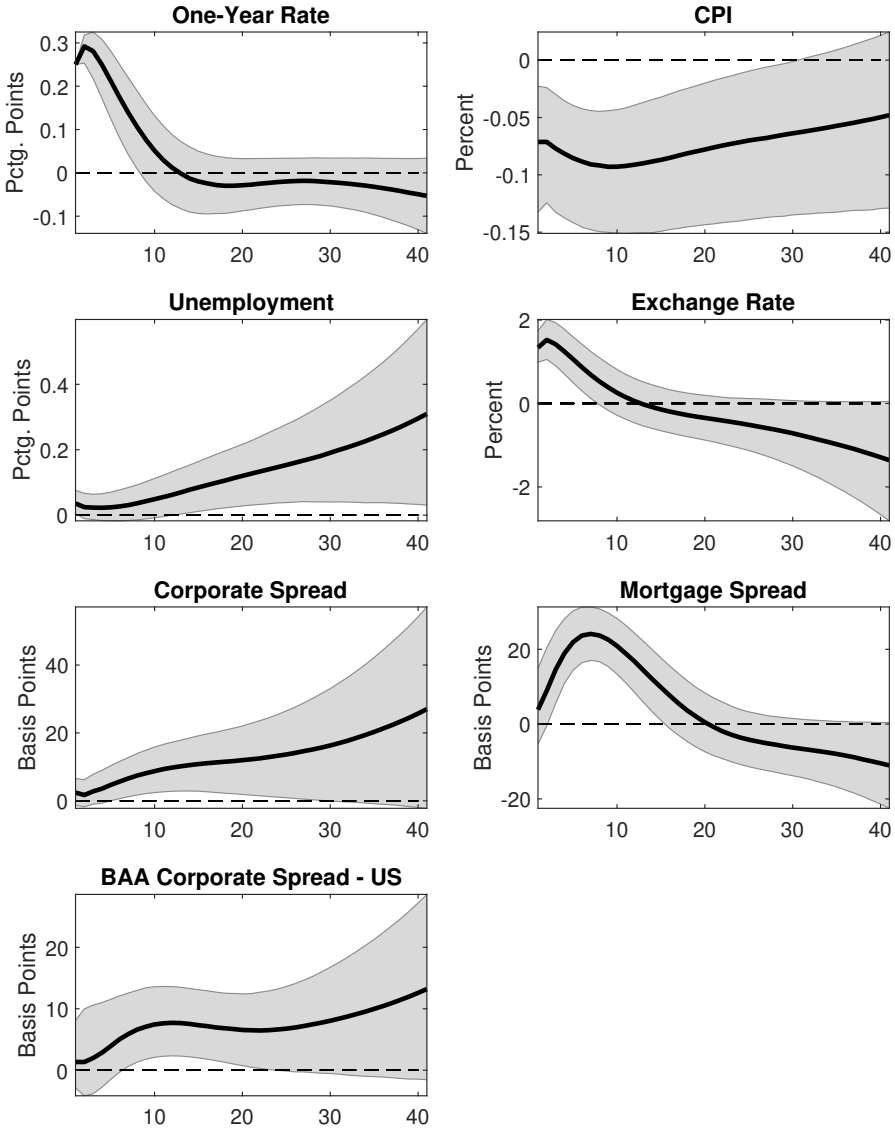

Figure S13 IRFs To A Monetary Policy Shock - Baseline Specification - Pre-ZLB sample. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2009:02 period. The 1-year Government Gilt Yield is instrumented using the third front contract of 3-month Sterling future. First stage results: F-Statistic: 21.4 and $R^2 = 0.10$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

