For Online Publication

The macroeconomic effects of monetary policy: A new measure for the United Kingdom: Online Appendix

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TABLE A1—DATA SOURCES

Variable	Source	Description	Series
GDP	ONS	GDP (CVM, seasonally adjusted)	ABMI
Household consumption	ONS	Household consumption expenditures (CVM, SA)	ABJR
Investment	ONS	Gross Fixed Capital Formation (CVM, SA)	NPQT
Hours worked	ONS	Weekly hours worked per capita	YBUS/MGRZ
Industrial production	ONS	Covers manufacturing, mining and quarrying and energy supply (S.A.)	CKYW
Inflation (RPIX)	ONS	Annual change in Retail Price Index excluding mortgage interest payments, extended back using Retail Prices Index	CDKQ (CZBH for 1975, RPI)
RPIX	ONS	Retail Prices Index excluding mortgage interest payments, extended back using Retail Prices Index	CHMK, CDKQ and CDKO
Retail Prices Index Inflation (RPI)	ONS	Annual change in Retail Price Index	CZBH
Consumer Prices Index	ONS	CPI long run series	
Interest rates	Bank of England	Bank Rate / Minimum Lending Rate / Repo Rate / Official Bank Rate	"Official Bank Rate history"
Unemployment rate	ONS	Unemployment rate (Age 16 and over). Claimant count and ILO measure (S.A.)	MGSX
Money supply M0	Bank of England	Monthly average amount outstanding of total sterling notes and coin in circulation, excluding backing assets for commercial banknote issue in Scotland and Northern Ireland (S.A.)	LPMAVAB
Money supply M4	Bank of England	Monetary financial institutions' sterling M4 liabilities to private sector), seasonally adjusted	Break-adjusted LPMAUZJ and LPMAUYN
Exchange rates Sterling/USD	Bank of England	Spot exchange rate, USD into Sterling (monthly average)	XUDLUSS, XUMAUSS
Exchange rates Sterling/DM	Bundesbank	Spot exchange rate DM into Sterling (monthly average)	BBK01.WT5005
Sterling effective exchange rate	Eurostat	Nominal Effective Exchange Rate - 24 trading partners	
Commodity price index	IMF	IMF Commodity price index converted to Sterling (S.A.)	Barakchian and Crowe (2013) data set
FTSE	Bloomberg	FTSE All Share Index	
United States data: Industrial production, CPI, effective exchange rate, commodity price index	Coibion (2012) dataset		
Romer and Romer (2004) shocks	Coibion (2012) and Romer and Romer (2004)	Extended using updated Federal Reserve Greenbook forecasts	

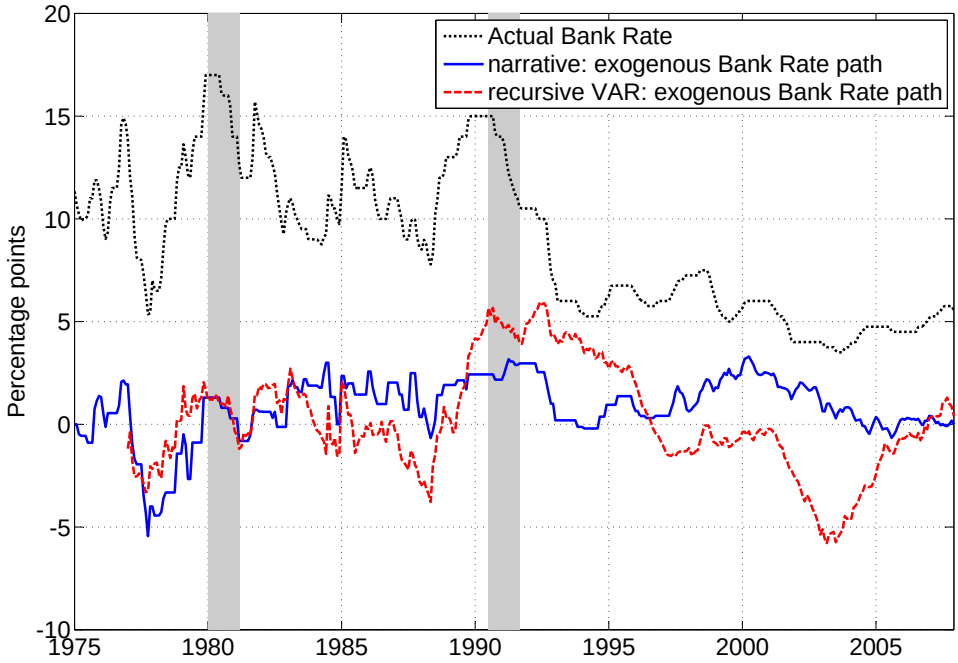
TABLE A2—VARIABLES OF REAL-TIME FORECASTS DATA SET

