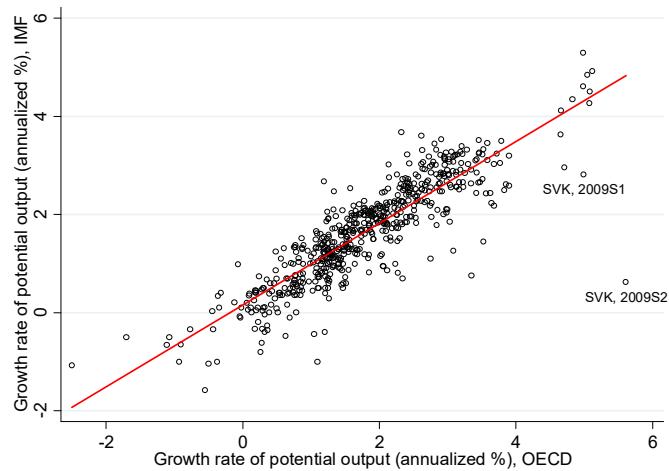


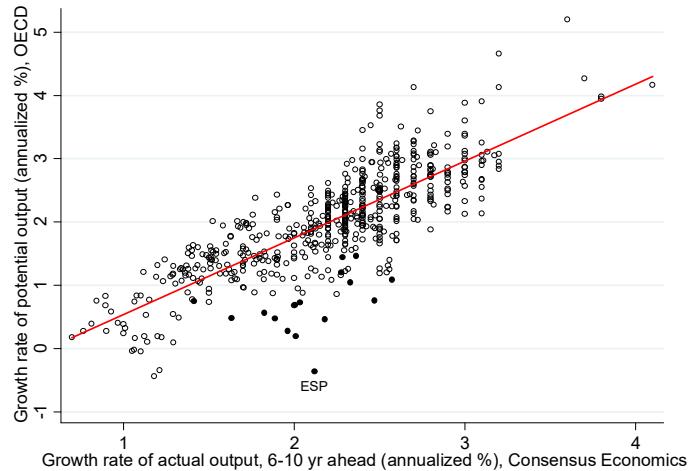
Online Appendix
To Accompany
Coibion, Gorodnichenko, and Ulate
The Cyclical Sensitivity in Estimates of Potential Output
BPEA, Fall 2018

Appendix Figure 1: Comparison of IMF and OECD estimates (nowcast) for potential output growth rate with forecasted long-term growth for actual output in Consensus Economics.

