

ONLINE APPENDIX (NOT INTENDED FOR PUBLICATION):  
DECOMPOSING THE EFFECTS OF MONETARY POLICY USING AN EXTERNAL  
INSTRUMENTS SVAR

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## IDENTIFICATION WITH EXTERNAL INSTRUMENTS

**SETUP FOR BASELINE IDENTIFICATION STRATEGY** The reduced-form covariance matrix in equation 2.2 is given by

$$\Sigma = \begin{pmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{pmatrix}$$

The instrumental variables estimation gives

$$B_{21}B_{11}^{-1} = E[Z_t u_t^p]^{-1} E[Z_t u_t^q]$$

With these two, we can calculate the following matrices

$$\begin{aligned} B_{12}B_{22}^{-1} &= \left[ (B_{12}B'_{12}(B_{21}B_{11}^{-1})') + (\Sigma_{21} - B_{21}B_{11}^{-1}\Sigma_{11})' \right] (B_{22}B_{22}^{-1}') \\ B_{12}B'_{12} &= (\Sigma_{21} - B_{21}B_{11}^{-1}\Sigma_{11})' Z^{-1} (\Sigma_{21} - B_{21}B_{11}^{-1}\Sigma_{11}) \\ B_{22}B'_{22} &= \Sigma_{22} + B_{21}B_{11}^{-1} (B_{12}B'_{12} - \Sigma_{11}) (B_{21}B_{11}^{-1})' \\ B_{11}B'_{11} &= \Sigma_{11} - B_{12}B'_{12} \\ Z &= B_{21}B_{11}^{-1}\Sigma_{11} (B_{21}B_{11}^{-1})' - \left( \Sigma_{21} (B_{21}B_{11}^{-1})' + B_{21}B_{11}^{-1}\Sigma'_{21} \right) + \Sigma_{22} \end{aligned}$$

The approach in Mertens and Ravn (2013) relies on estimating the matrix  $S_1$  which is related to the above estimable matrices in the following manner

$$S_1 S'_1 = (I - B_{12}B_{22}^{-1}B_{21}B_{11}^{-1}) B_{11}B'_{11} (I - B_{12}B_{22}^{-1}B_{21}B_{11}^{-1})'$$

In the case of 1 shock and 1 instrument, we can identify  $S_1$  up to a sign convention from the above equation. With more than 1 shock,  $S_1$  is not identified without further restrictions. As explained in section 2.1 in the main draft, the baseline identification strategy involves imposing a triangular structure on  $S_1$ , such that a Cholesky factorization of the above equation gives  $S_1$ . With  $S_1$  in hand, we can get

the relevant column of the impact matrix  $B_1 = \begin{bmatrix} B'_{11} & B'_{21} \end{bmatrix}$  from the following two equations

$$\begin{aligned} B_{11}S_1^{-1} &= (I - B_{12}B_{22}^{-1}B_{21}B_{11}^{-1})^{-1} \\ B_{21}S_1^{-1} &= B_{21}B_{11}^{-1}(I - B_{12}B_{22}^{-1}B_{21}B_{11}^{-1})^{-1} \end{aligned}$$

**SETUP FOR ALTERNATIVE IDENTIFICATION STRATEGY** The alternative identification strategy imposes zero restrictions on the relationship between the structural policy shocks and the instruments. We derive the estimating equations using the approach of Lunsford (2015). Recall the relevance and validity conditions of the instrument,  $E[Z_t\varepsilon_t^p] = \phi$  and  $E[Z_t\varepsilon_t^q] = 0$  and that the covariance matrix of the residuals is given by  $E(u_tu_t') = BB'$ .

Now consider  $E(Z_tu_t')$

$$\begin{aligned} E(Z_tu_t') &= E(Z_t[B\varepsilon_t]') \\ &= E\left(Z_t \begin{bmatrix} B_1 & B_2 \end{bmatrix} \begin{pmatrix} \varepsilon_t^p \\ \varepsilon_t^q \end{pmatrix}\right)' \\ &= E\left[\begin{pmatrix} Z_t\varepsilon_t^p \\ Z_t\varepsilon_t^q \end{pmatrix} (B_1 \ B_2)'\right] \\ &= E\left[\begin{pmatrix} \phi \\ 0 \end{pmatrix} (B_1 \ B_2)'\right] \\ &= \phi B'_1 \end{aligned}$$

Finally consider  $E(Z_tu_t') [E(u_tu_t')]^{-1} E(u_tZ_t')$

$$\begin{aligned} E(Z_tu_t') [E(u_tu_t')]^{-1} E(u_tZ_t') &= \phi B'_1 (BB')^{-1} B_1 \phi' \\ &= \phi B'_1 (B')^{-1} B^{-1} B_1 \phi' \\ &= \phi \phi' \end{aligned}$$

If we have an estimate of  $\phi$ , we can back out the relevant columns of the impact matrix  $B$ , which is  $B_1$

$$B_1 = E(u_t Z_t') (\phi')^{-1}$$

Again, if there is only one shock then  $\phi$  is a scalar and we can estimate it up to a sign convention. But if there are  $k > 1$  shocks (and instruments) then  $\phi$  has  $k^2$  unique elements, while  $E(Z_t u_t') [E(u_t u_t')]^{-1} E(u_t Z_t')$  is a symmetric matrix with only  $\frac{k(k+1)}{2}$  unique elements. The second strategy involves putting zero restrictions on  $\phi$ . We assume that  $\phi$  is triangular and thus a Cholesky factorization of  $\phi\phi'$  gives  $\phi$ . The interpretation of a zero restriction on  $\phi$  is straightforward from the relevance condition of the instruments. A zero restriction on the row  $i$  column  $j$  element in  $\phi$  implies that the  $j^{\text{th}}$  structural policy shock in  $\varepsilon_t^p$  is uncorrelated with the  $i^{\text{th}}$  instrument in  $Z_t$ . For the application in this paper we will use two instruments,  $Z_t = [Z_t^1 \quad Z_t^2]'$ . We can now re-write the relevance condition as

$$E \begin{pmatrix} Z_t^1 \varepsilon_t^{ff} & Z_t^1 \varepsilon_t^{fwd} \\ Z_t^2 \varepsilon_t^{ff} & Z_t^2 \varepsilon_t^{fwd} \end{pmatrix} = \begin{pmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{pmatrix}$$

Thus a triangular identifying assumption that imposes  $\phi_{21} = 0$  implies that  $E[Z_t^2 \varepsilon_t^{ff}] = 0$ . This assumption is justified by finding an instrument  $Z_2$  that is uncorrelated with the fed funds rate shock but correlated with the forward guidance shock. Specifically, we will use high frequency futures market data and apply the methodology of GSS. This involves performing a rotation of the principal components to construct a factor that satisfies the above requirement. This factor (labeled the path factor) captures shocks in longer term rates but is uncorrelated to fed funds rate shocks. The construction of the instruments is discussed in more detail next.

**TARGET AND PATH FACTOR CONSTRUCTION** The goal is to construct two new factors  $Z_1$  and  $Z_2$  from the first two principal components  $F_1$  and  $F_2$  by finding an orthogonal matrix  $U$

$$[Z_1 \quad Z_2] = [F_1 \quad F_2]U \tag{0.1}$$

$U$  matrix has 4 unique elements and requires 4 restrictions for identification

$$U = \begin{pmatrix} \alpha_1 & \beta_1 \\ \alpha_2 & \beta_2 \end{pmatrix}$$

The first two come from a simple normalization that imposes the columns of  $U$  to have unit length, i.e.  $\alpha_1^2 + \alpha_2^2 = 1$  and  $\beta_1^2 + \beta_2^2 = 1$ . Next, we maintain the orthogonality of the two factors  $E(Z_1 Z_2) = 0$ , which gives  $\alpha_1 \beta_1 + \alpha_2 \beta_2 = 0$ . Finally we impose the condition required for identification strategy II, that the second factor  $Z_2$  is not related to the current month's futures price change. This condition is given by  $\gamma_2 \alpha_1 - \gamma_1 \alpha_2 = 0$ . To see this last condition, let  $\gamma_1$  and  $\gamma_2$  be the factor loadings on  $F_1$  and  $F_2$  for change in current month's futures contract (given by  $X(1)$ )

$$X(1) = \gamma_1 F_1 + \gamma_2 F_2 \tag{0.2}$$

From equation 0.1 we can write

$$\begin{aligned} F_1 &= \frac{1}{\alpha_1 \beta_2 - \alpha_2 \beta_1} [\beta_2 Z_1 - \alpha_2 Z_2] \\ F_2 &= \frac{1}{\alpha_1 \beta_2 - \alpha_2 \beta_1} [-\beta_1 Z_1 + \alpha_1 Z_2] \end{aligned}$$

Now plug these into equation 0.2 and impose the condition that the loading of  $Z_2$  on  $X(1)$  is zero to get the restriction  $\gamma_2 \alpha_1 - \gamma_1 \alpha_2 = 0$ .

