Web Appendix

"Are the effects of monetary policy shocks big or small?"

Olivier Coibion

Appendix 1: Description of the Model-Averaging Procedure

This section describes the model-averaging procedure used in the paper. For simplicity, I describe the algorithm used for the single-equation method, but the same procedure applies to the VAR framework. Assume that the DGP is given by

$$y_t = c + \sum_{i=1}^{J_1^*} \beta_i y_{t-1} + \sum_{j=1}^{J_2^*} \gamma_j \varepsilon_{t-j}^{mp} + v_t \qquad \text{(A1)}$$

where $\boldsymbol{J}^* = [J_1^* \ \ J_2^*]$ is the true lag structure of the DGP, which is unobservable to the econometrician. We are interested in estimating some moment of the data $\boldsymbol{M}(\boldsymbol{J}^*)$ which can be recovered from equation (A1). These moments could include the impulse response of y to ε^{mp} shocks, counterfactual paths of y, etc…

Step 1: Let $\boldsymbol{J}$ denote the set of lag lengths considered by the econometrician. Use an information criterion to identify optimal lag length selection from $\boldsymbol{J}$ for equation (A1) given the data, denoted by $\boldsymbol{J}^{IC}$.

Step 2: For each $\boldsymbol{J_i} = [J_1^i \ \ J_2^i]$ in the set $\boldsymbol{J}$,

1. Estimate equation (A1) with $\boldsymbol{J_i}$ lags and associated moments $\widehat{\boldsymbol{M}}(\boldsymbol{J_i})$.
2. Given the estimated parameters of (A1) conditional on $\boldsymbol{J_i}$, generate N artificial time series.
3. For each n of the N artificial time series, use the information criterion to identify the optimal lag length selection $\boldsymbol{J}_{n,i}^{IC}$.
4. The bootstrapped estimate of the probability of observing $\boldsymbol{J}^{IC}$ when $\boldsymbol{J_i}$ is the true lag specification is

$$\hat{p}(\boldsymbol{J}^{IC} | \boldsymbol{J_i}) = \left(\frac{1}{N}\right) \sum_{n=1}^{N} I(\boldsymbol{J}_{n,i}^{IC} = \boldsymbol{J}^{IC})$$

where I is the indicator variable equal to one when the argument is true.

Step 3: Construct the model-averaging estimate of the moments of the data $\widehat{\boldsymbol{M}}(\boldsymbol{J})$ as

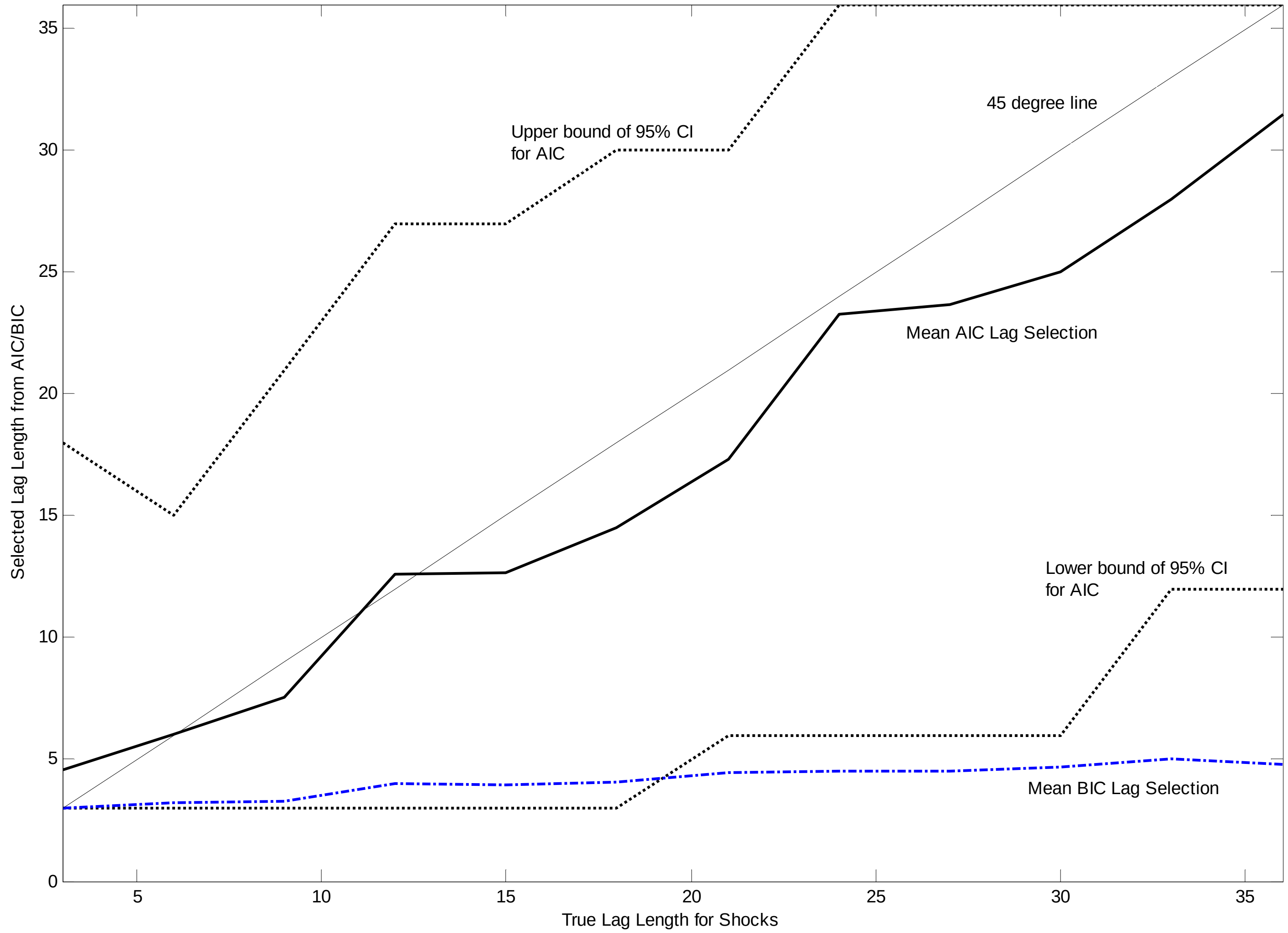
$$\widehat{\boldsymbol{M}}(\boldsymbol{J}) = \sum_{\boldsymbol{J_i} \in \boldsymbol{J}} \left(\frac{\hat{p}(\boldsymbol{J}^{IC} | \boldsymbol{J_i})}{\sum_{\boldsymbol{J_i} \in \boldsymbol{J}} \hat{p}(\boldsymbol{J}^{IC} | \boldsymbol{J_i})} \right) \widehat{\boldsymbol{M}}(\boldsymbol{J_i})$$