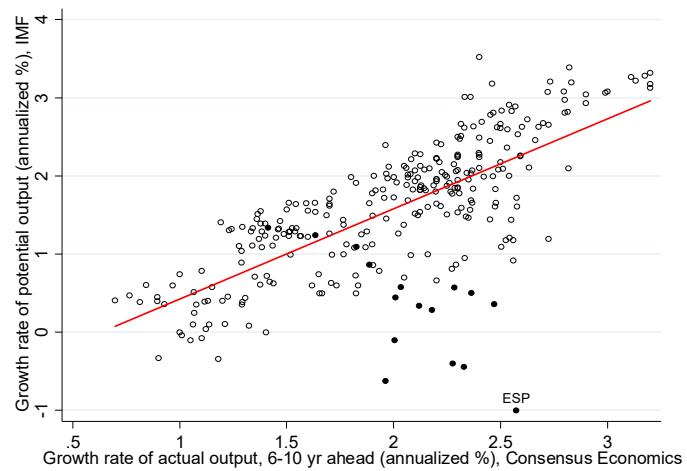
Panel A. IMF vs OECD



Panel B. OECD vs. Consensus Economics

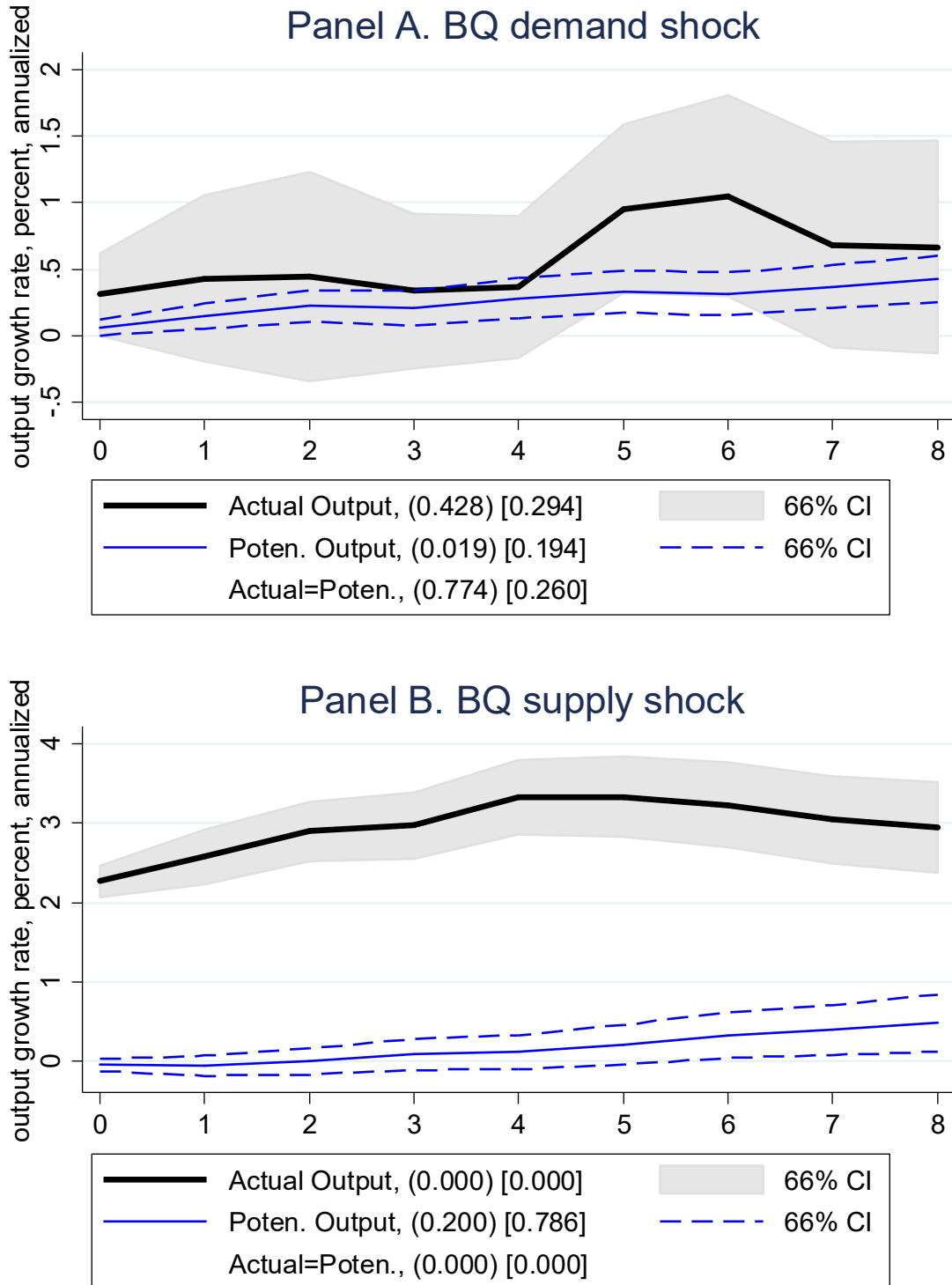


Panel C: IMF vs Consensus Economics



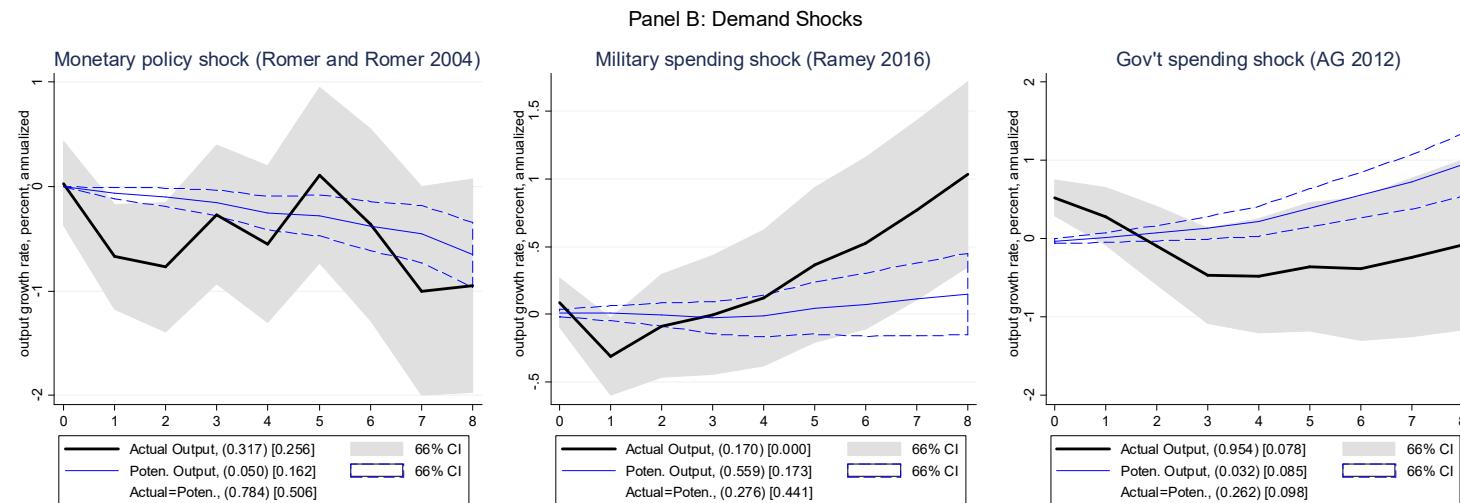
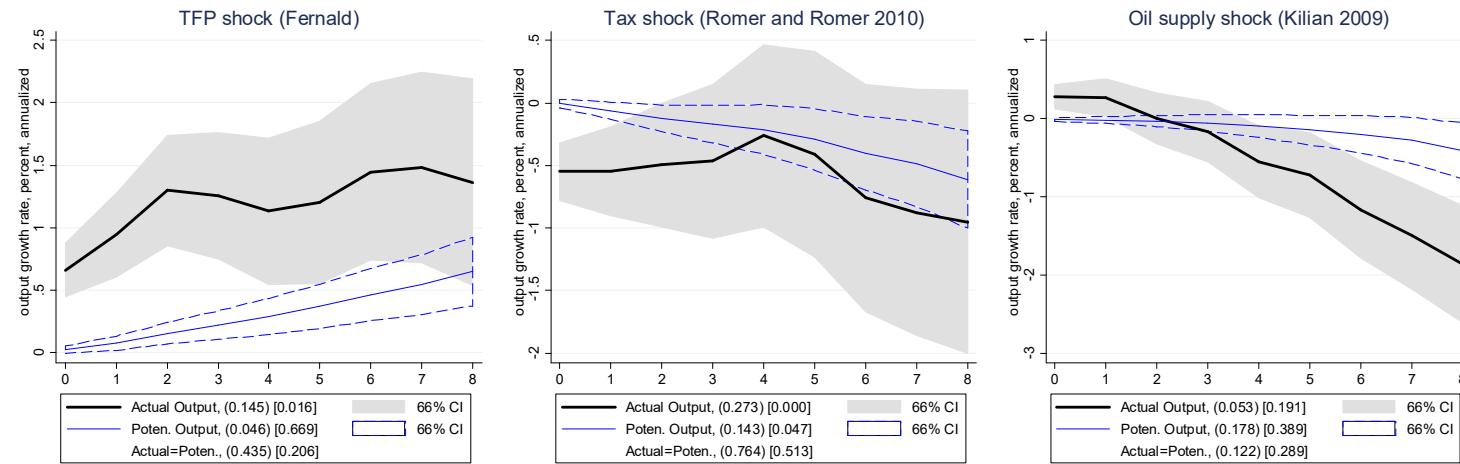
Notes: Filled markers in Panels B and C show observations for Spain in the 2009-2016 period.

Appendix Figure 2: Responses to BQ Identified Supply and Demand Shocks



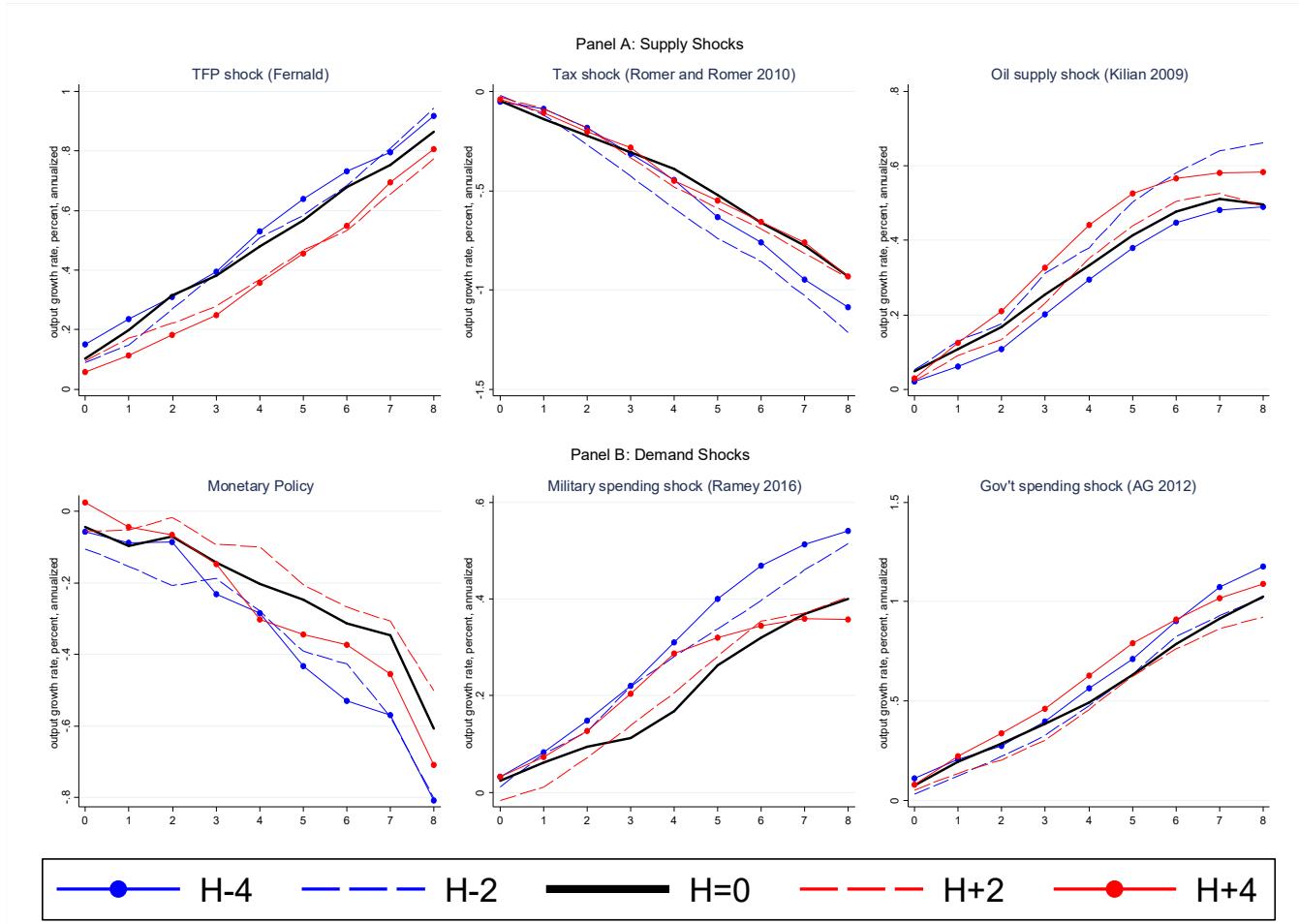
Notes: The figure reports impulse response functions (IRFs) estimated using equation (2) and (3). The estimation sample covers the benchmark time period for Greenbook forecasts. “Supply” and “Demand” shocks are identified as in Blanchard and Quah (1989). In parentheses we report the p-value for a test of whether the IRF of actual (potential) output is different from zero at the max horizon (8 quarters), while in square brackets we show the p-value for a test of whether the path of the IRF of actual (potential) output is different from zero over the entire duration of the IRF. The last row of the legend reports p-values for a test of equality of IRFs of actual and potential output at the max horizon (parentheses) and a test of equality of the paths of the responses for actual and potential output are equal across horizons.