C.2 Alternative Series of Monetary Policy Surprises

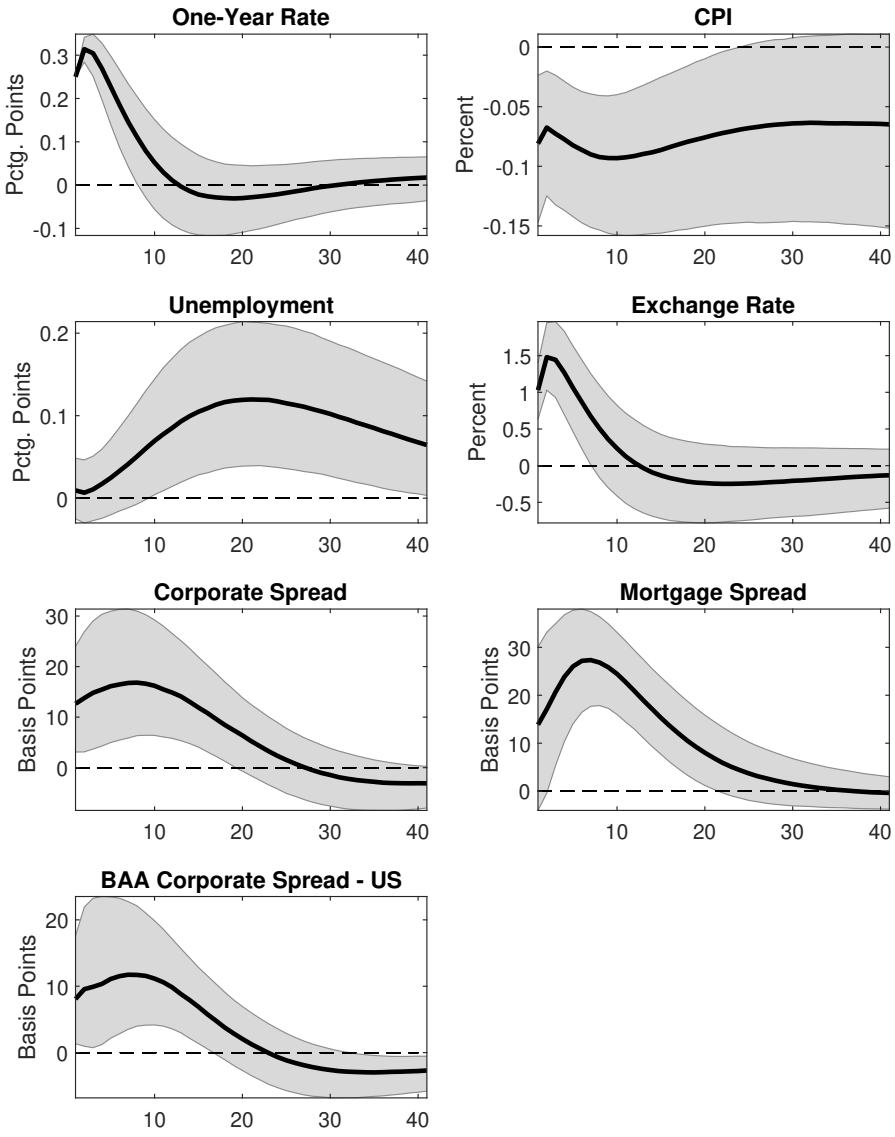

Figure S14 IRFs To A Monetary Policy Shock - Baseline Specification - Sum of Daily Surprises. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 26.2 and $R^2 = 0.09$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