which follows Bayesian averaging with equal priors.

Estimation of Model-Averaging Procedure in Section 2D

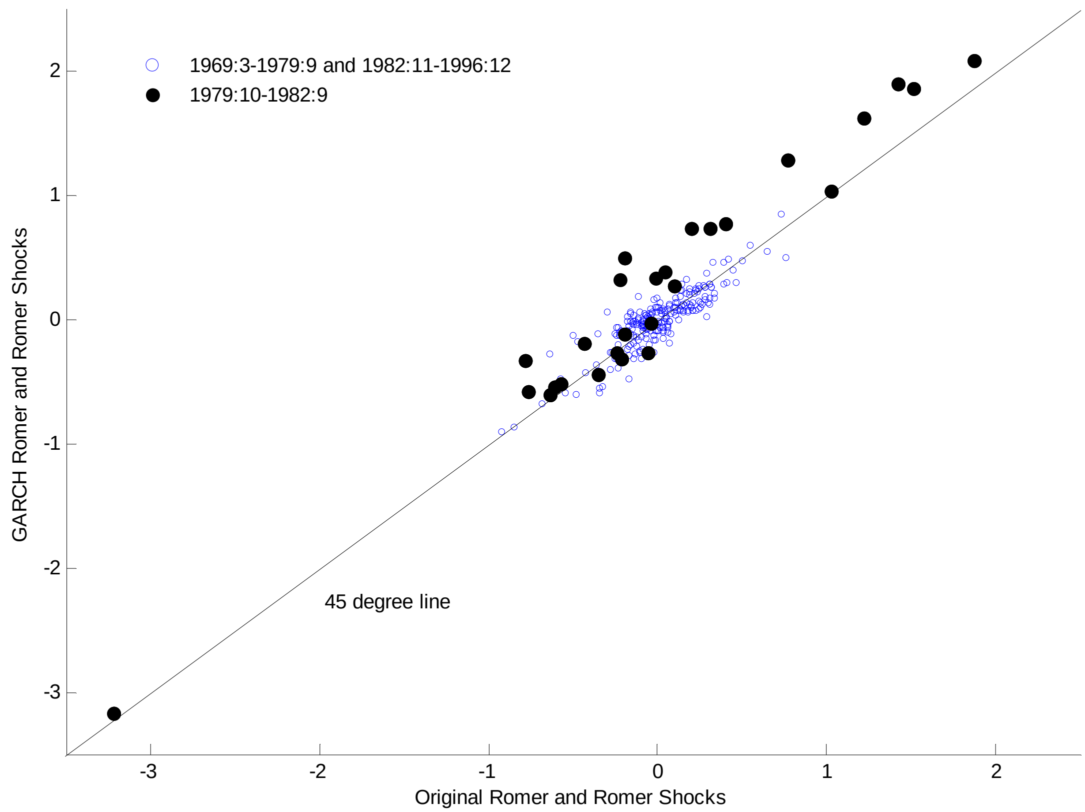
When applied to the single-equation approach, I consider $J_1 = [12\ 24]$ and J_2 goes from 3 months to 45 months in 3 month intervals. For the VAR's, J goes from 3 months to 36 months in 3 month intervals. In each case, N = 1,000. The moments used are the impulse responses of each macroeconomic variable to monetary policy shocks. For the inflation counterfactuals in Figure 12, the moments are the historical contribution of monetary policy shocks to annual inflation.