Appendix Figure 3: Responses of Output and Greenbook Estimates of Potential Output in U.S. to Shocks: ADL specification.
 Panel A: Supply Shocks



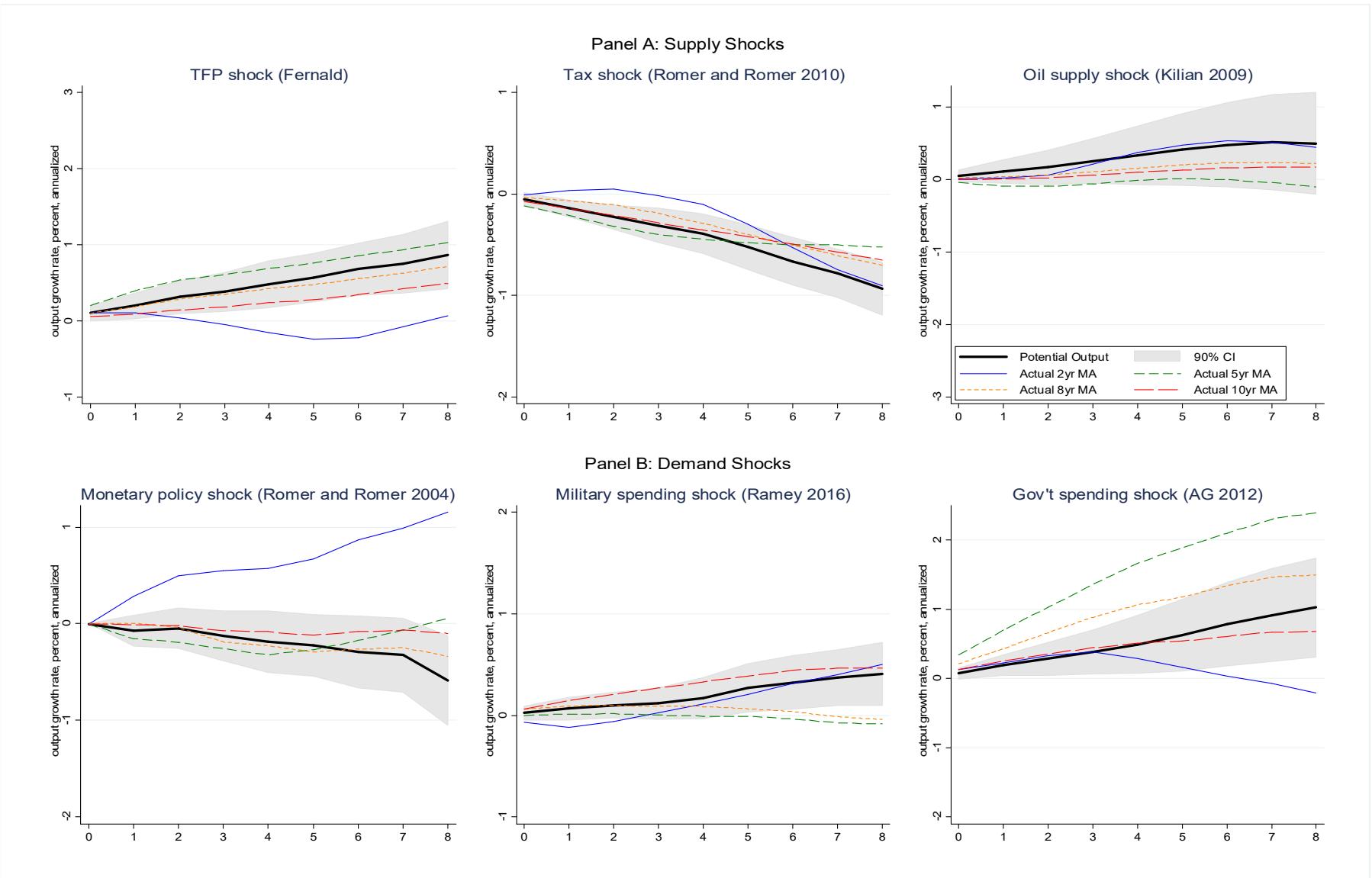
Notes: The figure reports impulse response functions (IRFs) estimated using equation (4), which is an auto-distributed lag specification. The estimation sample covers the longest possible period with non-missing observations for shocks and potential output (output gap) available at the Federal Reserve Bank of Philadelphia. In parentheses we report the p-value for a test of whether the IRF of actual (potential) output is different from zero at the max horizon (8 quarters), while in square brackets we show the p-value for a test of whether the path of the IRF of actual (potential) output is different from zero over the entire duration of the IRF. The last row of the legend reports p-values for a test of equality of IRFs of actual and potential output at the max horizon (parentheses) and a test of equality of the paths of the responses for actual and potential output are equal across horizons.

Appendix Figure 4: Responses of Backcasts and Forecasts of Potential Output.