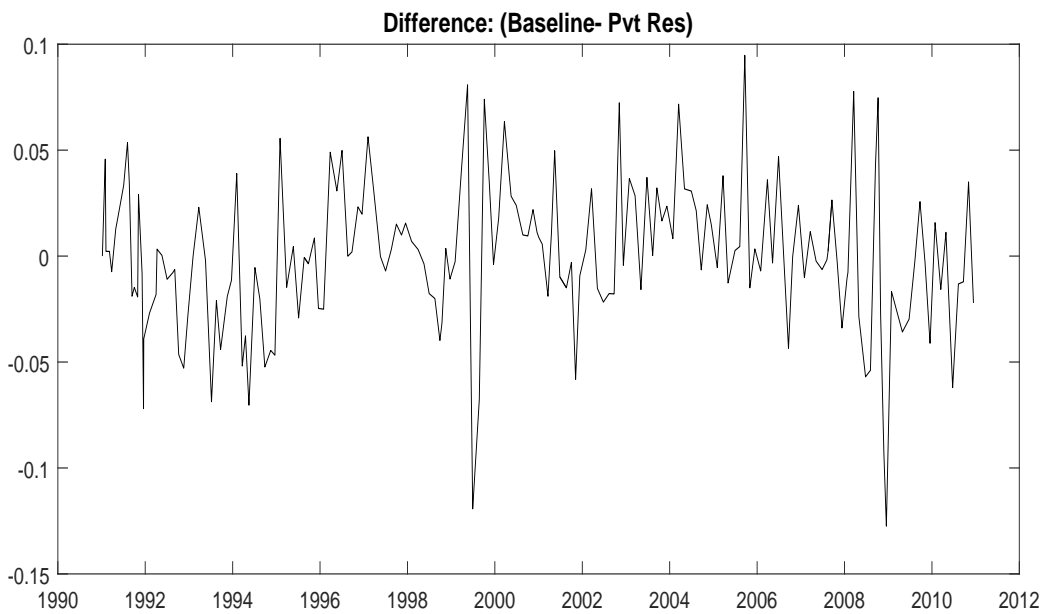
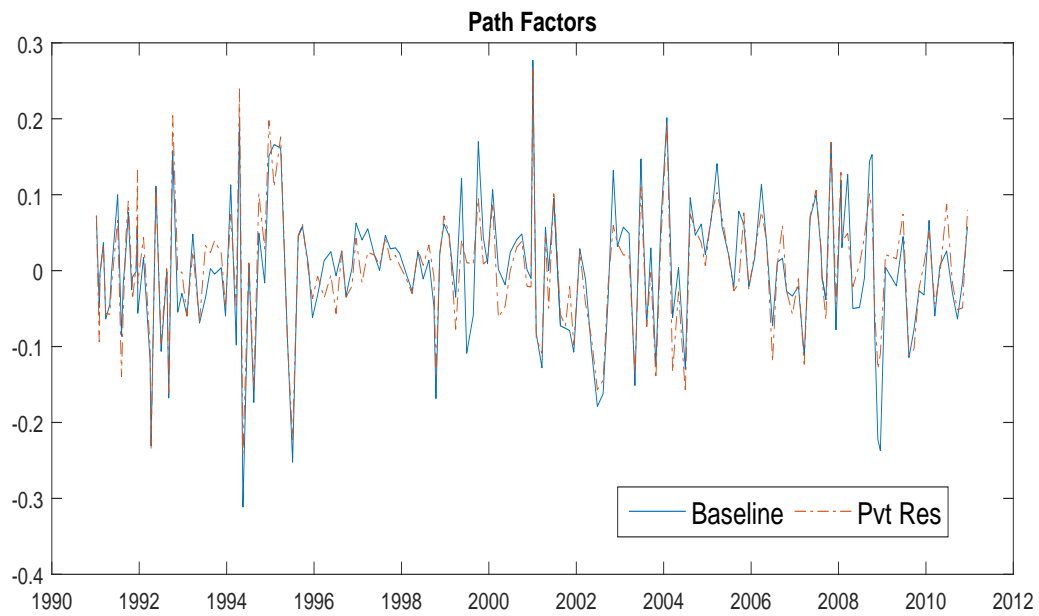


Figure 1: The top panel shows the path factors from the baseline specification (solid blue line) and the residual after controlling for Fed private info (dashed red line). The bottom panel shows the difference between the two series.

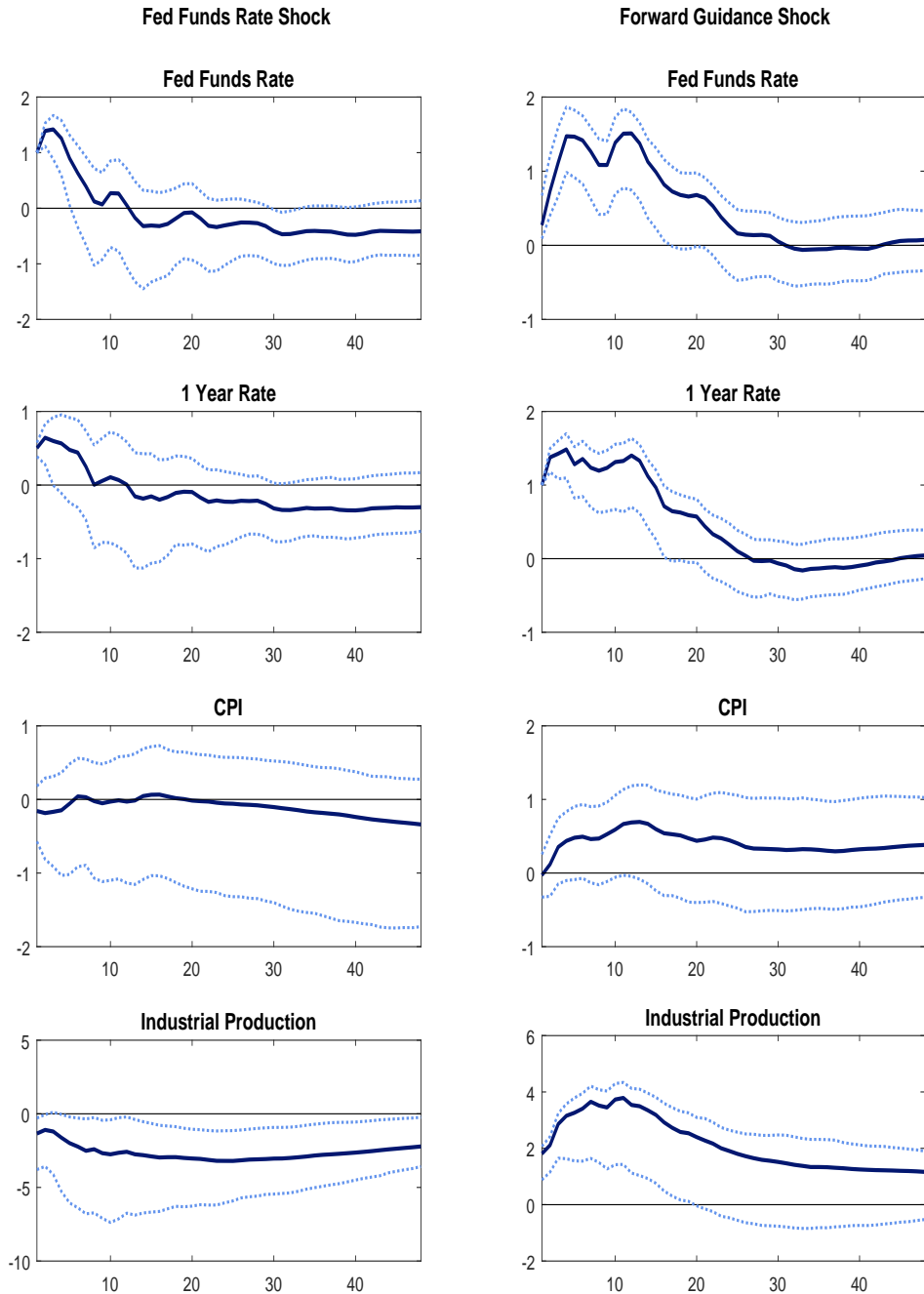


Figure 2: **Tight 30 minute window.** The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The monetary surprises are constructed using a 30 minute window around FOMC announcements. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