Appendix Figure 1: Monte Carlo Simulation of Lag Selection by Information Criteria



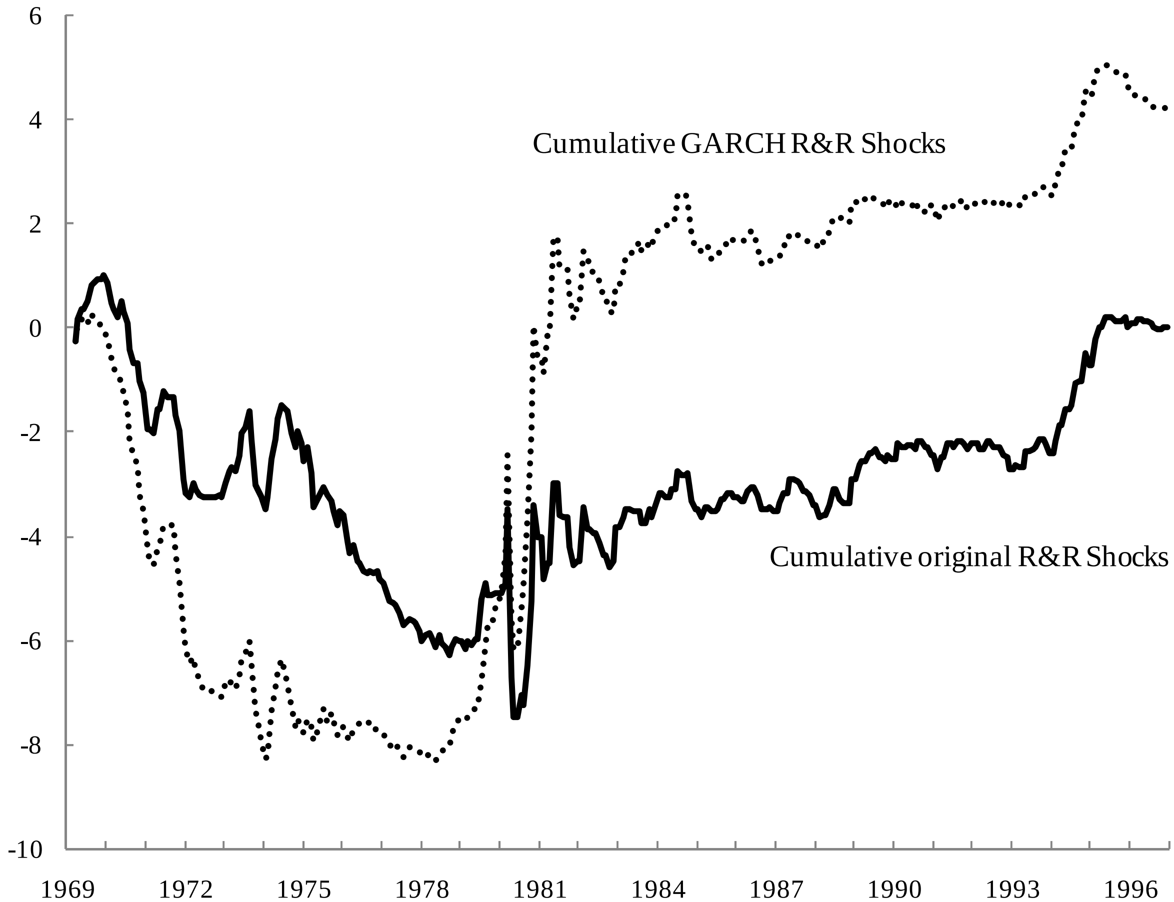
Note: The figure plots the results of a Monte Carlo simulation of equation (1) in the text for industrial production. The true autoregressive lag length is set to 12 months, while the number of lags of monetary policy shocks in the DGP varies, as indicated on the horizontal axis. For each value of the lag length for monetary policy shocks, 1,000 times artificial time series are generated. For each time series, the AIC and BIC are applied to select optimal lag lengths. The mean lag selection from each approach for each true lag length for shocks is plotted in the graph. In addition, the figure plots the 95% interval of lag selections from the AIC for each true lag length.