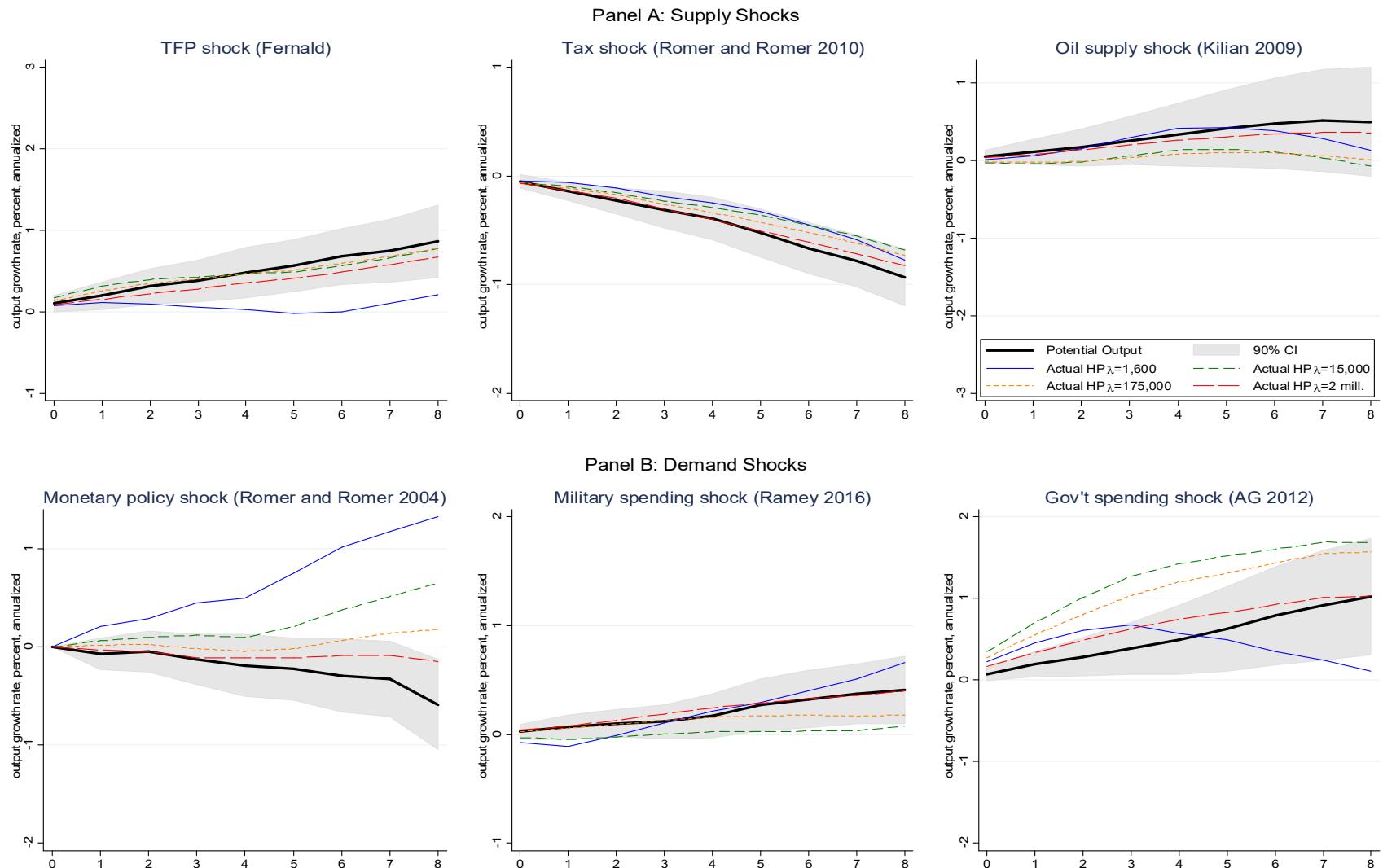
Notes: the figure shows impulse responses of horizon $H + k$ growth rate of potential output to structural shocks. $k > 0$ corresponds to forecasts, $k < 0$ correspond to backcasts, $k = 0$ is the nowcast (which corresponds to the results reported in Figure 6). All data are from Greenbooks.

Appendix Figure 5: Responses of Moving-Averages of Real-Time U.S. Output to Shocks.



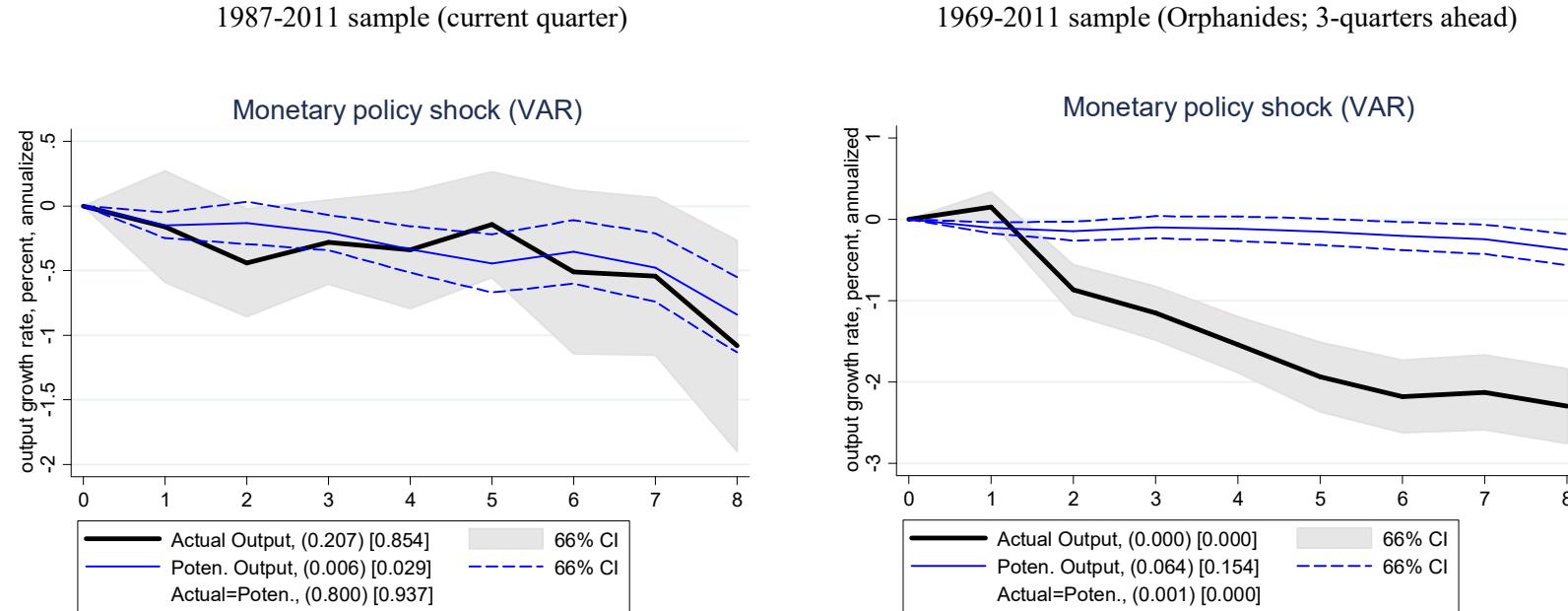
Notes: The figure reports impulse response functions (IRFs) estimated using equations (2) and (3). The estimation sample covers the longest possible period with non-missing observations for shocks and potential output (output gap) available at the Federal Reserve Bank of Philadelphia.

Appendix Figure 6: Responses of HP-filters of Real-Time U.S. Output to Shocks.