Variable	Source	Description	Period
Real GDP growth	Bank of England	Annualised quarterly real GDP growth rates (S.A.)	1997-07
RPIX	Bank of England	Annual RPIX inflation rate	1993-03
CPI	Bank of England	Annual CPI inflation rate	2003-07
Real GDP growth	NIESR & NIER	Annualised quarterly real GDP growth rates (S.A.)	1975-07
RPI/RPIX	NIESR & NIER	Annual RPI/RPIX inflation rate	1987-92 / 1993-2003
CPI	NIESR & NIER	Annual CPI inflation rate	2003-07
Consumer price defl.	NIESR & NIER	Annual change in consumer price deflator	1975-87

Notes: Bank of England data are based on Inflation Report forecasts which are available from the Bank of England website. NIER refers to the National Institute Economic Review. Where back-data are not included with the forecast, we make use of the Bank of England's real-time dataset (also available online) to construct the previous quarters associated with the forecast.

A1. Comparison with Bank Rate

FIGURE A1. CUMULATED SHOCK SERIES AND ACTUAL BANK RATE



Notes: Exogenous Bank Rate path is the cumulated shock series adjusted for the average Bank Rate.

TABLE A3—THE EFFECTS OF MONETARY POLICY INNOVATIONS IN PREVIOUS STUDIES

Authors	Country	Method	Peak Effects (in %)	
			Output	Prices/Inflation
Romer and Romer (2004)	US	narrative	-1.9 to -4.3 (IP)	-3.6 to -5.9 (CPI/PPI)
Coibion (2012)	US	narrative	-1.6 to -4.3 (IP)	-1.8 to -4.2 (CPI inflation)
Dedola and Lippi (2005)	UK	VAR	-0.5 (IP)	0.2 (CPI)
Mountford (2005)	UK	sign-restriction	-0.6 (GDP)	-0.15 (GDP defl.)
Ellis et al. (2014)	UK	FAVAR	-1.0/-2.0 (IP, 75-91/92-05)	-0.3/-2 on CPI (75-91/92-05)
			-0.5/-0.5 (GDP,75-91/92-05)	
Bernanke and Mihov (1998)	US	VAR	-0.6 to -1 (GDP)	-0.7 to -1.6 (GDP defl.)
Christiano et al. (1999)	US	VAR	-0.7 (GDP)	-0.6 (GDP defl.)
Bernanke et al. (2005)	US	FAVAR	-0.6 (IP)	-0.7 (CPI)
Uhlig (2005)	US	sign-restriction	-0.3 (GDP)	-1.0 (GDP defl.)
Barakchian and Crowe (2013)	US	Fed Futures data	-0.9 (IP)	-0.1 (CPI)
Gertler and Karadi (2015)	US	VAR-HFI[45]	-1.0 to -2.0 (IP)	-0.75 to 0.3 (CPI)

Notes: The results from previous studies listed in the table are from impulse responses displayed in these papers. We computed implied peak effects to a one percentage point increase in the interest rate. In brackets we report the specific output and price measure, where IP denotes industrial production. Coibion (2012) presents a range of exercises and magnitudes. These are taken from Coibion (2012) Figure 2, reporting the baseline specification results using a VAR and ADL model. The US narrative results are for the Romer and Romer (2004) sample 1969-1996.