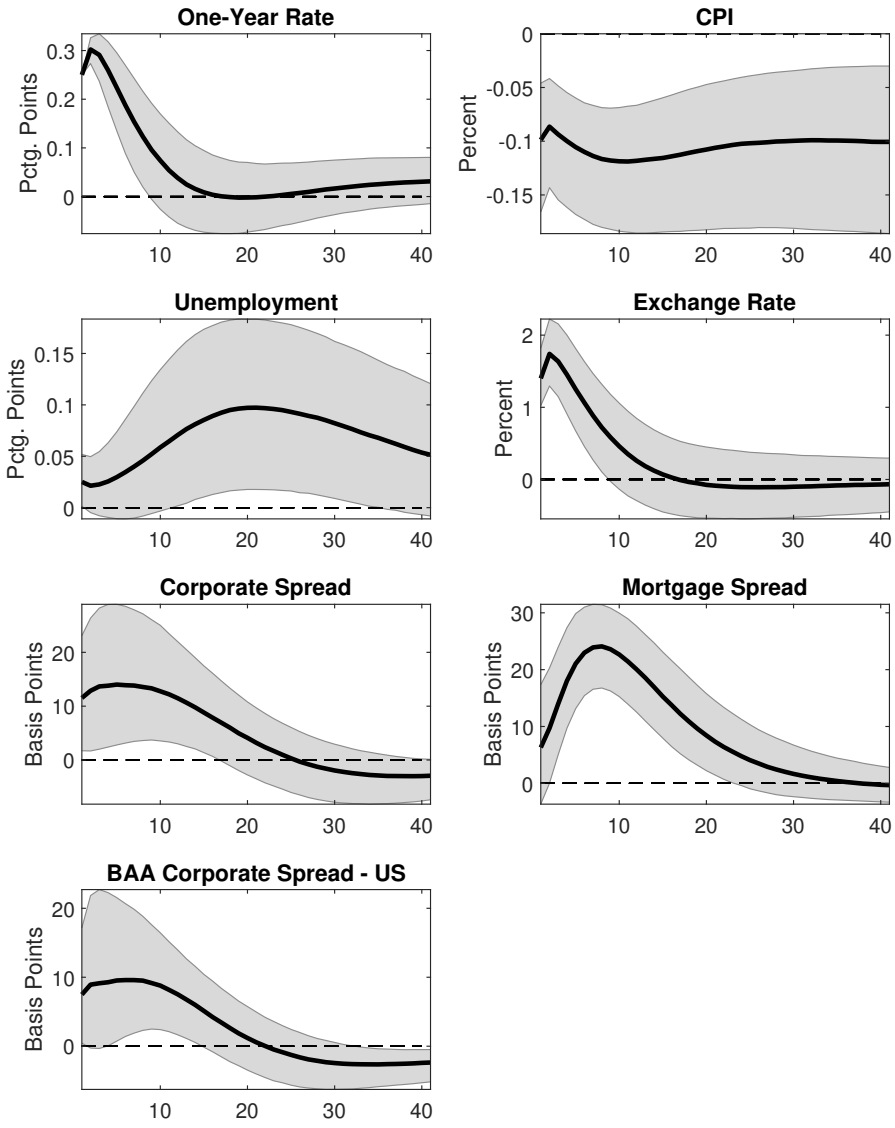

Figure S15 IRFs To A Monetary Policy Shock - Baseline Specification - Alternative Instrument. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the fourth front contract of 3-month Sterling future. First stage results: F-Statistic: 29.1 and $R^2 = 0.12$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