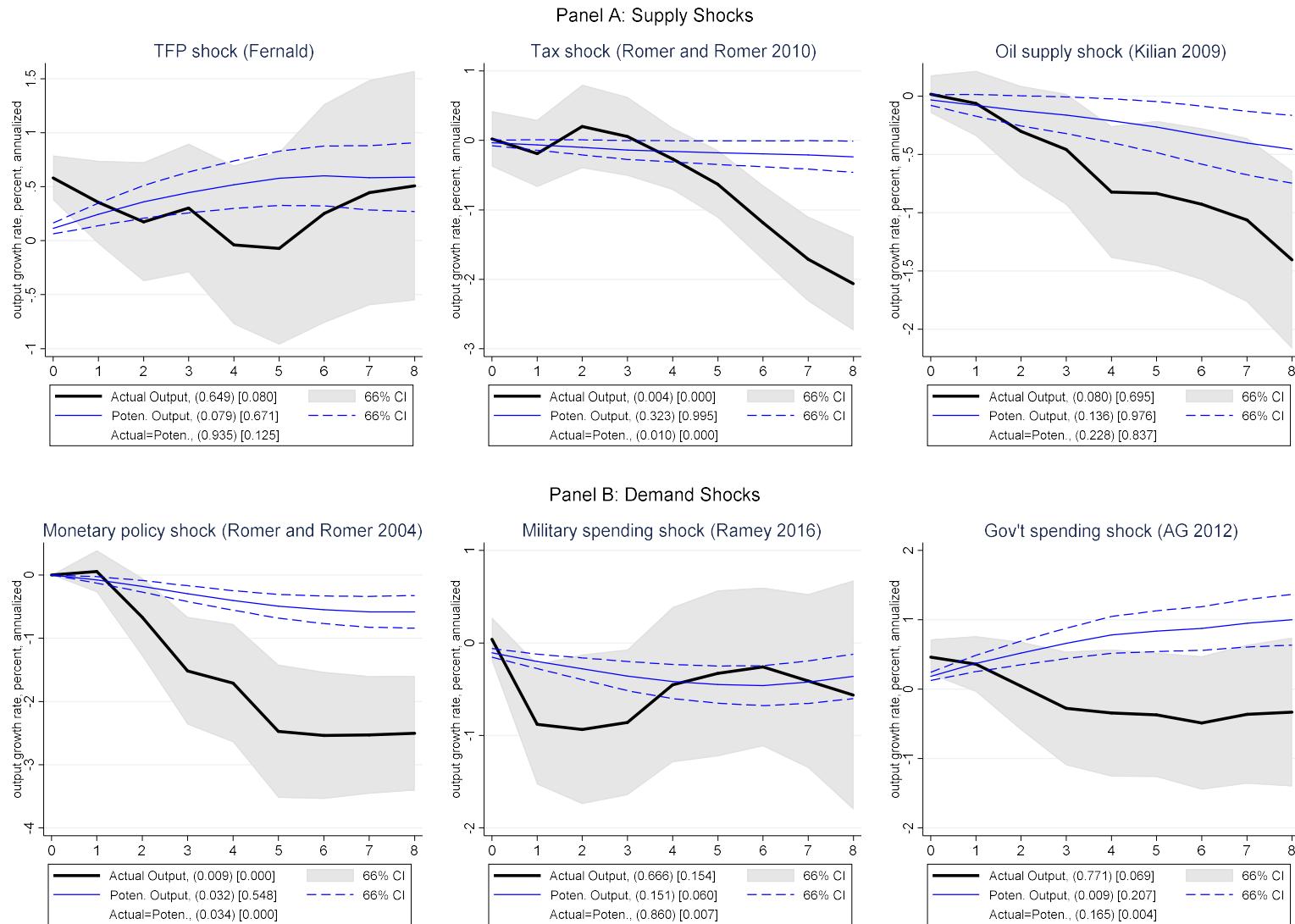
Notes: The figure reports impulse response functions (IRFs) estimated using equations (2) and (3). The estimation sample covers the longest possible period with non-missing observations for shocks and potential output (output gap) available at the Federal Reserve Bank of Philadelphia.

Appendix Figure 7: Robustness of Responses to Identification of Monetary Shocks.



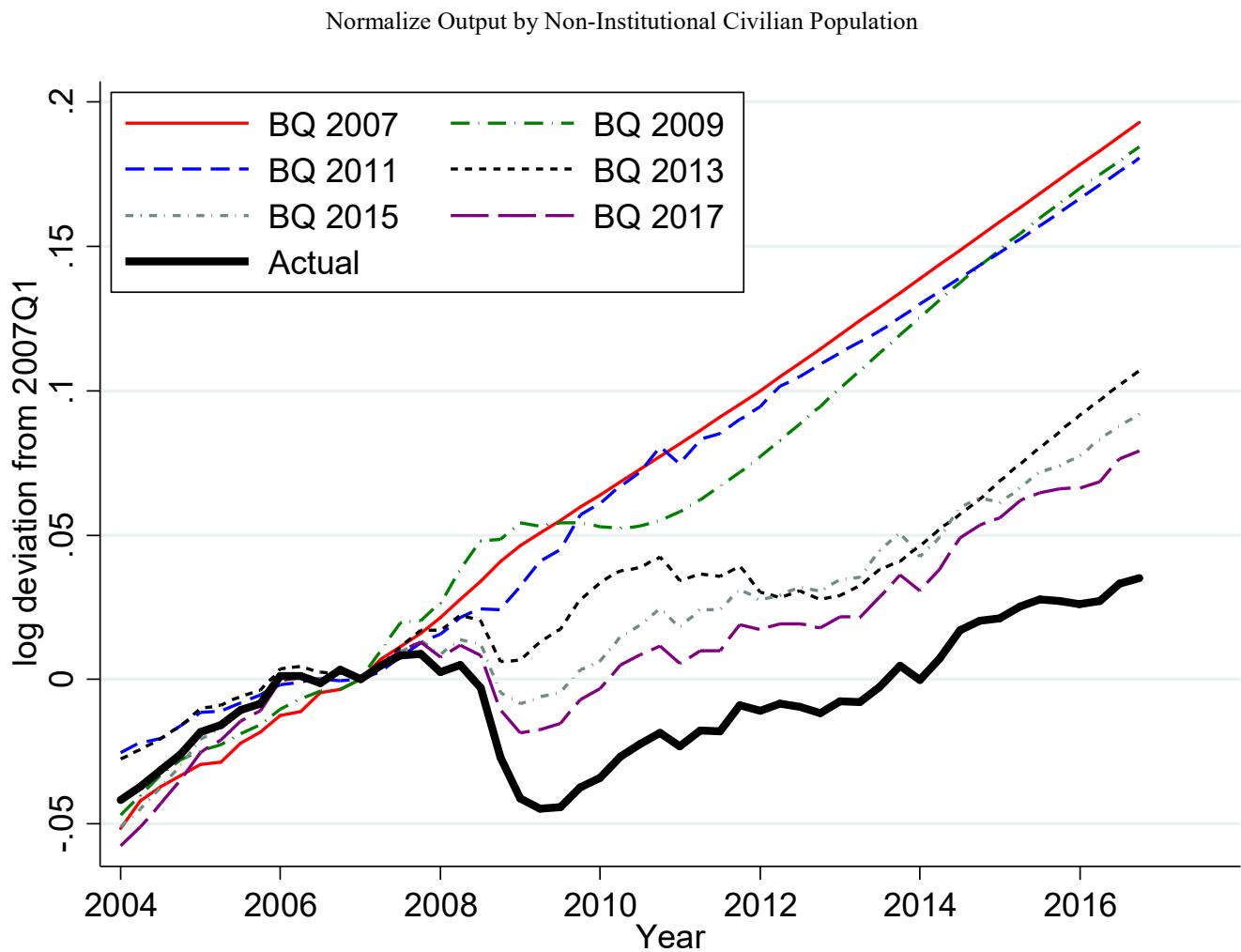
Notes: The figure reports impulse response functions (IRFs) estimated using equations (2) and (3). The estimation sample covers the longest possible period with non-missing observations for shocks and potential output (output gap) available at the Federal Reserve Bank of Philadelphia (left panel) and the extended measure of potential GDP from Orphanides (2004) in right panel. Monetary shocks are identified from a trivariate VAR(4) using Cholesky restrictions.