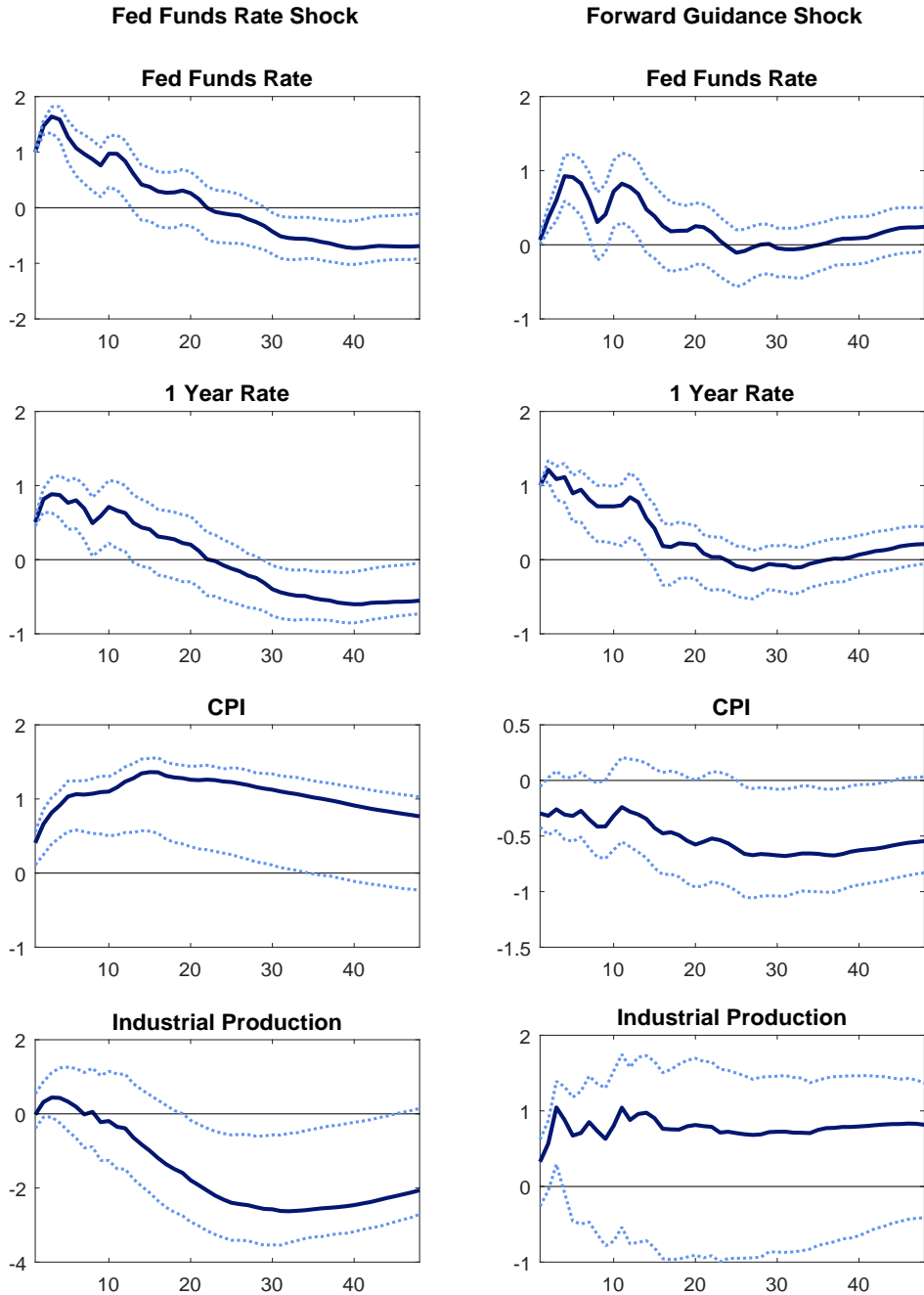


Figure 3: **Two day window**. The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The monetary surprises are constructed using a two day window around FOMC announcements. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)



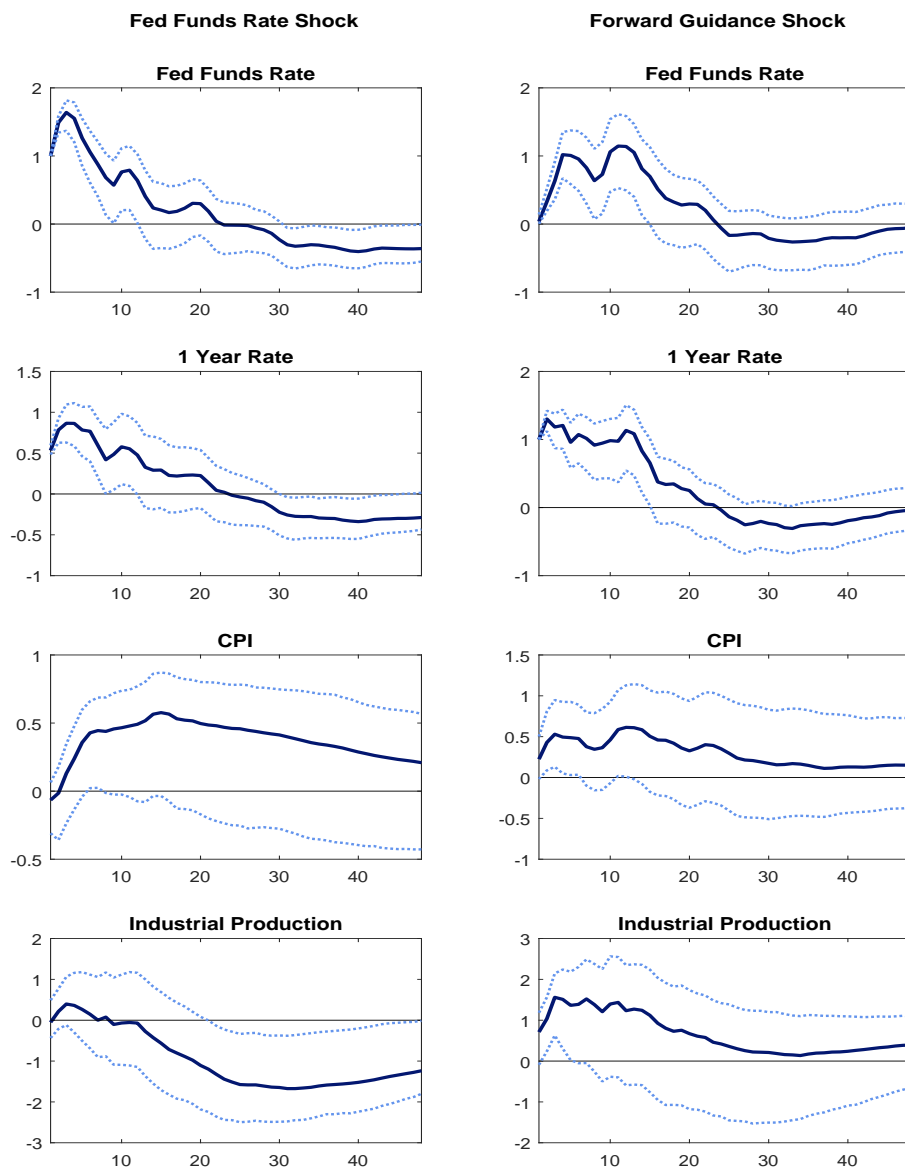


Figure 4: **Sample: July 1979 to November 2015** The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e. shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