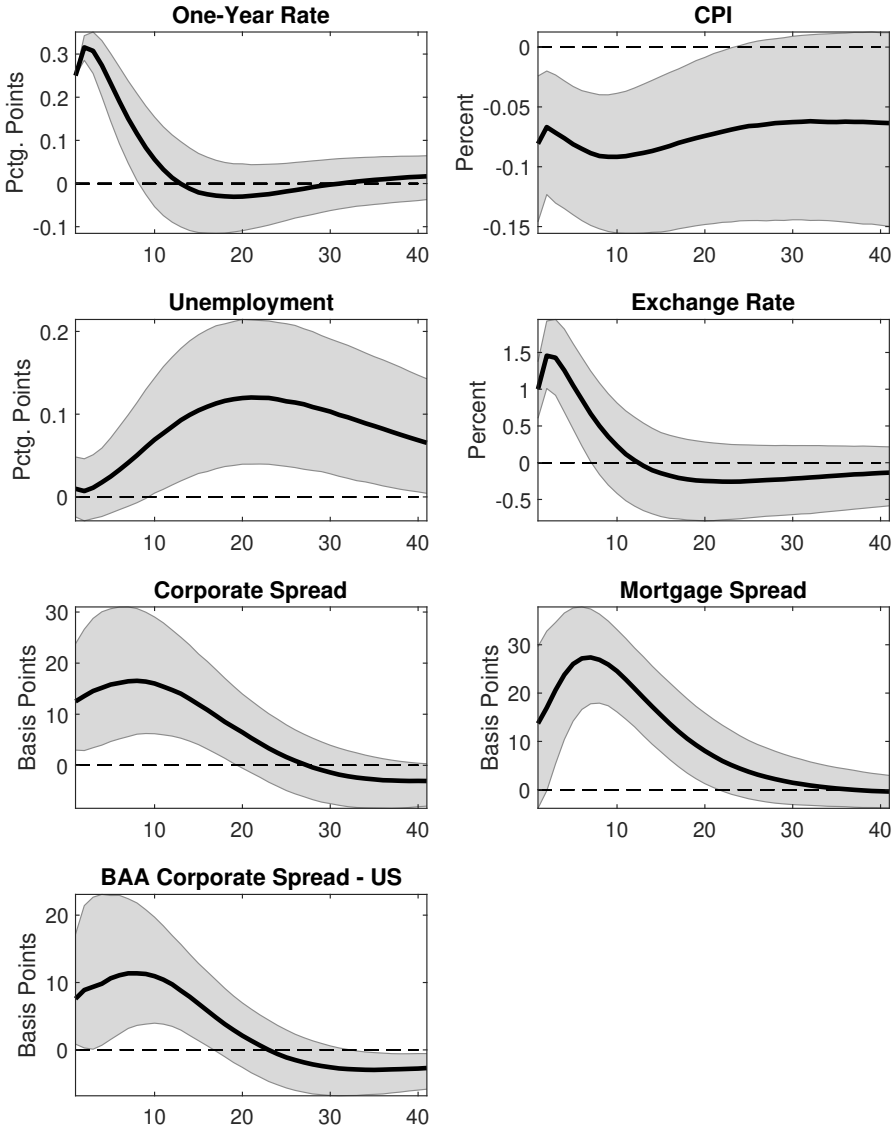

Figure S16 IRFs To A Monetary Policy Shock - Baseline Specification - Excluding Extraordinary MPC Meetings. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the second front contract of 3-month Sterling future. First stage results: F-Statistic: 26.1 and $R^2 = 0.09$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

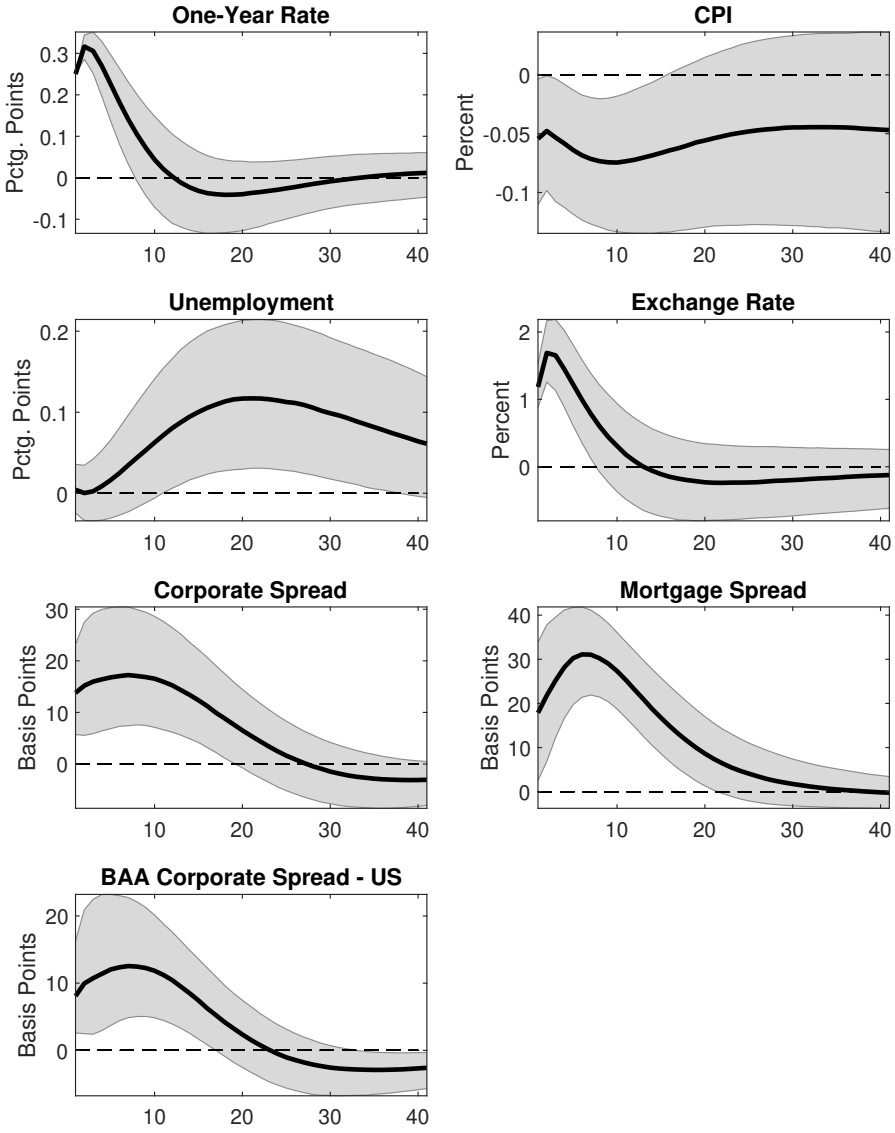

Figure S17 IRFs To A Monetary Policy Shock - Baseline Specification - Only MPC interest rate decisions. *Note.* VAR estimated in log levels, with 2 lags and a constant over the 1992:1-2015:1 period. The 1-year Government Gilt Yield is instrumented using the third front contract of 3-month Sterling future. First stage results: F-Statistic: 32.8 and $R^2 = 0.09$. The solid line and shaded areas report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