Appendix Figure 8: Responses of Final CBO Estimates of Potential to Economic Shocks



Notes: The figure reports impulse response functions (IRFs) estimated using equations (2) and (3). The estimation is identical to the baseline, except using final (2017) CBO estimates of potential GDP instead of real-time estimates.

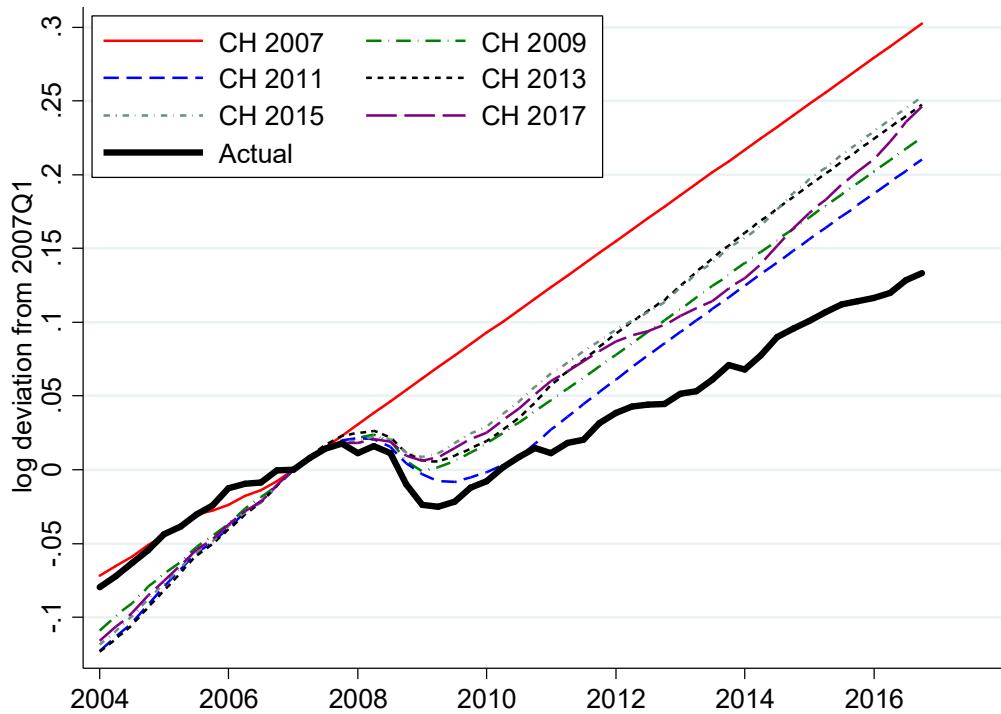
Appendix Figure 9: Robustness of Responses to BQ Estimates of Monetary Shocks.



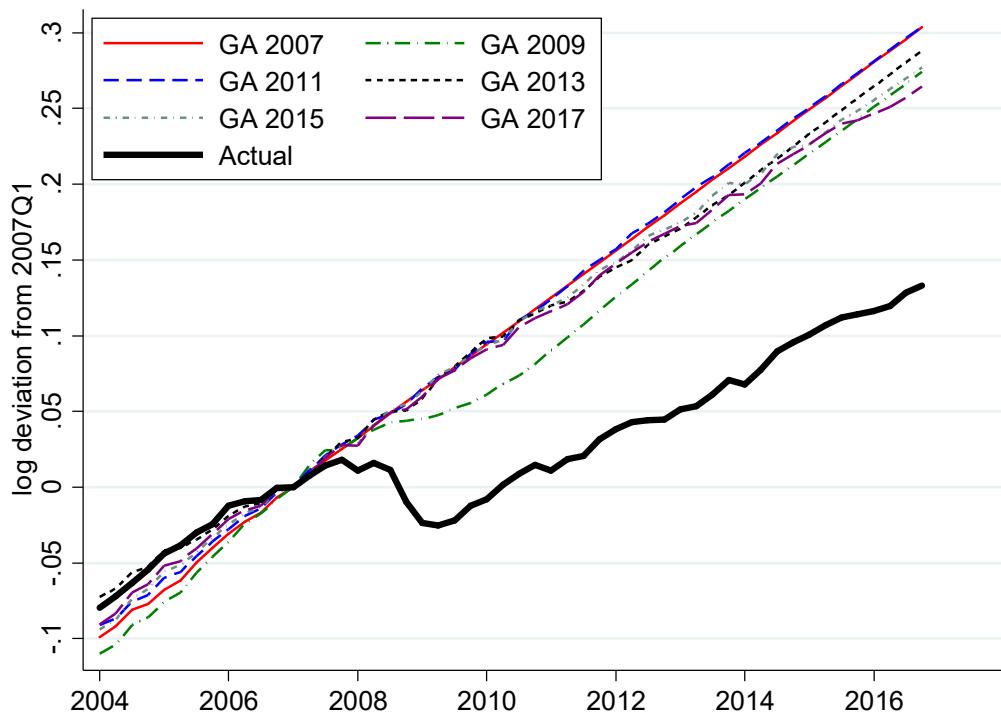
Notes: the figure reports results for the series normalized real GDP by non-institutional civilian population and use the 1947-2007 period to compute trend growth for the normalized variable.

Appendix Figure 10: Revisions in Potential GDP during the Great Recession from the Cochrane and Gali estimates

Panel A. Cochrane (1994) approach.