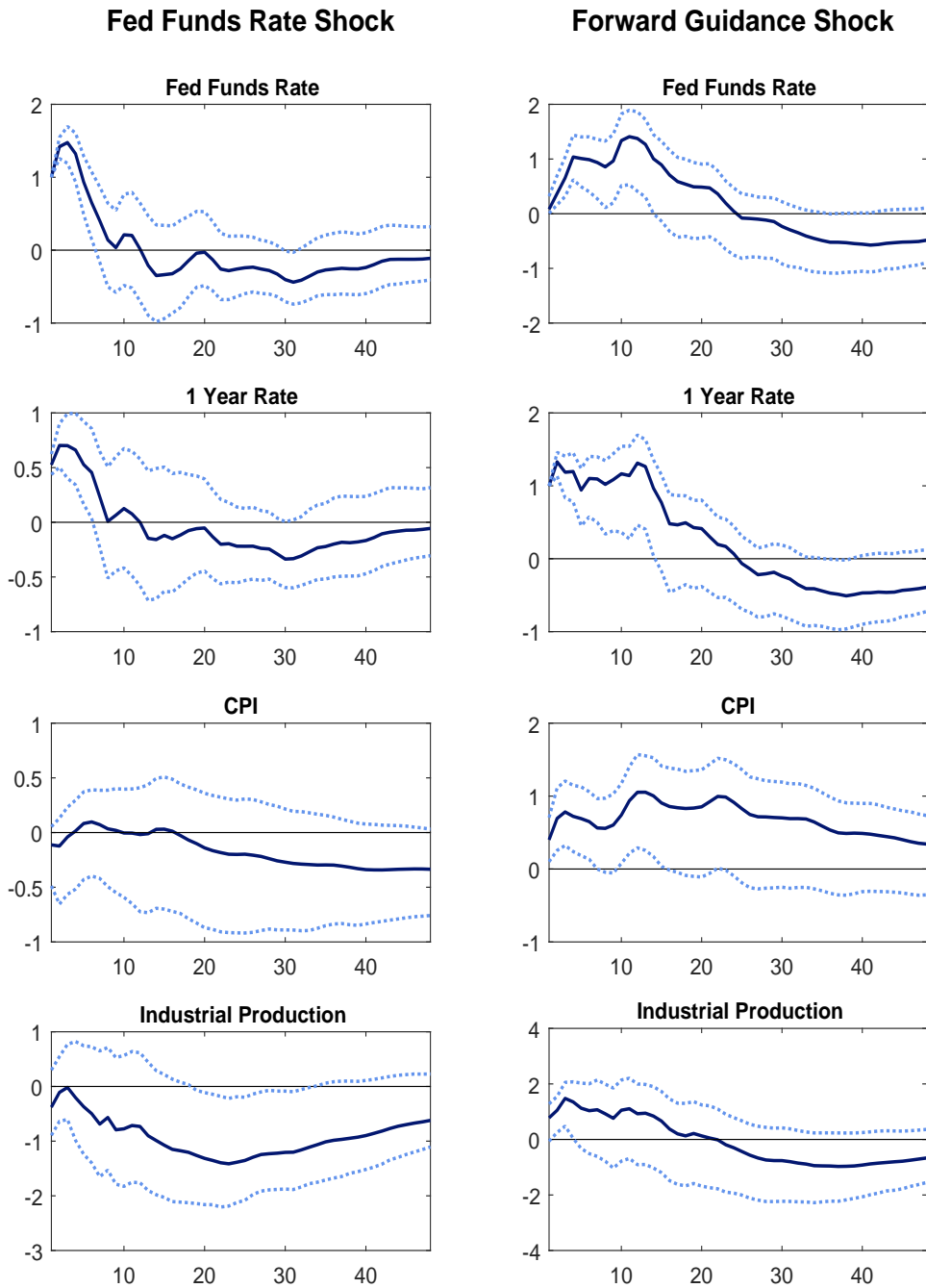


Figure 5: **Sample: July 1979 to December 2008.** The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

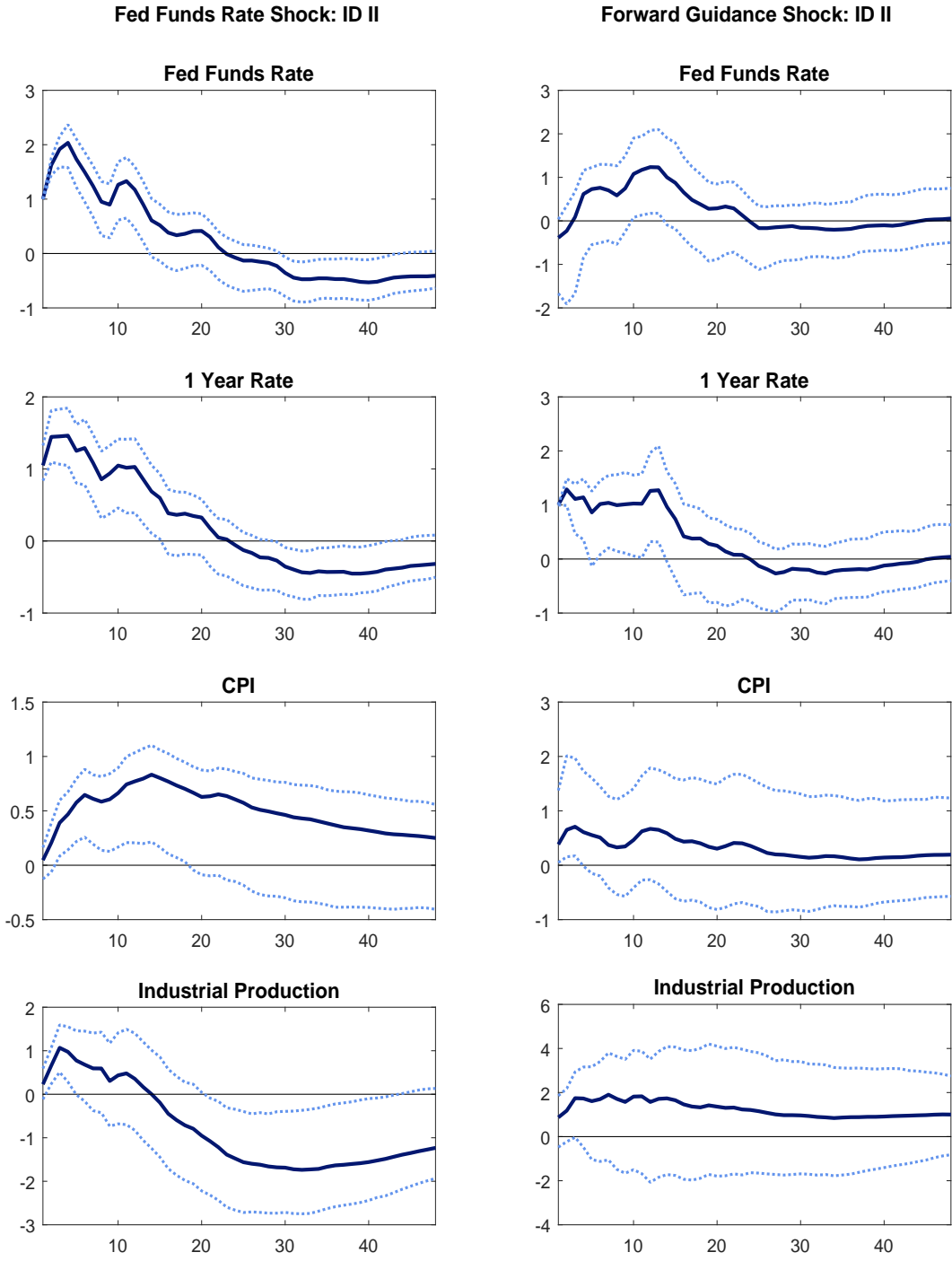


Figure 6: The impulse responses to a unit monetary policy shock identified using the external instruments alternate identification strategy, with 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