Appendix Figure 2: Original vs GARCH Romer and Romer Shocks



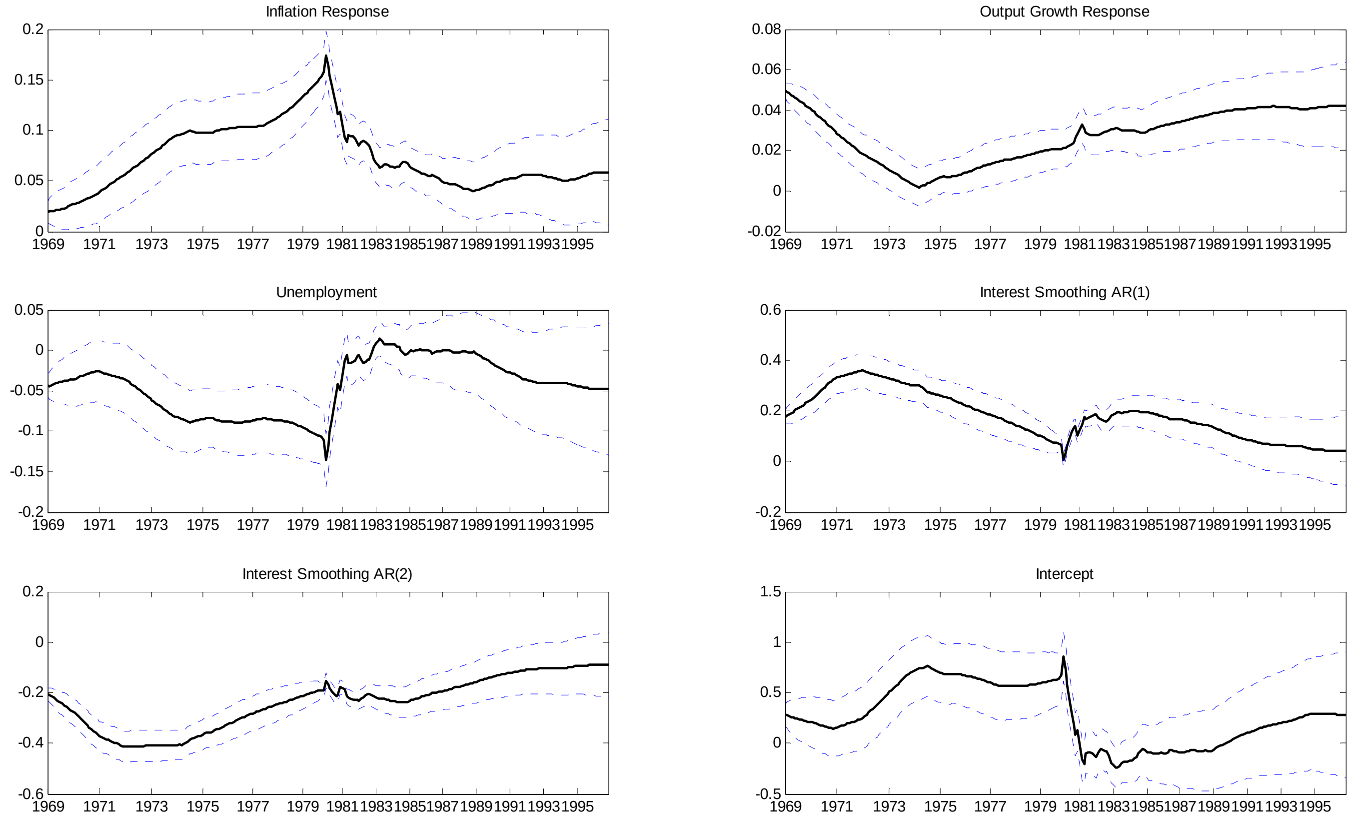
Note: The figure presents a scatter plot of the original Romer and Romer (2004) monetary policy shocks versus the residuals from estimating the same Taylor rule by GARCH(1,1). See section 3A for details.