D Overidentification test

This section presents additional results for the overidentification test. First, we perform the overidentification test using the original series of Cloyne and Hurtgen (2016), which end in December 2007. We cannot reject the null hypothesis in this case, with the lowest p-value being 0.49. Figure S18 reports the IRFs for the overidentified system using as instruments this series of shocks together with the high-frequency surprises over the common sample (1997:6-2007:12).

Second, we perform the overidentification test but using GDP instead of unemployment in the baseline specification. We also cannot reject the null hypothesis in this case, with the lowest p-value being 0.3. Figure S19 reports the IRFs for the overidentified system using as instruments the high-frequency monetary policy surprises and the extended series of Cloyne and Hurtgen (2016) over the common sample (1997:6-2009:2).

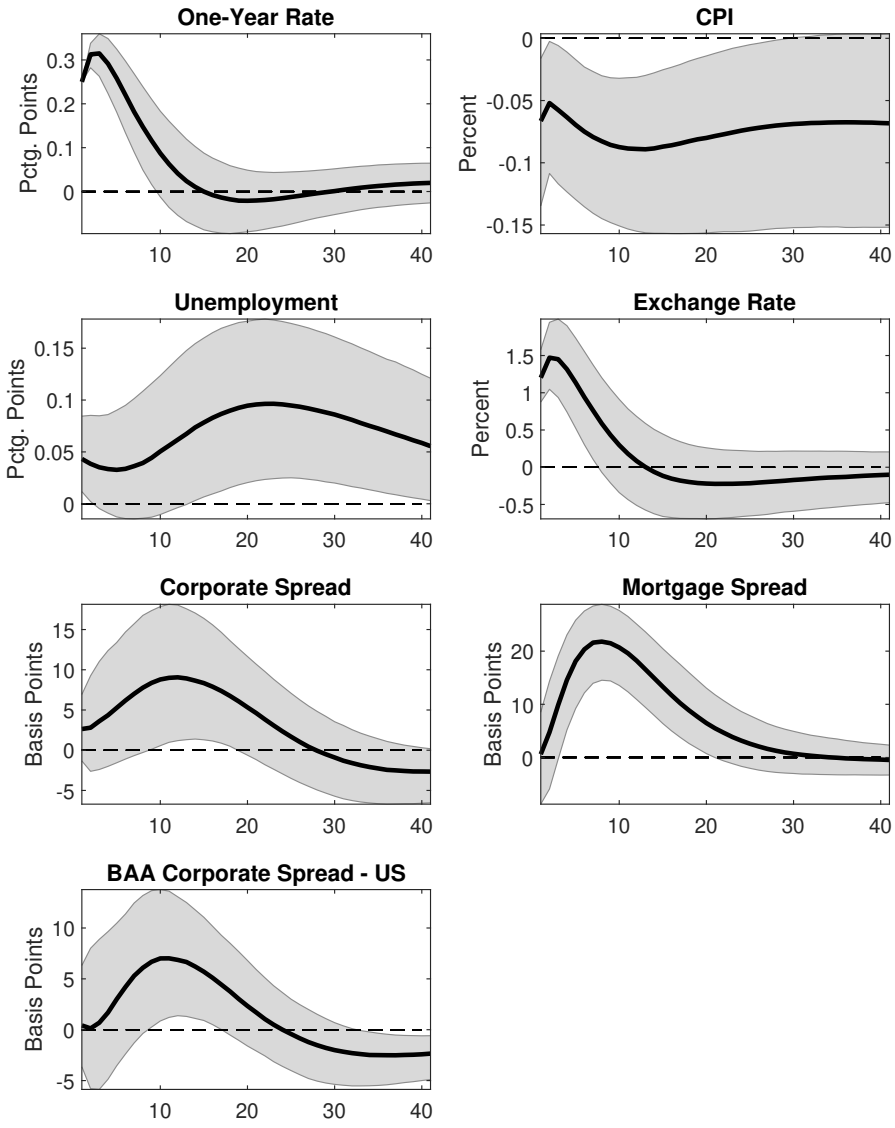

Figure S18 IRFs To A Monetary Policy Shock - 2 Instruments - Cloyne and Hurtgen (2016) original series *Note.* VAR estimated in log levels, with 2 lags, and a constant over the period 1992:1-2015:1. The IRFs are computed using the first column of B matrix from equation (10). First stage results: F-Statistic: 13.2 and $R^2 = 0.15$. The solid and dashed lines report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