ADDITIONAL ROBUSTNESS EXERCISES

B1. Expanding the first stage: money supply and exchange rates

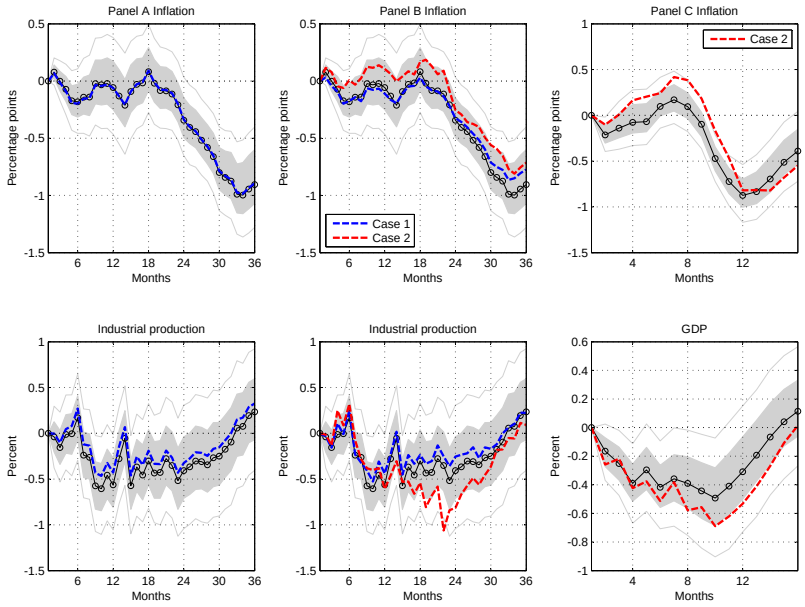
Although inflation targeting has been the stable policy regime since 1993, there have been a number of other policy environments since 1975. Monetary targeting was emphasised in the early 1980s and stricter control of the money supply had begun in the late 1970s. In addition, during the latter half of the 1980s the UK began shadowing the Deutsche Mark as a forerunner to the UK joining the European Exchange Rate Mechanism, which it then was forced to leave in 1992.

Batini and Nelson (2009) argue that short-term interest rates have consistently been used as the policy instrument even throughout these earlier periods of UK monetary policy. Nonetheless, to examine whether these extra objectives affected the setting of the policy target rate, we expand the variables in the first stage regression to include lagged money supply (M0) as well as the US Dollar-Sterling exchange rate and the Deutsche Mark/Euro-Sterling exchange rate.[46] Panel A of Figure B1 shows that our baseline results are largely unaffected by the inclusions of these extra variables.

[45]The authors combine high frequency identification (HFI) with a VAR approach. We report the range of results for the full sample 1979-2012 and the sample up to 2008 excluding the crisis.

[46]Clarida, Galí and Gertler (1998) estimate policy rules for several countries, among these for the UK economy, and include the Sterling-Deutsche Mark exchange rate as a relevant regressor.

FIGURE B1. ROBUSTNESS TO INCLUDING EXTRA FIRST STAGE REGRESSORS AND TO TIMING ASSUMPTIONS IN STAGE 1



Notes: Impulse responses to a one percentage point contractionary monetary policy shock (dashed line) of alternative specification compared to baseline specification (circled line) with corresponding 68 and 95 per cent confidence intervals. The baseline specification uses industrial production, RPIX12m inflation, commodity prices, and our shock measure. Panel A: first stage regression includes lagged money supply M0, US Dollar-Sterling exchange rate, DM (Euro)-Sterling exchange rate (dashed line). Panel B: Alternative first stage regressions: Case 1 (blue dashed): includes using additional observations when Bank Rate was unchanged but new forecasts have been released. Case 2 (red dashed): Using only observations when new forecasts have been released. Panel C: quarterly VAR with Case 2 (dashed line).

B2. Alternative timing assumptions in stage 1

In the main text we explained that, in deciding how to assign forecasts to policy changes, we keep all Bank Rate changes and assign the latest available forecast. In this section we consider two alternatives.

First we consider all forecast release dates as points where policy could have been changed. This is important pre-1992 where there was no set meeting date and we do not observe whether an unchanged policy rate was a deliberate decision or not. This adds 29 new observations to our first stage regression. Case 1 in Figure B1 Panel B shows that the effects hardly differ from our baseline results. We prefer our baseline shock series, however, since we cannot be sure that the additional observations are genuine monetary policy decisions.

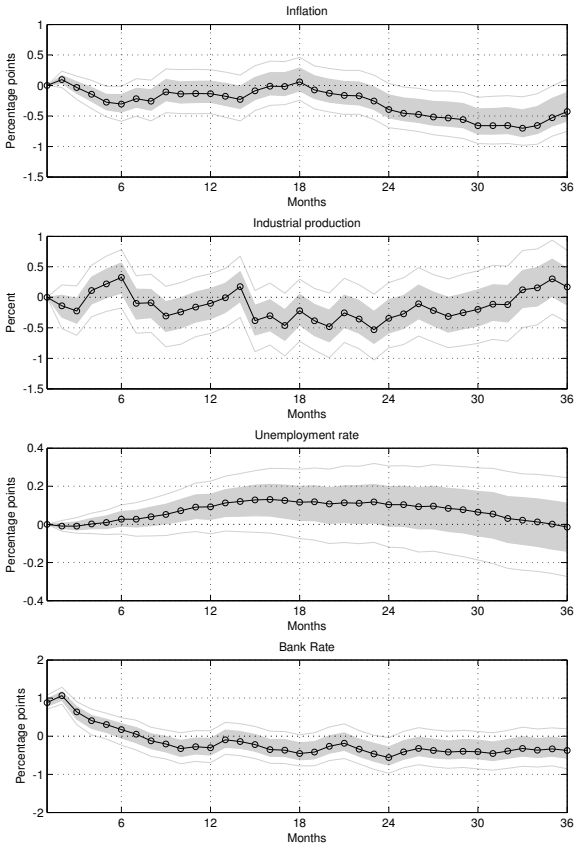
The second alternative we consider is to exclude policy changes where we do not have a new forecast. One concern is that there are quarters with multiple Bank Rate changes but which will be associated with the same forecast observation. To investigate this, we now only consider Bank Rate observations where new forecasts have been released. Since the forecast data is released at a quarterly frequency this also reduces the number of monetary policy shocks to a quarterly frequency. Case 2 in Figure B1 Panel B illustrates that the results are also very similar to our baseline findings. The advantage of our baseline approach is that we obtain a high-frequency monetary surprise series that