Appendix Figure 3: Cumulative Shocks from Romer and Romer (2004) and GARCH



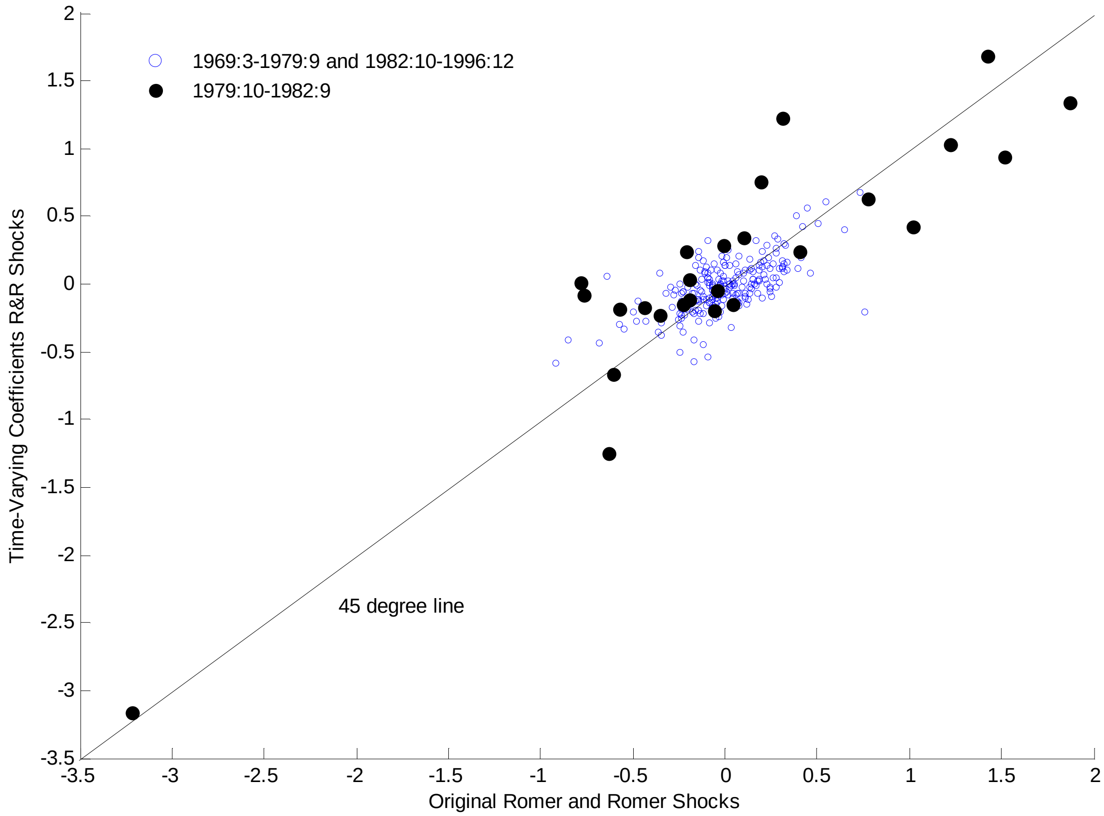
Note: The figure presents the cumulative sum of Romer and Romer (2004) monetary policy shocks and the cumulative sum of the residuals from estimating the same Taylor rule as in Romer and Romer (2004) by GARCH(1,1). See section 3A for details.

Appendix Figure 4: Estimated Coefficients from Time-Varying Parameters Approach



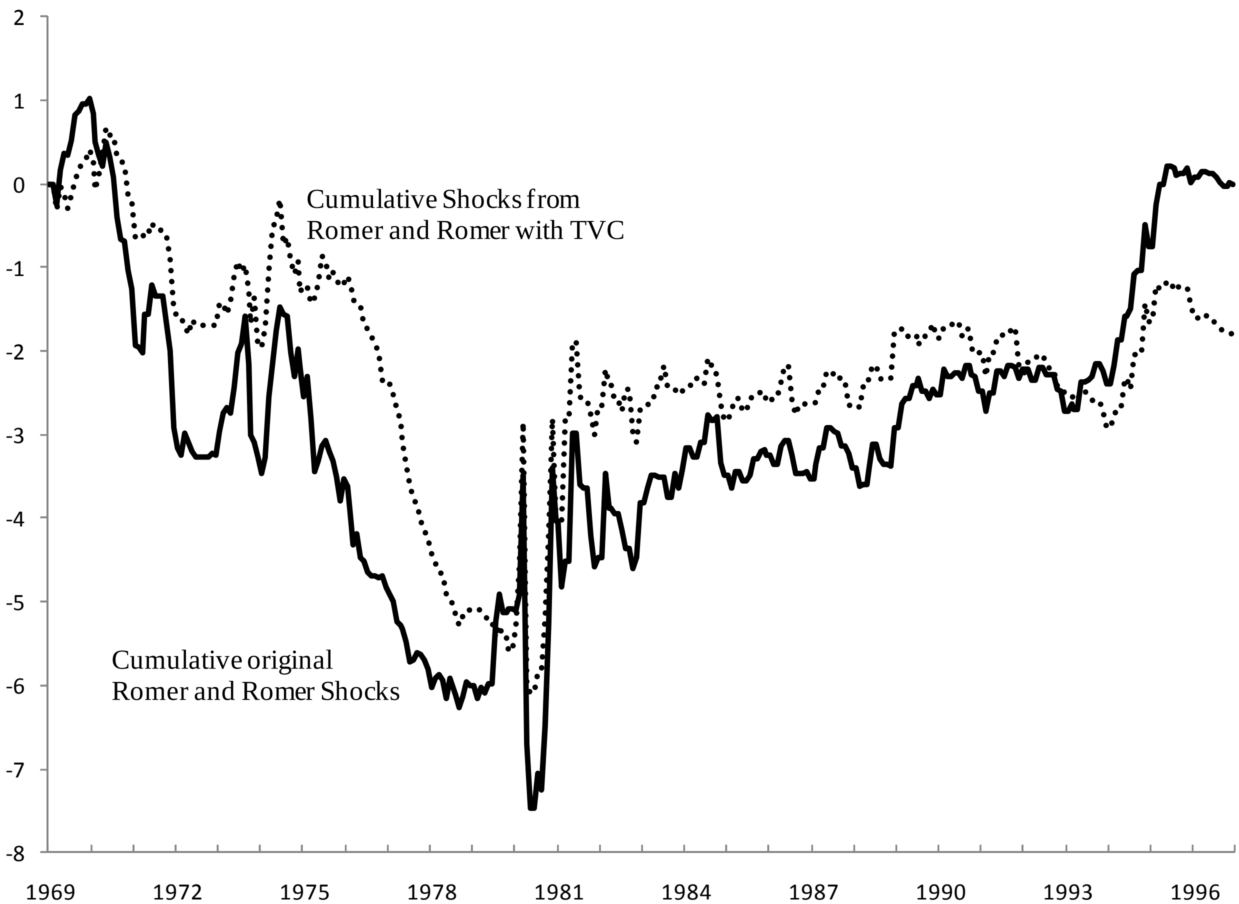
Note: The figure plots the estimated time-varying (smoothed) coefficients of the Taylor rule in section 3B. One standard deviation confidence intervals are denoted by the dashed lines.