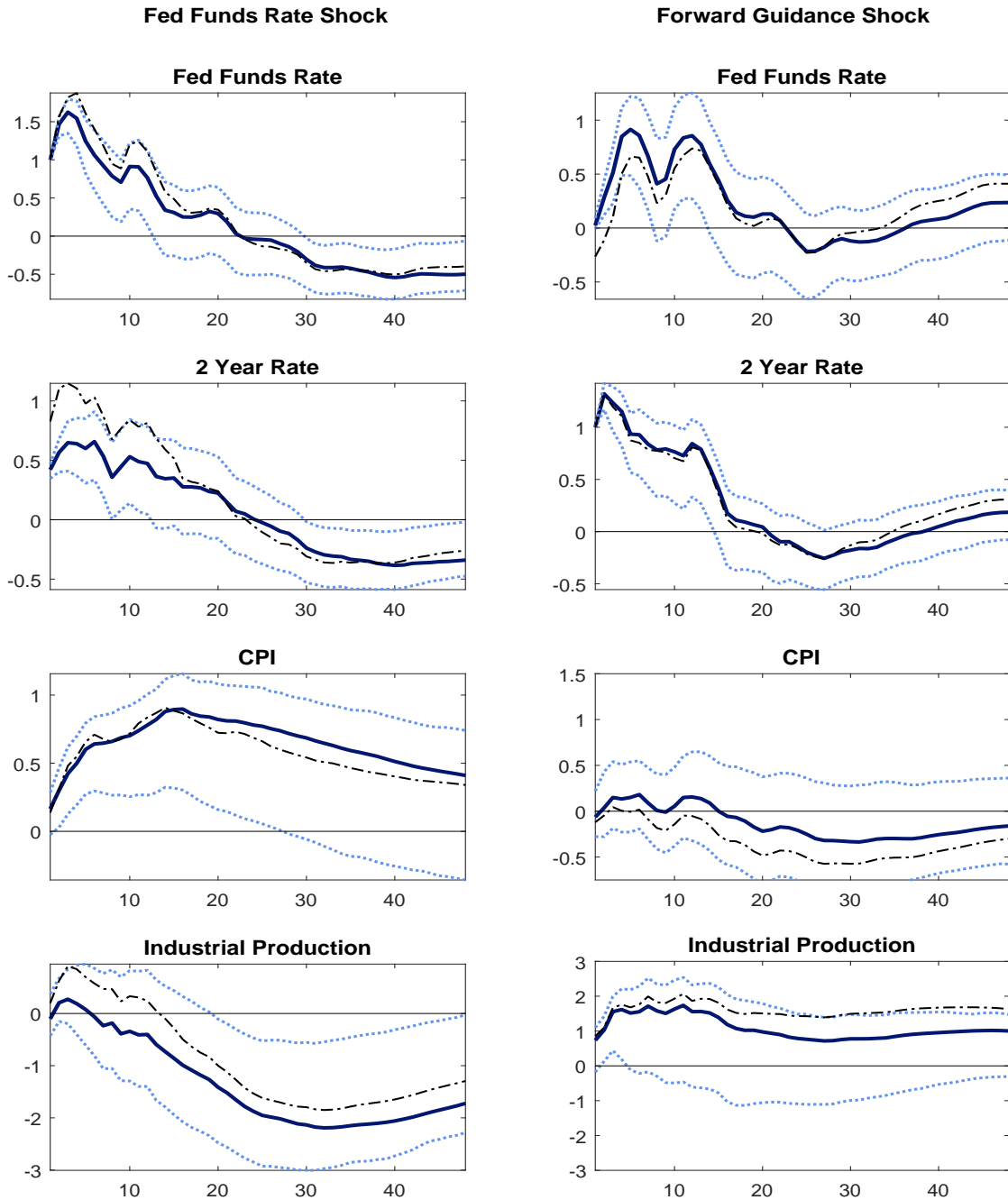


Figure 7: Impulse responses to a unit monetary policy shock with the 2 year rate as the forward guidance policy tool. The solid blue lines show responses using identification strategy I, with the dashed blue lines showing the 90% confidence intervals. The dashed black lines show the responses using identification strategy II. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation).

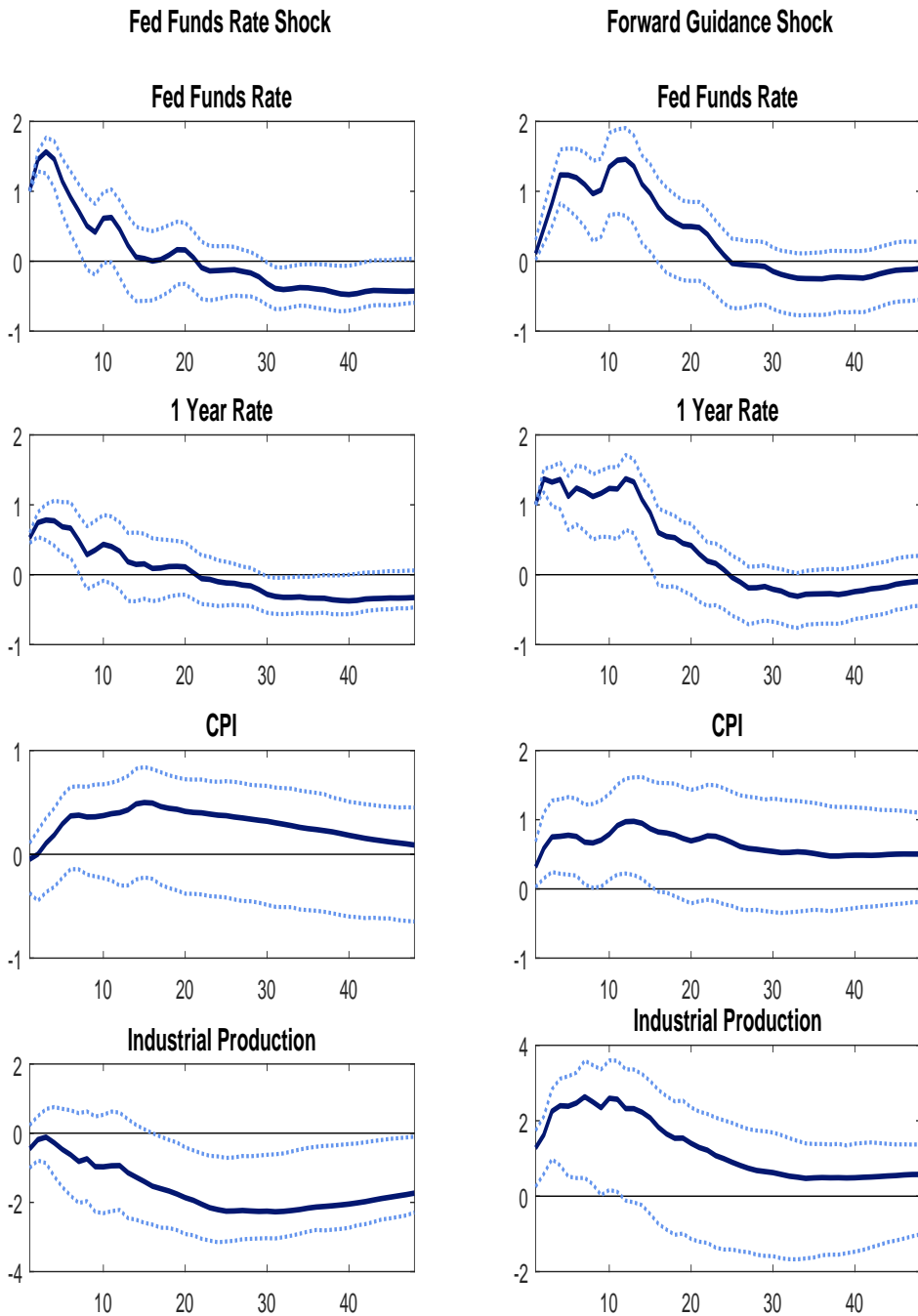


Figure 8: **Futures Data Sample: February 1994 to December 2011.** The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