identifies a monetary policy shock for all available Bank Rate decisions.

Case 2 naturally produce a quarterly shock series. It is therefore also natural to ask how robust our results are for quarterly GDP in the quarterly VAR specification considered in the robustness section of the paper. Reassuringly, the effects on GDP are very close to our baseline results, both in terms of peak effects and persistence, as shown in the last column of Figure B1. We therefore conclude that our baseline results (based on a monthly shock series) are robust to these alternative timing assumptions.

B3. Results from a larger VAR

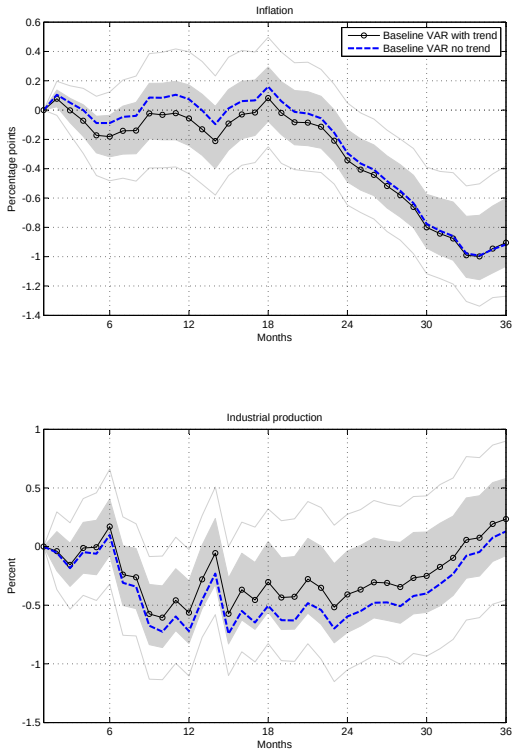
FIGURE B2. LARGE-SCALE VAR



Notes: Impulse responses to a one percentage point contractionary monetary policy shock with corresponding 68 and 95 per cent confidence intervals. The specification uses industrial production, RPIX12m inflation, unemployment rate, commodity prices, our new cumulated shock measure and Bank Rate.

B4. VAR specification sensitivity

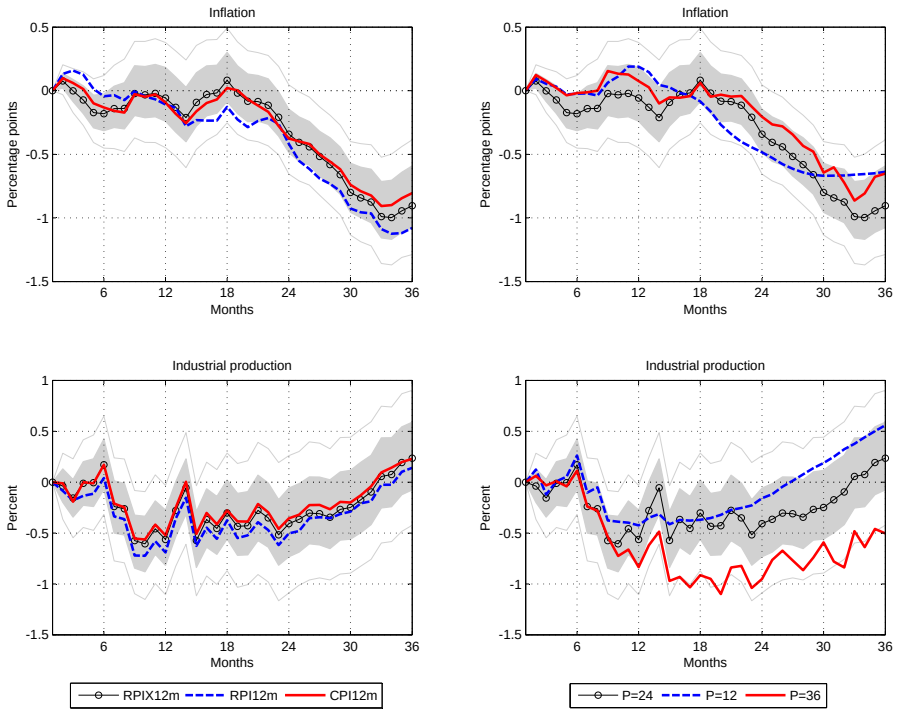
FIGURE B3. ROBUSTNESS TO VAR WITH AND WITHOUT TREND