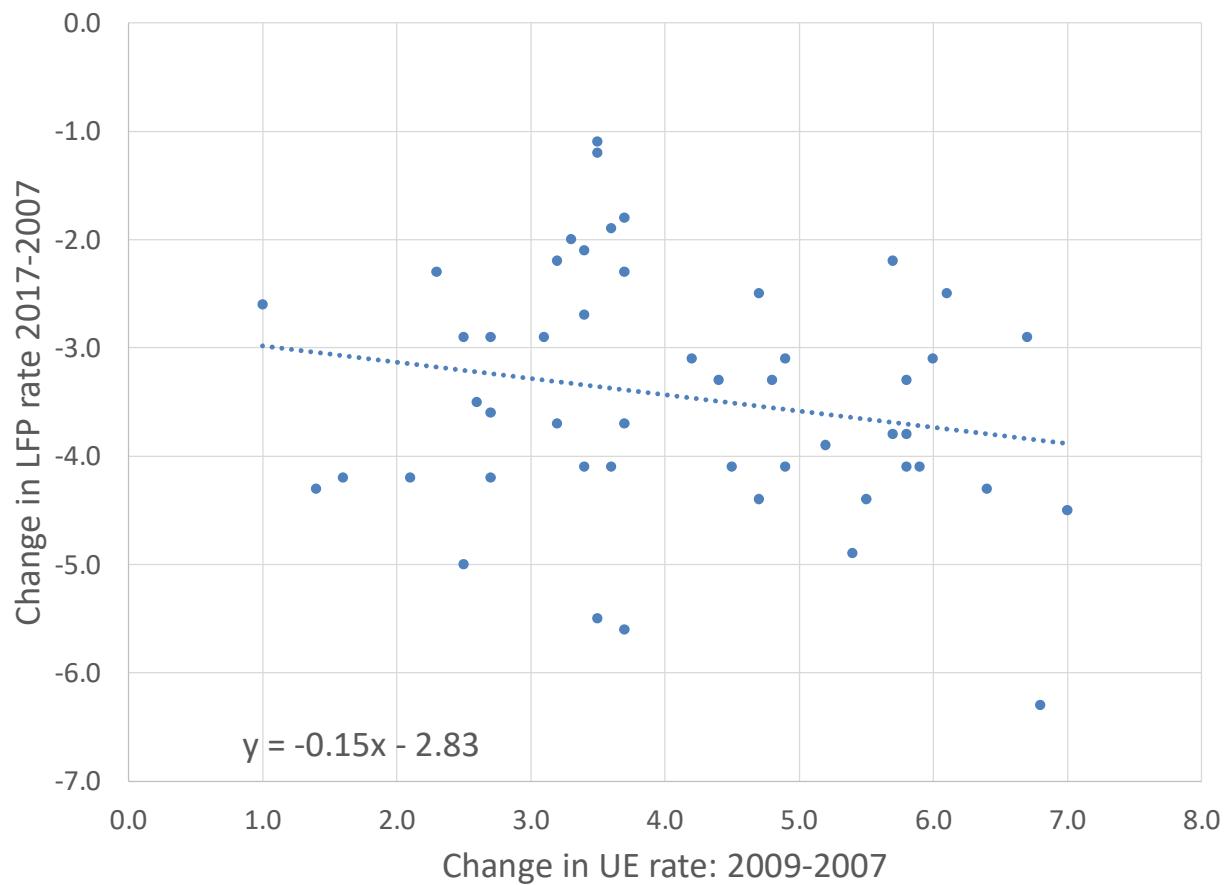


Panel B. Gali (1999) approach.



Notes: The figure shows real-time estimates of changes in potential output since 2007 using the method of Cochrane (1994) in panel A and Gali (1999) in Panel B. The solid black line is actual GDP. See Section 5.2 for details.

Appendix Figure 11: State Unemployment and Changes in Labor Force Participation since the Great Recession



Notes: The figure shows the evolution of total labor force participation from 2007-2017 for each U.S. state (vertical axis) relative to the change in their unemployment rate from 2007 -2009.

Appendix Table 1. Data coverage for cross-country analysis.

Country	Prod. Shock	Oil Shock	Monetary Shock	Fiscal Shock	Actual IMF	Potential IMF	Actual OECD	Potential OECD	Actual C.E.
Australia	1981-2018	1980-2016	1983-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	No data
Austria	No data	1980-2016	1989-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	No data
Belgium	1981-2018	1980-2016	1984-2016	1998-2013	2003-2016	2003-2016	1986-2016	1989-2016	No data
Canada	1981-2018	1980-2016	1994-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
Switzerland	No data	1980-2016	1994-2016	1998-2014	No data	No data	1986-2016	1989-2016	1998-2016
Cyprus	No data	1980-2015	2001-2016	No data	2003-2016	2009-2016	No data	No data	No data
Czech Republic	1994-2018	1990-2016	1996-2016	1998-2009	No data	No data	1996-2016	2005-2016	No data
Germany	1992-2018	1980-2016	1994-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
Denmark	No data	1980-2016	1984-2016	1998-2010	2003-2016	2009-2016	1986-2016	1989-2016	No data
Spain	No data	1980-2016	1987-2016	1998-2012	2003-2016	2003-2016	1986-2016	1989-2016	1995-2016
Estonia	1996-2018	1990-2016	1995-2016	2010-2014	2003-2016	2012-2016	2008-2016	2011-2016	No data
Finland	1981-2018	1980-2016	1989-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	No data
France	1981-2018	1980-2016	1983-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
United Kingdom	1981-2018	1980-2016	1990-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
Greece	No data	1980-2016	No data	1998-2001	2003-2016	2009-2016	1986-2016	1989-2016	No data
Hungary	No data	1980-2016	2002-2016	1998-2003	No data	No data	1996-2016	2005-2016	No data
Ireland	1991-2018	1980-2016	2000-2016	1998-2014	2003-2016	2003-2016	1996-2016	1996-2016	No data
Iceland	1981-2018	1980-2016	1999-2016	1998-2014	No data	No data	1986-2016	2000-2016	No data
Italy	1981-2018	1980-2016	1984-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
Japan	1981-2018	1980-2016	1994-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016
Korea	1981-2018	1980-2016	1994-2016	1999-2014	2003-2016	2012-2016	1997-2016	2005-2016	No data
Luxembourg	1986-2018	1980-2016	1997-2016	1998-2014	2003-2016	2012-2016	1986-2016	2005-2016	No data
Malta	No data	1980-2015	No data	No data	2003-2016	2009-2016	No data	No data	No data
Netherlands	1981-2018	1980-2016	1984-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	1995-2016
Norway	1981-2018	1980-2016	1981-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	1998-2016
New Zealand	1990-2018	1980-2016	1987-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	No data
Poland	No data	1980-2016	1997-2015	1998-2011	No data	No data	1996-2016	2005-2016	No data
Portugal	1981-2018	1980-2016	1993-2016	1998-2014	2003-2016	2003-2016	1986-2016	1994-2016	No data
Slovak Republic	No data	1980-2016	2001-2016	2008-2009	2003-2016	2009-2016	2000-2016	2005-2016	No data
Slovenia	No data	1992-2016	1997-2016	2014-2014	2003-2016	2009-2016	2008-2016	2010-2016	No data
Sweden	1981-2018	1980-2016	1984-2016	1998-2014	2003-2016	2003-2016	1986-2016	1989-2016	1995-2016
Turkey	No data	1980-2016	2001-2016	1998-2002	No data	No data	1986-2016	2005-2016	No data
United States	1981-2018	1980-2016	1981-2016	1987-2014	2003-2016	2003-2016	1986-2016	1989-2016	1989-2016

Notes: The table describes time periods for which shocks and measures of potential output are available for each country and source of data. “C.E.” are forecasts of 6-10 year ahead GDP growth. See Section 2 for descriptions of measures of potential GDP, and Sections 3 and 4 for details on construction of shocks.