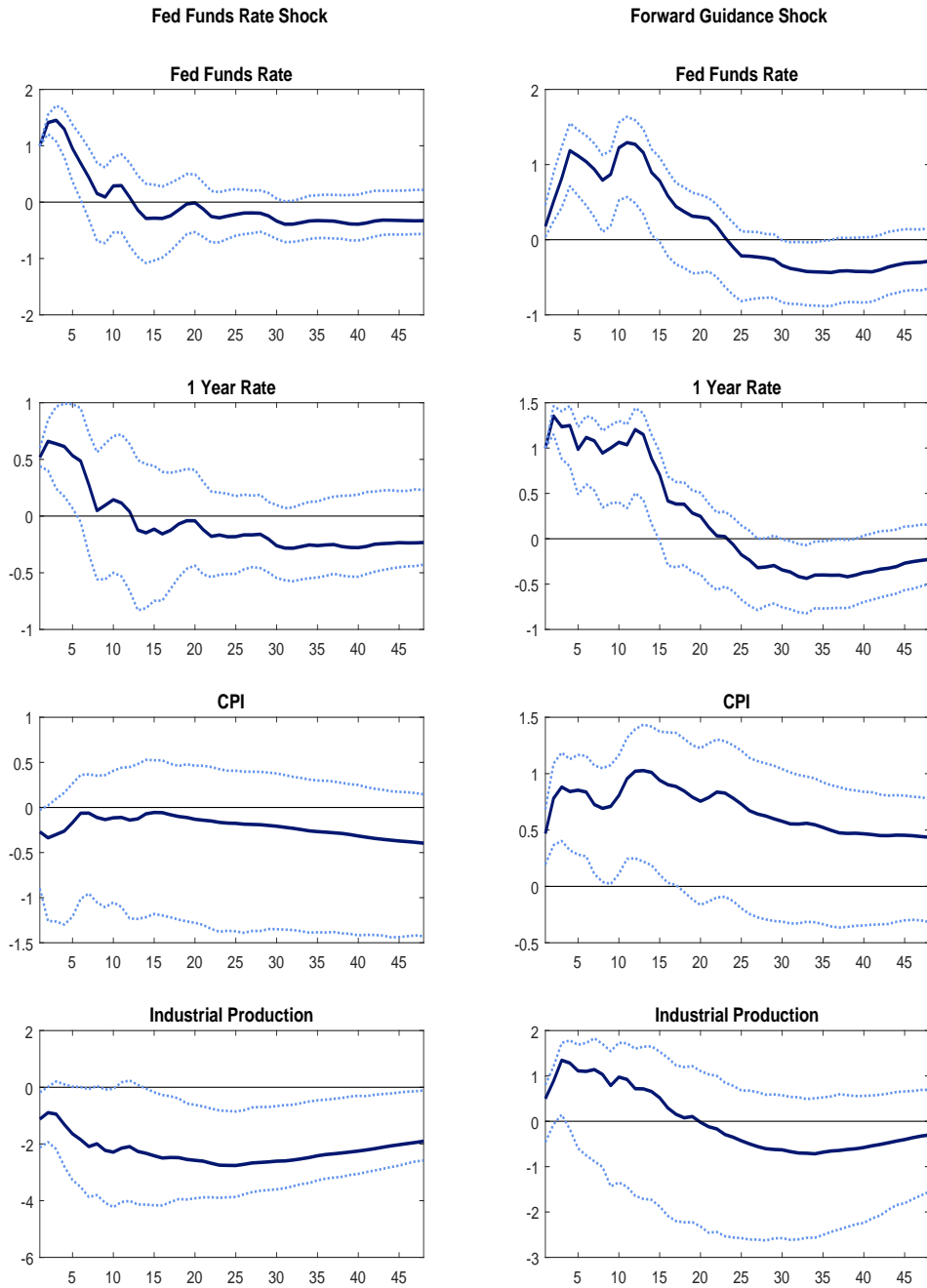


Figure 9: The impulse responses to a unit monetary policy shock identified using the external instruments identification strategy I outlined in the text, with 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation). The daily futures shock series is aggregated to a monthly series by weighing it based on which day of the month the FOMC meeting occurred. If the FOMC meeting occurs in the final 5 days of the month, then the shock is assigned to the next month.

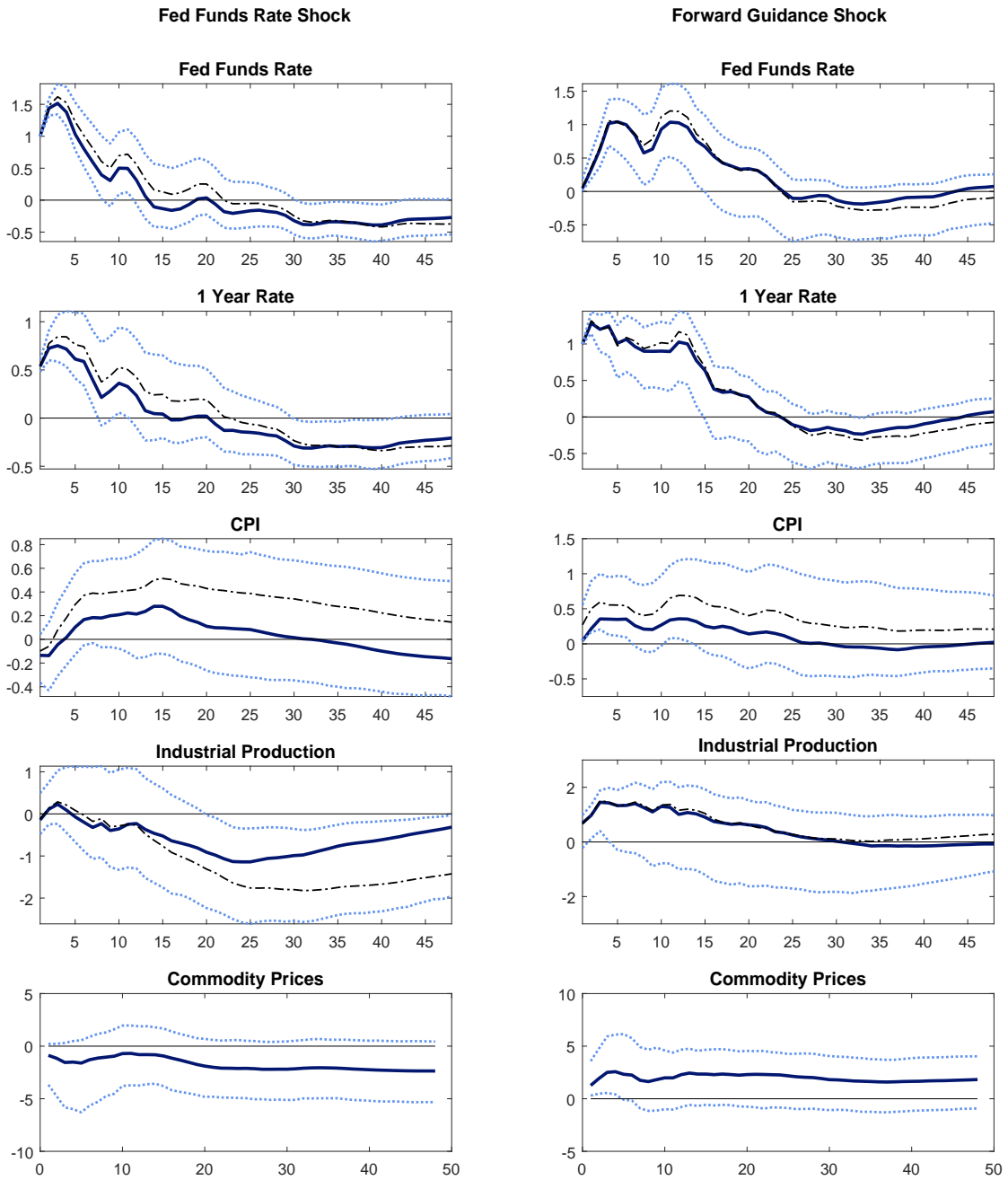


Figure 10: The solid blue lines show the impulse responses to a unit monetary policy shock for the VAR with commodity prices added to the baseline specification, using identification strategy I. The dashed black lines show the responses from the baseline specification. The dashed blue lines show the 90% confidence intervals. The first column shows the response to a conventional monetary policy shock (i.e. shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation)