Notes: Impulse responses to a one percentage point contractionary monetary policy shock (dashed line) of alternative specification compared to baseline specification (circled line) with corresponding 68 and 95 per cent confidence intervals. The baseline specification uses industrial production, RPIX12m inflation, commodity prices, and our shock measure. The blue dotted line depicts the VAR without trend. P=24. Sample: 1975-2007. Confidence bands indicate 68 and 95 per cent intervals.

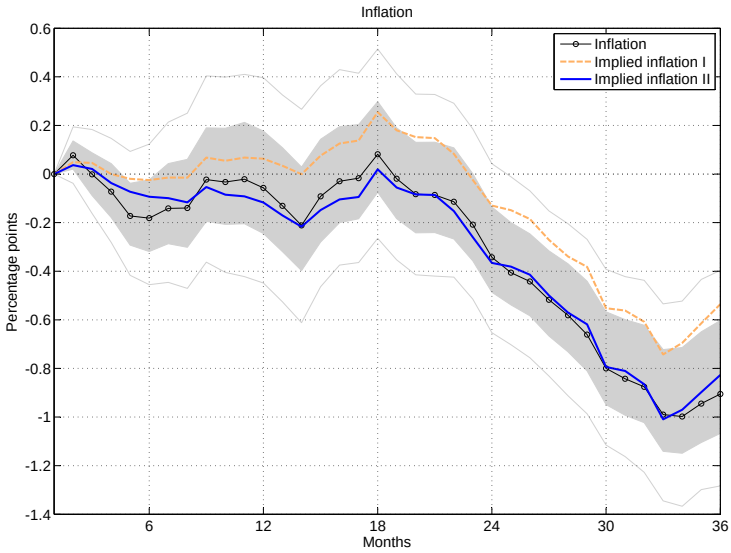
B5. Alternative price measures and lag length sensitivity

FIGURE B4. ROBUSTNESS TO ALTERNATIVE PRICE MEASURES AND LAG LENGTH



Notes: Impulse responses to a one percentage point contractionary monetary policy shock (dashed line) of alternative specifications compared to baseline specification (circled line) with corresponding 68 and 95 per cent confidence intervals. The baseline specification uses industrial production, RPIX12m inflation, commodity prices, and our shock measure. The first column compares the dynamics for various inflation measures (RPI and CPI) to the baseline VAR with RPIX. The second column provides the baseline VAR results compared to using 12 and 36 lags.

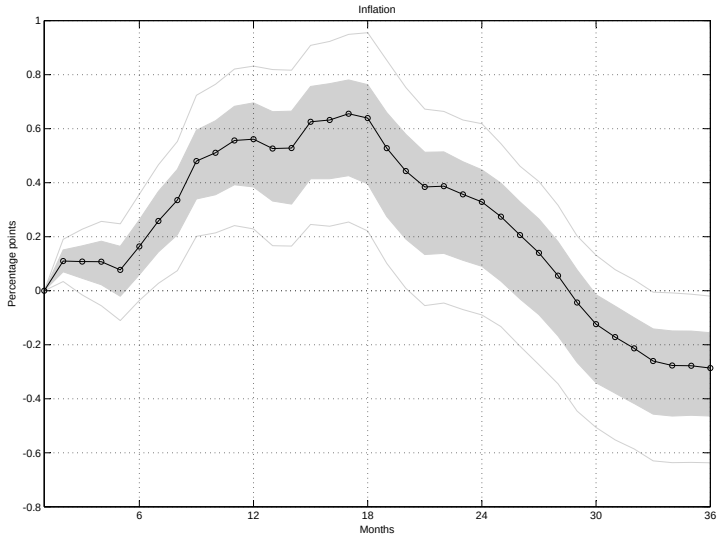
FIGURE B5. VAR COMPARISON: PRICE LEVEL AND INFLATION



Notes: Impulse responses to a one percentage point contractionary monetary policy shock. VAR with industrial production, inflation rate (RPIX12m) and RPIX price level (dashed line), and 1-month RPIX inflation (blue), commodity prices, and narrative monetary policy measure. The impulse responses are transformed to the implied 12 month inflation rate. in P=24. Sample: 1975-2007. Confidence bands indicate 68 and 95 per cent intervals.