Appendix Figure 5: Original Romer and Romer Shocks vs TVC Shocks



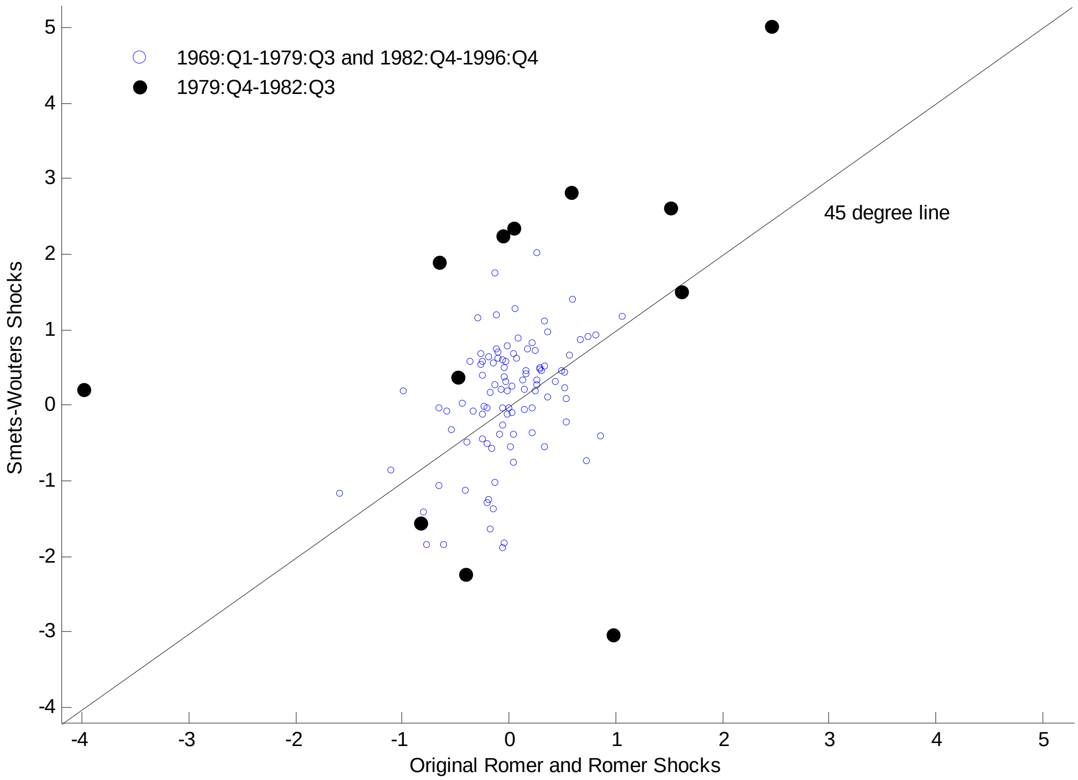
Note: The figure presents a scatter plot of the original Romer and Romer (2004) monetary policy shocks versus the shocks estimated from the restricted Romer and Romer Taylor rule with time-varying coefficients. See section 3B for details.