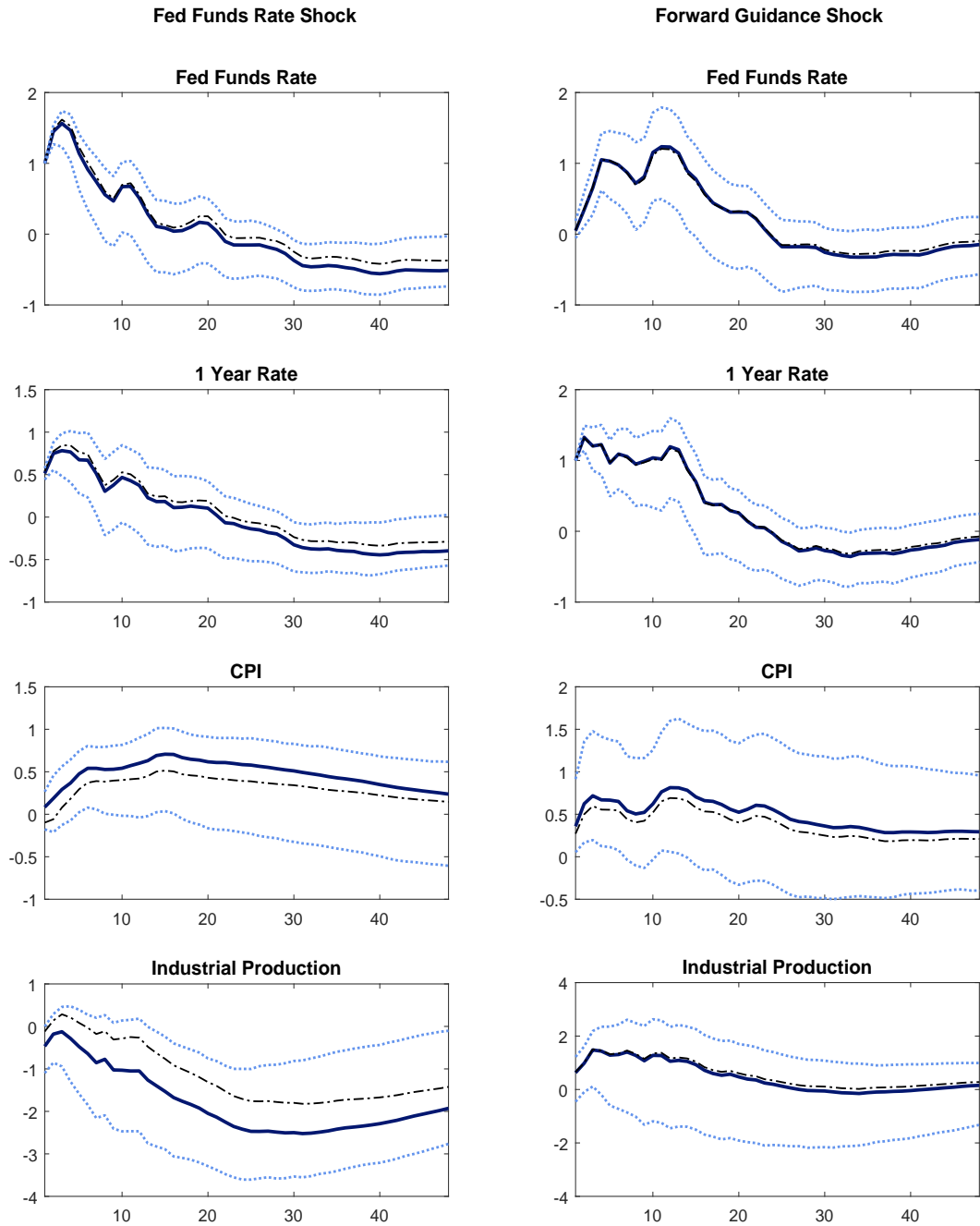


Figure 11: The impulse responses to a unit monetary policy shock with 90% confidence intervals. The solid blue lines show the responses where only the scheduled FOMC meetings are used, while the dashed black line shows the baseline specification with both scheduled and unscheduled meetings. The first column shows the response to a conventional monetary policy shock (i.e shock to the federal funds rate equation), while the second column shows the response to a forward guidance shock (i.e. shock to the 1 year rate equation).



FOMC Meeting	Sched?	Stat?	FOMC Meeting	Sched?	Stat?	FOMC Meeting	Sched?	FOMC Meeting	Sched?	Stat?
1/8/1991	0	0	7/3/1996	1	0	11/6/2002	1	3/18/2009	1	1
2/1/1991	0	0	8/20/1996	1	0	12/10/2002	1	4/29/2009	1	1
2/7/1991	1	0	9/24/1996	1	0	1/29/2003	1	6/24/2009	1	1
3/8/1991	0	0	11/13/1996	1	0	3/18/2003	1	8/12/2009	1	1
3/27/1991	1	0	12/17/1996	1	0	5/6/2003	1	9/23/2009	1	1
4/30/1991	0	0	2/5/1997	1	0	6/25/2003	1	11/4/2009	1	1
5/15/1991	1	0	3/25/1997	1	1	8/12/2003	1	12/16/2009	1	1
7/5/1991	1	0	5/20/1997	1	0	9/16/2003	1	1/27/2010	1	1
8/6/1991	0	0	7/2/1997	1	0	10/28/2003	1	3/16/2010	1	1
8/21/1991	1	0	8/19/1997	1	0	12/9/2003	1	4/28/2010	1	1
9/13/1991	0	0	9/30/1997	1	0	1/28/2004	1	6/23/2010	1	1
10/2/1991	1	0	11/12/1997	1	0	3/16/2004	1	8/10/2010	1	1
10/30/1991	0	0	12/16/1997	1	0	5/4/2004	1	9/21/2010	1	1
11/6/1991	1	0	2/4/1998	1	0	6/30/2004	1	11/3/2010	1	1
12/6/1991	0	0	3/31/1998	1	0	8/10/2004	1	12/14/2010	1	1
12/18/1991	1	0	5/19/1998	1	0	9/21/2004	1	1/26/2011	1	1
12/20/1991	0	0	7/1/1998	1	0	11/10/2004	1	3/15/2011	1	1
2/6/1992	1	0	8/18/1998	1	0	12/14/2004	1	4/27/2011	1	1
4/1/1992	1	0	9/29/1998	1	1	2/2/2005	1	6/22/2011	1	1
4/9/1992	0	0	10/15/1998	0	1	3/22/2005	1	8/9/2011	1	1
5/20/1992	1	0	11/17/1998	1	1	5/3/2005	1	9/21/2011	1	1
7/2/1992	1	0	12/22/1998	1	0	6/30/2005	1	11/2/2011	1	1
8/19/1992	1	0	2/3/1999	1	0	8/9/2005	1	12/13/2011	1	1
9/4/1992	0	0	3/30/1999	1	0	9/20/2005	1	1/25/2012	1	1
10/7/1992	1	0	5/18/1999	1	1	11/1/2005	1	3/13/2012	1	1
11/18/1992	1	0	6/30/1999	1	1	12/13/2005	1	4/25/2012	1	1
12/23/1992	1	0	8/24/1999	1	1	1/31/2006	1	6/20/2012	1	1
2/4/1993	1	0	10/5/1999	1	1	3/28/2006	1	8/1/2012	1	1
3/24/1993	1	0	11/16/1999	1	1	5/10/2006	1	9/13/2012	1	1
5/19/1993	1	0	12/21/1999	1	1	6/29/2006	1	10/24/2012	1	1
7/8/1993	1	0	2/2/2000	1	1	8/8/2006	1	12/12/2012	1	1
8/18/1993	1	0	3/21/2000	1	1	9/20/2006	1	1/30/2013	1	1
9/22/1993	1	0	5/16/2000	1	1	10/25/2006	1	3/20/2013	1	1
11/17/1993	1	0	6/28/2000	1	1	12/12/2006	1	5/1/2013	1	1
12/22/1993	1	0	8/22/2000	1	1	1/31/2007	1	6/19/2013	1	1
2/4/1994	1	1	10/3/2000	1	1	3/21/2007	1	7/31/2013	1	1
3/22/1994	1	1	11/15/2000	1	1	5/9/2007	1	9/18/2013	1	1
4/18/1994	0	1	12/19/2000	1	1	6/28/2007	1	10/30/2013	1	1
5/17/1994	1	1	1/3/2001	0	1	8/7/2007	1	12/18/2013	1	1
7/6/1994	1	0	1/31/2001	1	1	8/17/2007	0	1/29/2014	1	1
8/16/1994	1	1	3/20/2001	1	1	9/18/2007	1	3/19/2014	1	1
9/27/1994	1	0	4/18/2001	0	1	10/31/2007	1	4/30/2014	1	1
11/15/1994	1	1	5/15/2001	1	1	12/11/2007	1	6/18/2014	1	1
12/20/1994	1	0	6/27/2001	1	1	1/22/2008	0	7/30/2014	1	1
2/1/1995	1	1	8/21/2001	1	1	1/30/2008	1	9/17/2014	1	1
3/28/1995	1	0	9/17/2001	0	1	3/18/2008	1	10/29/2014	1	1
5/23/1995	1	0	10/2/2001	1	1	4/30/2008	1	12/17/2014	1	1
7/6/1995	1	1	11/6/2001	1	1	6/25/2008	1	1/28/2015	1	1
8/22/1995	1	0	12/11/2001	1	1	8/5/2008	1	3/18/2015	1	1
9/26/1995	1	0	1/30/2002	1	1	9/16/2008	1	4/29/2015	1	1
11/15/1995	1	0	3/19/2002	1	1	10/8/2008	0	6/17/2015	1	1
12/19/1995	1	1	5/7/2002	1	1	10/29/2008	1	7/29/2015	1	1
1/31/1996	1	1	6/26/2002	1	1	11/25/2008	0	9/17/2015	1	1
3/26/1996	1	0	8/13/2002	1	1	12/16/2008	1	10/28/2015	1	1
5/21/1996	1	0	9/24/2002	1	1	1/28/2009	1	12/16/2015	1	1

Table 1: FOMC meeting dates with a 1 in the “Sched?” (“Stat?”) column indicating a scheduled meeting (released statement) and a 0 indicating an unscheduled meeting (no released statement).