B6. The price puzzle

FIGURE B6. BASELINE VAR USING BANK RATE TO MEASURE MONETARY POLICY SHOCKS



Notes: Impulse responses to a one percentage point increase in Bank Rate with corresponding 68 and 95 per cent confidence intervals. The specification uses industrial production, RPIX12m inflation, commodity prices, and Bank Rate. P=24, sample=1975-2007.

A COMPARISON BETWEEN THE VAR AND SINGLE EQUATION APPROACHES

In this section we present two additional sets of results. First, we use our new shock series in a simple auto-regressive distributed lag framework exactly following Romer and Romer (2004). This can be seen as the counterpart of the single equation results in the main text estimated using local projections. Second, we show that the results from the single equation set-up can be reconciled with our VAR results.

More precisely, we exactly follow Romer and Romer (2004) and regress each macroeconomic variable (x_t) on its lags and lags of the policy innovations m_t directly estimated from the first stage:

$$\Delta x_t = c + \sum_{i=1}^{P} \beta_i \Delta x_{t-i} + \sum_{j=1}^{Q} \gamma_j m_{t-j} + \epsilon_t \,. \tag{C1}$$

As mentioned above, the data are monthly. To ensure comparability with Romer and Romer (2004) we set $P = 24$ and $Q = 36$ for industrial production and $P = 24$ and $Q = 48$ for prices.

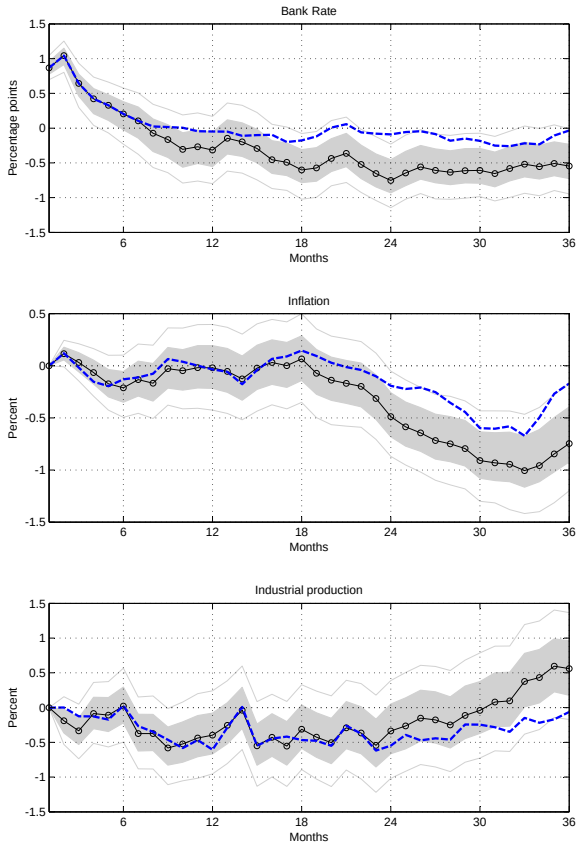
Our VAR results have the same qualitative signs as the results from the single equation regressions, but have a quantitatively smaller magnitude and a different persistence. As mentioned in the paper, these differences can largely be explained by the different policy paths generated by the two methods. Being specified in differences, simulations of equation (C1) assumes that the shock to the level of the policy rate is permanent. However, as noted in Coibion (2012), the effect this produces on the implied policy path can significantly affect the magnitudes reported from impulse response functions. To harmonise the exercises, we simulate a shock sequence in the ADL model that produces the same path for the positive part of the policy rate in the VAR.

Figure C1 reproduces the VAR results from the previous section for the response of industrial production and inflation and, for reference, also shows the actual response of the policy rate.[47] The results of the new single equation simulation are shown in the blue dotted lines. When we use this alternative shock profile in the single equation method, it is quite striking how close these two sets of results become, suggesting the two methods (VAR and ADL) differ largely due to the size and dynamics of the policy response, as has been emphasized by Coibion (2012) for the US.