Appendix Table 2. P-values for tests for U.S. data

Shocks	Measure of actual output		Potential output		Equality of IRFs for measure of actual and potential output	
	IRF is equal to zero pointwise	IRF is zero at the max horizon	IRF is equal to zero pointwise	IRF is zero at the max horizon	pointwise	at the max horizon
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Greenbook, 1987-2011, Measure of actual = actual						
TFP shock	0.020	0.296	0.126	0.001	0.174	0.962
Government spending shock, (AG 2012)	0.065	0.922	0.093	0.017	0.030	0.336
Tax shock (RR 2010)	0.002	0.106	0.000	0.000	0.001	0.983
Military spending shock (Ramey 2016)	0.000	0.204	0.183	0.029	0.000	0.506
Oil price shock (Kilian 2009)	0.018	0.012	0.894	0.242	0.038	0.002
Monetary policy shock (RR 2004)	0.409	0.533	0.455	0.035	0.446	0.788
Panel B. Greenbook, 1969-2011, Measure of actual = actual						
TFP shock	0.030	0.687	0.452	0.067	0.048	0.930
Government spending shock, (AG 2012)	0.012	0.919	0.901	0.163	0.019	0.479
Tax shock (RR 2010)	0.000	0.004	0.548	0.027	0.001	0.070
Military spending shock (Ramey 2016)	0.107	0.728	0.002	0.000	0.264	0.450
Oil price shock (Kilian 2009)	0.409	0.067	0.007	0.000	0.136	0.002
Monetary policy shock (RR 2004)	0.000	0.018	0.001	0.005	0.000	0.100
Panel C1. Greenbook, 1987-2011, Measure of actual = 5yr MA of last vintage of actual						
TFP shock	0.441	0.016	0.126	0.001	0.991	0.935
Government spending shock, (AG 2012)	0.041	0.001	0.093	0.017	0.408	0.069
Tax shock (RR 2010)	0.977	0.868	0.000	0.000	0.096	0.077
Military spending shock (Ramey 2016)	0.955	0.218	0.183	0.029	0.539	0.020
Oil price shock (Kilian 2009)	0.967	0.296	0.894	0.242	0.236	0.002
Monetary policy shock (RR 2004)	0.313	0.461	0.455	0.035	0.000	0.012
Panel C2. Greenbook, 1987-2011, Measure of actual = 5yr MA of real time actual						
TFP shock	0.488	0.008	0.126	0.001	0.980	0.567
Government spending shock, (AG 2012)	0.004	0.000	0.093	0.017	0.079	0.011
Tax shock (RR 2010)	0.973	0.285	0.000	0.000	0.334	0.363
Military spending shock (Ramey 2016)	0.999	0.794	0.183	0.029	0.776	0.116
Oil price shock (Kilian 2009)	0.993	0.893	0.894	0.242	0.953	0.140
Monetary policy shock (RR 2004)	0.806	0.884	0.455	0.035	0.000	0.008
Panel C3. Greenbook, 1987-2011, Measure of actual = HP of real time actual						
TFP shock	0.514	0.010	0.126	0.001	0.951	0.266
Government spending shock, (AG 2012)	0.205	0.010	0.093	0.017	0.198	0.986
Tax shock (RR 2010)	0.089	0.001	0.000	0.000	0.344	0.567
Military spending shock (Ramey 2016)	0.779	0.078	0.183	0.029	0.063	0.963
Oil price shock (Kilian 2009)	0.998	0.419	0.894	0.242	0.910	0.470
Monetary policy shock (RR 2004)	0.998	0.640	0.455	0.035	0.000	0.001
Panel D. CBO, 1991-2011, Measure of actual = actual						
TFP shock	0.250	0.041	0.000	0.001	0.916	0.843
Government spending shock, (AG 2012)	0.290	0.141	0.017	0.001	0.360	0.922
Tax shock (RR 2010)	0.000	0.024	0.000	0.001	0.000	0.984
Military spending shock (Ramey 2016)	0.000	0.006	0.000	0.000	0.382	0.636
Oil price shock (Kilian 2009)	0.017	0.227	0.959	0.503	0.036	0.031
Monetary policy shock (RR 2004)	0.994	0.922	0.720	0.844	0.900	0.959

Notes: The table reports p-values for responses of actual GDP (columns 1-2) or estimates of potential GDP (columns 3-4) in response to shocks. Column 1 tests null that actual GDP is always zero in IRFs, column 2 tests null that its response is zero at the max horizon of IRFs. Columns 3 and 4 are equivalent but for responses of the estimates of potential GDP. Column 5 tests the null that the IRFs of actual GDP and estimated potential are the same at all horizons while column 6 tests the null they are the same at the final horizon. Panels A and C (1, 2 and 3) use the same measure of potential GDP (Greenbook 1987-2001); what changes between these panels is the measure of actual GDP (panel A uses the last vintage of actual output, panel C1 uses a 5 year moving average of the last vintage of actual output, panel C2 uses a 5 year moving average of actual output in real time and panel C3 uses an actual output in real time filtered with the Hodrick and Prescott method).

Appendix Table 3. P-values for tests for international data

Shocks	Measure of actual output		Potential output		Equality of IRFs for measure of actual and potential output	
	IRF is equal to zero pointwise	IRF is zero at the max horizon	IRF is equal to zero pointwise	IRF is zero at the max horizon	pointwise	at the max horizon
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. IMF, Measure of actual = actual						
TFP shock	0.000	0.000	0.046	0.011	0.000	0.000
Oil price shock (Kilian 2009)	0.001	0.098	0.007	0.101	0.008	0.171
Monetary policy shock (VAR)	0.000	0.123	0.002	0.036	0.000	0.128
Government spending shock, (AG 2012)	0.033	0.364	0.001	0.002	0.086	0.825
Panel B. IMF, Measure of actual = HP of real time actual						
TFP shock	0.289	0.128	0.046	0.011	0.301	0.272
Oil price shock (Kilian 2009)	0.004	0.002	0.007	0.101	0.000	0.000
Monetary policy shock (VAR)	0.003	0.000	0.002	0.036	0.163	0.433
Government spending shock, (AG 2012)	0.023	0.000	0.001	0.002	0.139	0.430
Panel C. OECD, Measure of actual = actual						
TFP shock	0.000	0.000	0.003	0.000	0.000	0.000
Oil price shock (Kilian 2009)	0.061	0.445	0.338	0.081	0.117	0.955
Monetary policy shock (VAR)	0.080	0.023	0.470	0.070	0.289	0.118
Government spending shock, (AG 2012)	0.002	0.081	0.000	0.000	0.002	0.583
Panel D. OECD, Measure of actual = HP of real time actual						
TFP shock	0.001	0.000	0.003	0.000	0.000	0.004
Oil price shock (Kilian 2009)	0.578	0.313	0.338	0.081	0.173	0.361
Monetary policy shock (VAR)	0.044	0.001	0.470	0.070	0.052	0.001
Government spending shock, (AG 2012)	0.000	0.000	0.000	0.000	0.577	0.486
Panel E. Consensus Economics, Measure of actual = actual						
TFP shock	0.000	0.000	0.226	0.019	0.000	0.000
Oil price shock (Kilian 2009)	0.116	0.707	0.020	0.003	0.065	0.370
Monetary policy shock (VAR)	0.001	0.000	0.938	0.418	0.027	0.001
Government spending shock, (AG 2012)	0.025	0.986	0.074	0.002	0.018	0.583
Panel F. Consensus Economics, Measure of actual = HP of real time actual						
TFP shock	0.043	0.001	0.226	0.019	0.051	0.001
Oil price shock (Kilian 2009)	0.511	0.075	0.020	0.003	0.794	0.842
Monetary policy shock (VAR)	0.073	0.070	0.938	0.418	0.074	0.057
Government spending shock, (AG 2012)	0.006	0.000	0.074	0.002	0.018	0.000

Notes: The table reports p-values for different statistics of responses of actual GDP (columns 1-2) or estimates of potential GDP (columns 3-4) in response to shocks listed in the table using different measures of potential GDP. Column 1 tests null that actual GDP is always zero in IRFs while column 2 tests null that its response is zero at the maximum horizon of IRFs. Columns 3 and 4 are equivalent but for responses of the estimates of potential GDP. Column 5 tests the null that the IRFs of actual GDP and estimated potential are the same at all horizons while column 6 tests the null they are the same at the final horizon. See Section 4 for details. Notice also that the measure of potential output is the same in panels A and B, in panels C and D and in panels E and F, what differs between these pairs is that the first uses the last vintage of actual output as a measure of actual output while the second uses real time actual output filtered with an HP filter with $\lambda = 800$.