Appendix Figure 6: Cumulative Shocks from Original and TVC Romer-Romer Taylor Rule



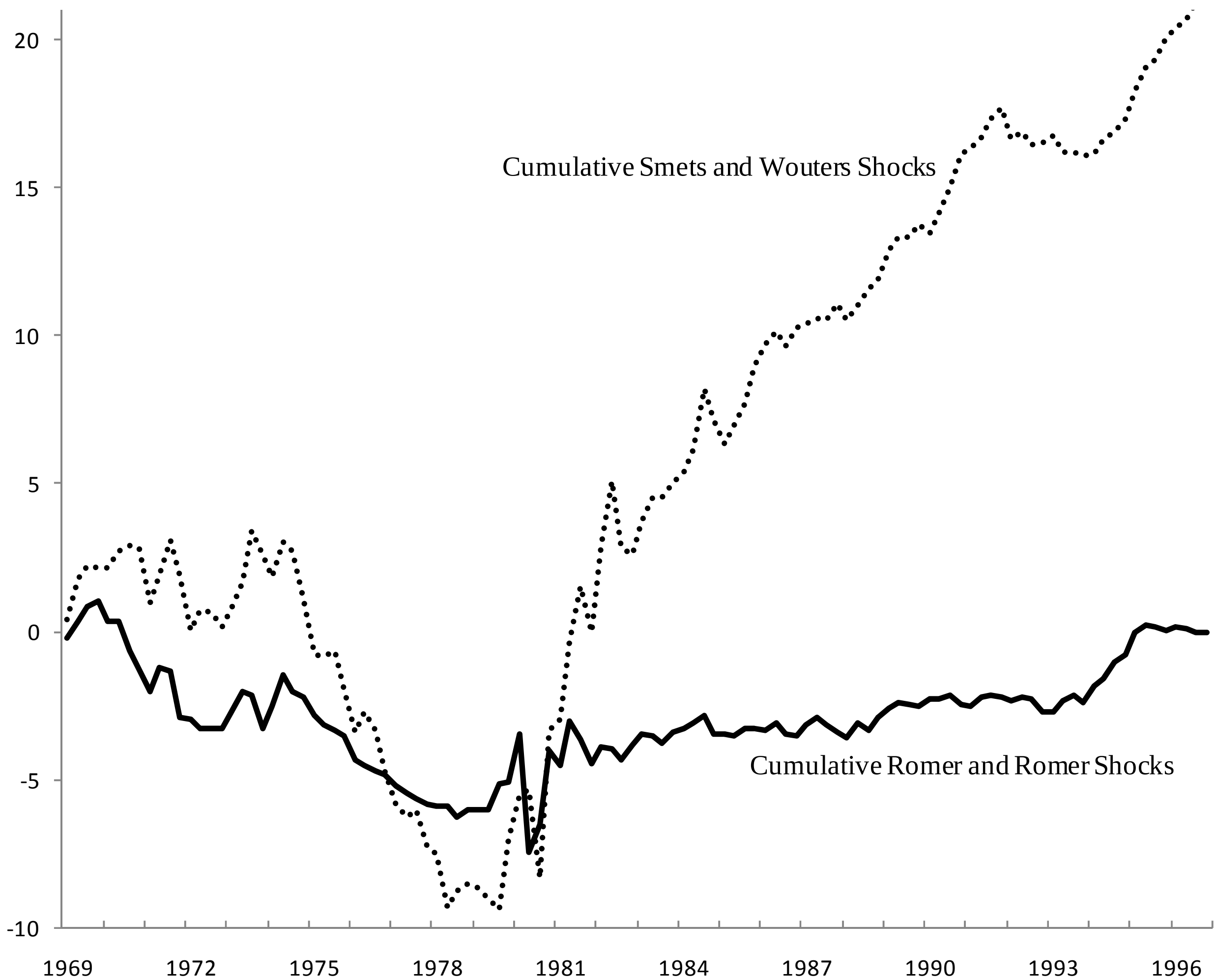
Note: The figure presents the cumulative sum of the original Romer and Romer (2004) monetary policy shocks and the cumulative sum of the shocks from the restricted Romer and Romer Taylor rule with time-varying coefficients. See section 3B for details.

Appendix Figure 7: Original Romer and Romer Shocks vs Smets-Wouters Shocks



Note: The figure presents a scatter plot of the original Romer and Romer (2004) monetary policy shocks versus Smets-Wouters (2007) shocks from an estimated DSGE model. See section 3C for details.

Appendix Figure 8: Cumulative Shocks from Romer-Romer and Smets-Wouters



Note: The figure presents a scatter plot of the original Romer and Romer (2004) monetary policy shocks versus Smets and Wouters (2007) shocks from an estimated DSGE model. See section 3C for details.

Appendix Table 1: Monte Carlo Simulations of Information Criteria and Model-Averaging

	Imposed Lag Length			Information Criteria Lag Selections		Model-Averaging
	Correct Lags (12)	Insufficient Lags (6)	Excessive Lags (24)	AIC	BIC	AIC-based
Mean Lag Selection						
Autoregressive Lags	12	12	12	10.5	6.1	14.0
Monetary Policy Shock Lags	12	6	24	11.5	6.4	14.5
Fraction of Correct Lag Selections	na	na	na	55.6%	0.3%	na
Peak Effect of MP Shocks						
Mean % Error of Estimated Peak Effect	2.0%	-57.7%	8.7%	-7.0%	-56.9%	-6.1%
Standard Deviation of Estimated Peak Effects	0.0115	0.0085	0.0127	0.0134	0.0099	0.0122
MSE of Impulse Responses						
Mean	0.0028	0.0108	0.0038	0.0040	0.0106	0.0034
Ratio of mean MSE to when using correct lags	1.00	3.86	1.36	1.43	3.79	1.21