In summary, while the single equation estimates may initially seem large, this section shows they can be reconciled with the VAR estimates. Since VARs are dominant in the empirical literature, we prefer to cite our VAR-based results as the baseline estimates.

[47] In the VAR case, the policy rate is added to the VAR as the final variable, implying that our shocks affect the policy rate immediately.

FIGURE C1. RECONCILIATION OF VAR AND SINGLE EQUATION APPROACH



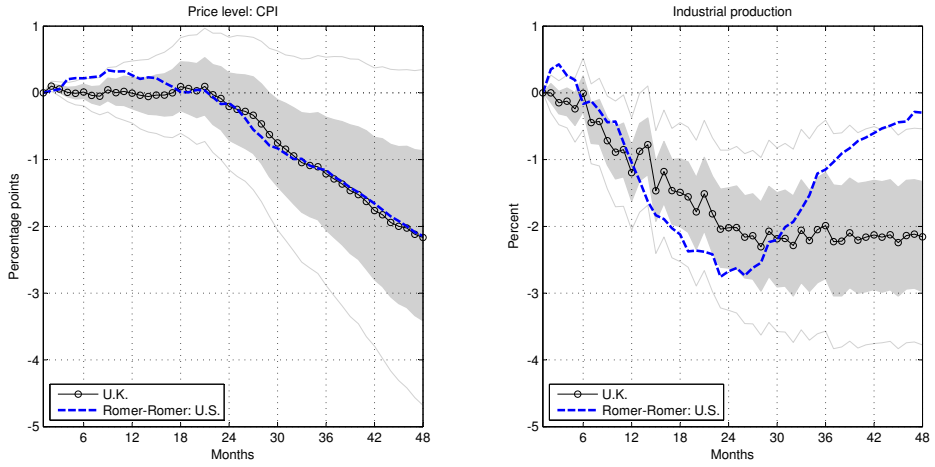
Notes: Impulse responses to one percentage point contractionary monetary policy shock. Confidence bands indicate 68 and 95 per cent intervals.

ADDITIONAL SINGLE EQUATION RESULTS

D1. UK vs. US results using the single equation approach

For completeness we now compare the UK and US results using the baseline single equation approach employed in Romer and Romer (2004). As argued before, in comparing the UK and US results we use the same sample period, i.e. from 1975 to 2007, for both countries.[48] Comparing the single equation results, Figure D1 shows that our findings are very similar to those for the US following the RR method. The 68 and 95 per cent confidence bands are bootstrapped using 2,000 repetitions.

FIGURE D1. SINGLE EQUATION REGRESSIONS FOR THE UK AND THE US



Notes: Impulse responses to a permanent one percentage point contractionary monetary policy shock. Confidence bands indicate 68 and 95 per cent intervals.

It is noteworthy that the industrial production response for the US is largely within the 95 per cent confidence bands of the UK industrial production response. In both countries the peak decline is reached after around two years, although in the US industrial production returns faster towards zero. Note that, to be directly comparable with the RR results for the US, in this section we compare the response of the price level.[49] The dynamics and the magnitude of the response of consumer prices in the US almost exactly match the estimated price dynamics for the UK. It is also remarkable that the price response is relatively small for both countries in the first two years, but falls significantly thereafter.

D2. Results for other variables

One of the advantages of the single equation approach is that it is straightforward to consider the effects on a range of further variables.[50] In this section we show the response of other macroeconomic