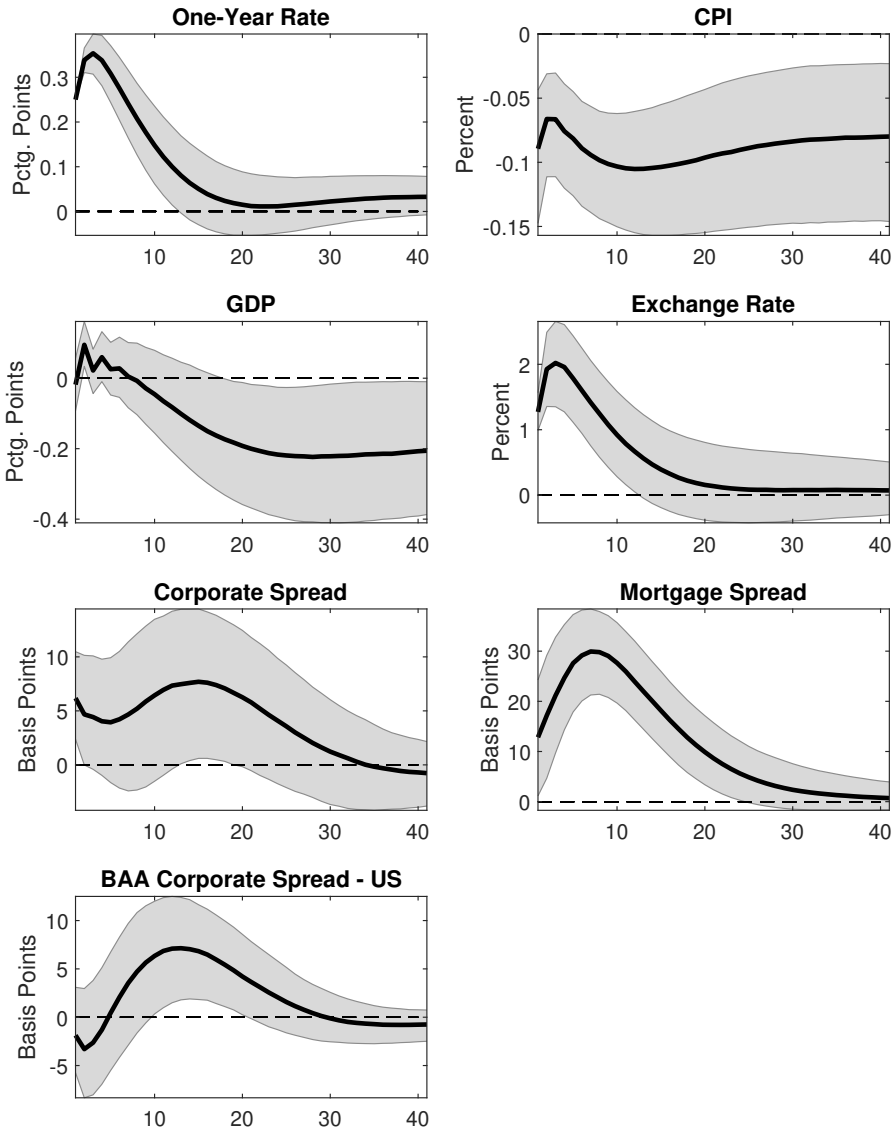

Figure S19 IRFs To A Monetary Policy Shock - 2 Instruments - GDP *Note*. VAR estimated in log levels, with 2 lags, and a constant over the period 1992:1-2015:1. The IRFs are computed using the first column of B matrix from equation (10). First stage results: F-Statistic: 22.2 and $R^2 = 0.16$. The solid and dashed lines report the mean and the 68% confidence intervals computed using moving block bootstrap with 5,000 replications.

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