	(a)	(b)	(c)	(d)
VARIABLES	FFR residual	1 year residual	FFR residual	1 year residual
Target Factor	0.662*** (0.134)	0.763*** (0.140)	0.852*** (0.195)	1.032*** (0.235)
Path Factor	-0.168 (0.131)	0.324** (0.161)	-0.217 (0.221)	0.177 (0.330)
Constant	-0.005 (0.010)	0.000 (0.012)	-0.006 (0.010)	-0.000 (0.013)
Observations	252	252	252	252
R-squared	0.106	0.108	0.090	0.082
Adjusted R-squared	0.0991	0.101	0.0830	0.0749
Robust F-statistic	12.49	17.37	10.23	9.777

Table 2: First stage regression of residuals from the reduced form VAR on the target and path factors. Columns (a) and (b) show the results using a 2 day window, while columns (c) and (d) show the results using a 30 minute window. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.809*** (0.128)	0.893*** (0.167)
Path Factor	-0.150 (0.168)	0.310 (0.219)
Constant	-0.006 (0.008)	0.000 (0.011)
Observations	299	299
R-squared	0.115	0.099
Adjusted R-squared	0.109	0.0930
Robust F-statistic	20.75	14.59

Table 3: **Sample: July 1979 to November 2015** : First stage regression of residuals from the reduced form VAR on the target and path factors, from the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

VARIABLES	(1) FFR residual	(2) 1 year residual
Target Factor	0.780*** (0.140)	0.951*** (0.175)
Path Factor	-0.207 (0.188)	0.350 (0.252)
Constant	-0.004 (0.011)	-0.002 (0.014)
Observations	216	216
R-squared	0.121	0.111
Adjusted R-squared	0.113	0.102
Robust F-statistic	16.32	14.95

Table 4: **Sample: July 1979 to December 2008.** : First stage regression of residuals from the reduced form VAR on the target and path factors, from the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

VARIABLES	FFR residual	1 year residual
Target Factor	0.819*** (0.110)	0.724*** (0.172)
Path Factor	-0.033 (0.131)	0.301 (0.191)
Constant	-0.010 (0.007)	-0.002 (0.011)
Observations	252	252
R-squared	0.229	0.093
Adjusted R-squared	0.223	0.0862
Robust F-statistic	27.76	9.422

Table 5: **Sample: July 1984 to December 2011.** : First stage regression of residuals from the reduced form VAR on the target and path factors, from the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.732***	0.792***
	(0.135)	(0.158)
Path Factor	-0.212	0.206
	(0.177)	(0.218)
Constant	-0.008	-0.004
	(0.010)	(0.012)
Observations	252	252
R-squared	0.099	0.080
Adjusted R-squared	0.0919	0.0726
Robust F-statistic	15.37	12.67

Table 6: First stage regression of residuals from the reduced form VAR on the target and path factors, from the model with the excess bond premium added to the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.671***	0.814***
	(0.147)	(0.182)
Path Factor	-0.119	0.356
	(0.163)	(0.233)
Constant	-0.002	0.004
	(0.010)	(0.012)
Observations	252	252
R-squared	0.085	0.088
Adjusted R-squared	0.0776	0.0807
Robust F-statistic	10.67	10.80

Table 7: First stage regression of residuals from the reduced form VAR on the target and path factors, from the model with commodity prices added to the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.798*** (0.146)	0.828*** (0.169)
Path Factor	-0.143 (0.185)	0.309 (0.228)
Constant	-0.005 (0.010)	0.004 (0.013)
Observations	252	252
R-squared	0.106	0.082
Adjusted R-squared	0.0986	0.0750
Robust F-statistic	15.44	12.09

Table 8: First stage regression of residuals from the reduced form VAR on the target and path factors, from the model with the unemployment rate added to the baseline specification. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.725*** (0.167)	0.857*** (0.199)
Path Factor	-0.195 (0.187)	0.205 (0.286)
Constant	-0.005 (0.010)	0.000 (0.013)
Observations	252	252
R-squared	0.069	0.061
Adjusted R-squared	0.0613	0.0532
Robust F-statistic	10.10	9.340

Table 9: First stage regression of residuals from the reduced form VAR on the target and path factors where the FOMC meeting dates without an accompanying statement are excluded. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

VARIABLES	(1) FFR residual	(2) 1 year residual
Target Factor	0.783*** (0.157)	0.836*** (0.193)
Path Factor	-0.205 (0.192)	0.245 (0.276)
Constant	0.004 (0.010)	0.014 (0.014)
Observations	216	216
R-squared	0.105	0.073
Adjusted R-squared	0.0966	0.0642
Robust F-statistic	13.03	9.382

Table 10: **Futures Data Sample: February 1994 to December 2011.** First stage regression of residuals from the reduced form VAR on the target and path factors. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

VARIABLES	(1) FFR residual	(2) 1 year residual
Target Factor	0.907*** (0.230)	1.071*** (0.237)
Path Factor	0.005 (0.186)	0.412* (0.247)
Constant	-0.005 (0.010)	0.000 (0.013)
Observations	252	252
R-squared	0.078	0.089
Adjusted R-squared	0.0710	0.0819
Robust F-statistic	7.888	12.43

Table 11: First stage regression of residuals from the reduced form VAR on the target and path factors. The daily futures shock series is aggregated to a monthly series by weighing it based on which day of the month the FOMC meeting occurred. If the FOMC meeting occurs in the final 5 days of the month, then the shock is assigned to the next month. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(a)	(b)
Variables	FFR residual	1 year residual
MP1	1.090*** (0.123)	
FF4		1.138*** (0.237)
Constant	0.014 (0.011)	0.018 (0.013)
Observations	252	252
R-squared	0.188	0.102
Adjusted R-squared	0.185	0.0980
Robust F-statistic	78.58	23.11

Table 12: First stage regression of residuals from the reduced form VAR with only one policy tool. Panel (a) is the model with only fed funds rate as policy tool and MP1 as the instrument. Panel (b) is the model with only the 1 year rate as the policy tool with FF4 as the instrument. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)	(2)
VARIABLES	FFR residual	1 year residual
Target Factor	0.790*** (0.132)	0.929*** (0.169)
Path Factor (Pvt Res)	-0.082 (0.183)	0.402 (0.252)
Constant	-0.006 (0.010)	-0.001 (0.013)
Observations	241	241
R-squared	0.108	0.107
Adjusted R-squared	0.100	0.0990
Robust F-statistic	18.59	15.36

Table 13: First stage regression of residuals from the reduced form VAR on the target factor and cleansed path factor (Pvt Res). Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .



	(a)	(b)
Variables	FFR residual	1 year residual
Target Factor	0.896*** (0.287)	0.810** (0.340)
Path Factor	-0.237 (0.192)	0.234 (0.263)
Constant	-0.006 (0.010)	0.000 (0.013)
Observations	252	252
R-squared	0.048	0.027
Adjusted R-squared	0.0401	0.0191
Robust F-statistic	5.081	3.458

Table 14: First stage regression of residuals from the reduced form VAR on the target and path factors with only the scheduled FOMC meeting dates. Robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	(1)				(2)			
	Target Factor				Path Factor			
GDPt1	0.009 (0.013)	GDPt1lag	0.011 (0.013)	GDPt1	0.003 (0.015)	GDPt1lag	-0.005 (0.012)	
GDPt2	0.005 (0.016)	GDPt2lag	-0.022 (0.012)	GDPt2	0.005 (0.014)	GDPt2lag	-0.007 (0.012)	
GDPt3	-0.008 (0.015)	GDPt3lag	0.020 (0.016)	GDPt3	0.019 (0.015)	GDPt3lag	0.018 (0.015)	
GDPt4	0.020 (0.022)	GDPt4lag	-0.014 (0.020)	GDPt4	0.027 (0.018)	GDPt4lag	-0.051 (0.021)	
CPIt1	-0.001 (0.009)	CPIt1lag	-0.001 (0.007)	CPIt1	0.008 (0.008)	CPIt1lag	-0.001 (0.007)	
CPIt2	-0.010 (0.019)	CPIt2lag	0.032 (0.017)	CPIt2	-0.058*** (0.022)	CPIt2lag	-0.015 (0.023)	
CPIt3	0.033 (0.039)	CPIt3lag	-0.079 (0.037)	CPIt3	0.003 (0.039)	CPIt3lag	0.089 (0.037)	
CPIt4	-0.031 (0.042)	CPIt4lag	0.038 (0.042)	CPIt4	0.077 (0.050)	CPIt4lag	-0.097 (0.052)	
Ut1	-0.146 (0.082)	Ut1lag	-0.111 (0.078)	Ut1	-0.134 (0.103)	Ut1lag	-0.001 (0.100)	
Ut2	-0.010 (0.120)	Ut2lag	0.392 (0.123)	Ut2	-0.029 (0.135)	Ut2lag	0.043 (0.176)	
Ut3	0.141 (0.132)	Ut3lag	-0.173 (0.122)	Ut3	0.113 (0.146)	Ut3lag	-0.033 (0.145)	
Ut4	-0.023 (0.116)	Ut4lag	-0.112 (0.117)	Ut4	0.001 (0.114)	Ut4lag	-0.067 (0.118)	
Constant		0.002 (0.010)				0.010 (0.012)		
Observations		177				177		
R-squared		0.134				0.188		
Adjusted R-squared		-0.00307				0.0588		

Table 15: Regression results of target and path factor on measure of Federal Reserve private information, which are forecasts differences between Greenbook and Blue Chip forecasts for GDP, CPI and unemployment. Robust standard errors are presented in parentheses.