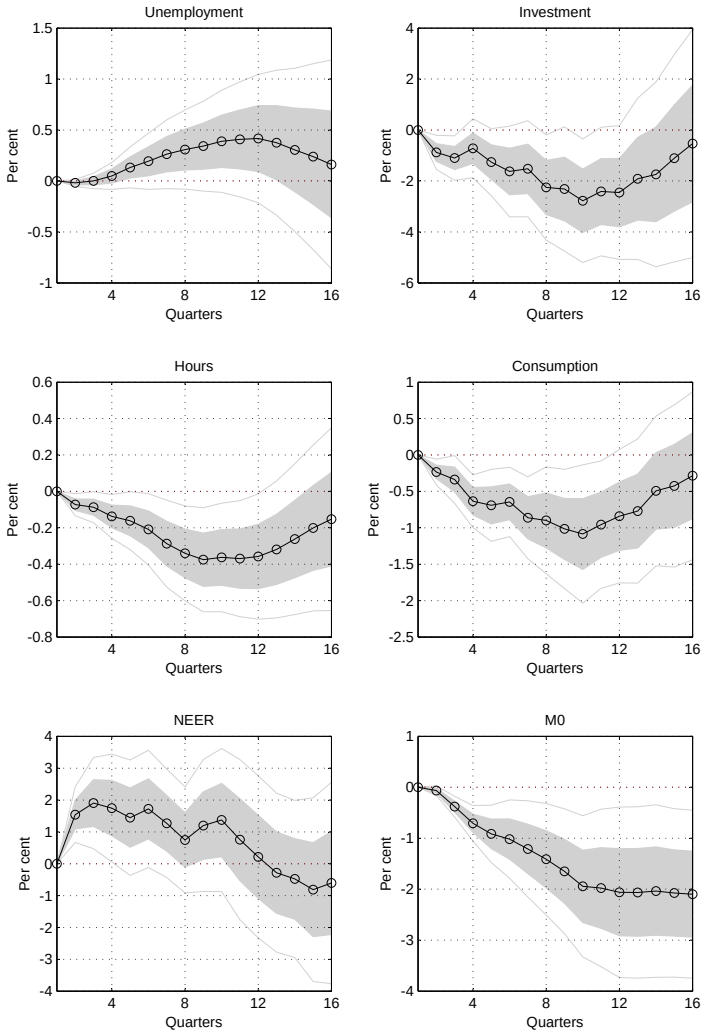
[48] Extending the US sample to 1969-2007 does not alter the results.

[49] In the comparison to the US we use the consumer price index for both countries as the UK producers price index is not available for our full sample.

[50] We thank one of the anonymous referees for pointing this out.

variables of interest using the single equation approach estimated using local projections, as discussed in the robustness section of the main paper. The effects on unemployment rate, investment, hours, consumption, the nominal effective exchange rate, and money supply to a contractionary monetary policy shock are reported in Figure D2. For brevity (and since our main focus is on output and inflation) we do not discuss each of the responses in detail, but all results accord well with the expected signs based on other empirical studies and theoretical macroeconomic models.

FIGURE D2. QUARTERLY SINGLE EQUATION RESULTS



Notes: Impulse responses to a one percentage point contractionary monetary policy shock with corresponding 68 and 95 per cent confidence intervals. We use P=4, Q=8 and estimate impulse responses using local projections. Full sample 1975-2007.

FURTHER RESULTS FOR THE POST-1992 SAMPLE

E1. Predictability tests for the post-1992 subsample

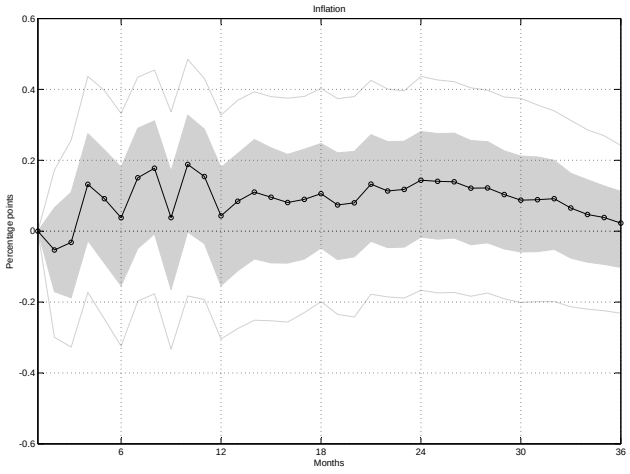
TABLE E1—PREDICTABILITY OF MONETARY POLICY INNOVATIONS: 1993 TO 2007

	I = 3 lags		I = 6 lags	
Variable	F-statistics	P-values	F-statistics	P-values
Change in industrial production	0.67	0.57	0.64	0.70
Monthly inflation	1.85	0.14	1.32	0.25
Unemployment rate	0.00	1.00	0.87	0.52
Money growth M4	0.62	0.60	0.41	0.87
Commodity price inflation	0.43	0.73	1.02	0.42
Change in FTSE	0.88	0.45	0.94	0.47

Notes: The table reports F-statistics and P-values for the null hypothesis that all coefficients β_i are equal to zero. The standard errors are corrected for the possible presence of serial correlation and heteroskedasticity using a Newey-West variance covariance matrix.

E2. The inflation response in a conventional VAR after 1992

FIGURE E1. SMALL-SCALE VAR WITH BANK RATE



Notes: Impulse responses to a one percentage point contractionary monetary policy shock with corresponding 68 and 95 per cent confidence intervals. VAR with industrial production, RPIX12m inflation, commodity prices and Bank Rate. P=12.