Note: The table presents results from Monte Carlo simulations of the ability of standard information criteria and a model-averaging approach to recover the true peak effects of monetary policy shocks. The Monte Carlo simulations are done as follows. First, estimate equation (1) in the text for industrial production and the original R&R shocks using 12 autoregressive lags and 12 lags of monetary policy shocks. This is assumed to be the true DGP. Second, generate 1,000 artificial time series from this specification, by feeding in random draws from the estimated residuals of (1) and the concurrent monetary policy shocks. Each time series has a burn-in sample of 100 periods then an additional 320 observations are generated to be used in subsequent steps. Third, for each simulated time series, apply the AIC and BIC criterion to select the optimal lag length from the set of I={6,12,24} and J={6,12,24}. Fourth, apply the model-averaging procedure described in section 2D to calculate conditional probabilities to assign to each model. The first two rows of the table present the average lag selection of the AIC and BIC, as well as the mean of the weighted average of lags from the model-averaging procedure. The third row presents the frequency at which the AIC and BIC select the true lag specification. Fifth, for each simulated time series, I compute the estimated peak effect of monetary policy shocks on industrial production using a) the correct lag specification (I=12, J=12), b) using fewer lags of the shocks (I=12, J=6), c) using more lags of the shocks (I=12, J=24), d) the AIC-selected lag specification, e) the BIC-selected lag specification, and f) the model-averaging approach, which takes a weighted average of the impulse responses across possible lag specifications where the weights are determined by the estimated conditional probabilities assigned to each model. The fourth row of the table then displays the mean percentage error (relative to the true peak effect assumed) associated with each approach, while the fifth row shows the standard deviation of estimated peak effects across simulations. Sixth, for each simulation, I compute the Mean Squared Error (MSE) of each impulse response relative to the assumed true impulse response over 36 months. The last two rows display the average MSE across simulations for each approach, as well as the ratio of these means to that achieved when using the correct lag specification.

Appendix Table 2: Estimated Coefficients of the Taylor Rule in Romer and Romer (2004)

	Original R&R		Restricted R&R		GARCH R&R	
	coef	se	coef	se	coef	se
Constant	0.17	(0.12)	0.27	(0.16)	0.32	(0.09)
Initial Level of intended funds rate	-0.02	(0.01)	-0.02	(0.01)	-0.01	(0.01)
Forecasted inflation						
Quarters Ahead:						
-1	0.02	(0.03)	0.02	(0.04)	0.02	(0.01)
0	-0.04	(0.03)	-0.06	(0.04)	0.00	(0.02)
1	0.01	(0.07)	0.04	(0.08)	-0.01	(0.02)
2	0.05	(0.06)	0.03	(0.09)	-0.02	(0.03)
Change in forecasted inflation since previous meeting						
Quarters Ahead:						
-1	0.06	(0.05)	0.04	(0.05)	0.03	(0.03)
0	0.00	(0.04)	0.01	(0.05)	0.00	(0.03)
1	0.03	(0.07)	0.00	(0.10)	0.04	(0.04)
2	-0.06	(0.07)	-0.03	(0.09)	0.06	(0.05)
Forecasted output growth						
Quarters Ahead:						
-1	0.01	(0.01)	0.00	(0.01)	0.00	(0.01)
0	0.00	(0.01)	0.00	(0.02)	0.02	(0.01)
1	0.01	(0.02)	0.01	(0.03)	0.02	(0.02)
2	0.02	(0.03)	0.04	(0.04)	0.02	(0.02)
Change in forecasted output growth since previous meeting						
Quarters Ahead:						
-1	0.05	(0.03)	0.06	(0.04)	0.02	(0.02)
0	0.15	(0.04)	0.15	(0.04)	0.06	(0.02)
1	0.02	(0.04)	0.03	(0.05)	0.03	(0.03)
2	0.02	(0.04)	-0.01	(0.06)	-0.02	(0.04)
Forecasted UE rate, current quarter	-0.05	(0.02)	-0.07	(0.02)	-0.06	(0.01)
Conditional Variance Equation (for GARCH)						
Constant					0.00	(0.00)
Lag of Squared Residual					0.48	(0.12)
Lag of Forecast Variance					0.57	(0.08)
Sample	1969:3-1996:12		1972:11-1996:12		1972:11-1996:12	
N	263		221		221	

Note: The table presents estimates of the Taylor rule in Romer and Romer (2004). The first specification replicates the OLS estimation of Romer and Romer, the second estimates the same Taylor rule by OLS starting in 1972:11, and the third estimates the same Taylor rule by GARCH(1,1) over the restricted sample. See section 3A for details.