# Online appendix - not for publication

## Appendix A: Additional tables and figures

Table A.1: Coefficients on the interaction terms and corresponding t-statistics

Panel A: Unemployment expectations

| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | 0.45 | 0.14 | 5.17 | 0.19 |
| 1 | -3.25 | -0.66 | 46.23 | 1.37 |
| 2 | 2.43 | 0.56 | 26.41 | 0.77 |
| 3 | -2.33 | -0.59 | 7.76 | 0.21 |
| 4 | 1.04 | 0.25 | 16.68 | 0.57 |
| 5 | 4.81 | 1.27 | 54.63 | 1.31 |
| 6 | 4.06 | 1.00 | 107.46 | 2.37 |
| 7 | 2.89 | 0.45 | 71.28 | 2.11 |
| 8 | 7.01 | 1.09 | 66.24 | 1.79 |

Panel B: Inflation expectations

| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | 0.34 | 1.27 | 1.77 | 0.92 |
| 1 | 0.61 | 1.81 | 1.49 | 0.78 |
| 2 | 0.04 | 0.15 | 2.46 | 1.00 |
| 3 | -0.09 | -0.24 | -0.14 | -0.06 |
| 4 | 0.78 | 1.95 | 3.26 | 1.37 |
| 5 | 0.19 | 0.61 | 0.76 | 0.36 |
| 6 | 0.04 | 0.14 | -2.05 | -1.00 |
| 7 | 0.33 | 1.31 | -1.37 | -0.79 |
| 8 | -0.04 | -0.21 | -0.11 | -0.05 |

Panel C: Interest rate expectations

| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | 6.33 | 0.94 | 98.02 | 2.10 |
| 1 | 4.38 | 0.68 | 145.99 | 2.61 |
| 2 | 9.76 | 1.02 | 50.40 | 0.92 |
| 3 | -11.43 | -1.35 | 19.85 | 0.32 |
| 4 | -10.93 | -1.35 | 35.79 | 0.70 |
| 5 | -12.92 | -1.42 | -102.26 | -1.51 |
| 6 | -21.95 | -2.74 | -217.56 | -3.94 |
| 7 | -2.61 | -0.22 | -212.19 | -3.08 |
| 8 | -10.73 | -0.94 | -200.13 | -2.94 |

Panel D: Economic policy satisfaction

| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | -7.77 | -2.63 | -55.17 | -2.99 |
| 1 | -2.38 | -0.59 | -54.84 | -1.78 |
| 2 | -0.93 | -0.25 | -37.94 | -1.48 |
| 3 | -0.20 | -0.05 | 8.63 | 0.29 |
| 4 | -7.10 | -1.58 | -19.73 | -0.62 |
| 5 | -7.33 | -1.40 | -56.45 | -1.77 |
| 6 | -3.54 | -0.78 | -30.44 | -0.89 |
| 7 | 3.67 | 0.86 | -46.98 | -1.27 |
| 8 | 5.29 | 0.84 | -103.00 | -2.33 |

Panel E: Consumption intentions

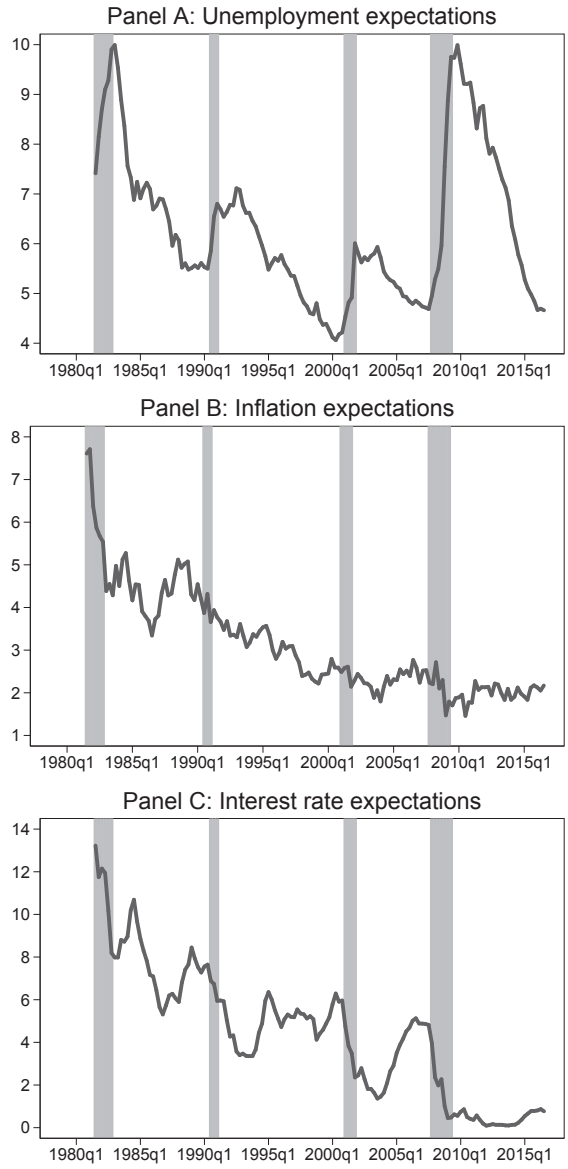
| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | -9.29 | -3.06 | 18.17 | 0.87 |
| 1 | -9.43 | -1.63 | 34.26 | 1.00 |
| 2 | -6.45 | -1.50 | -16.83 | -0.61 |
| 3 | -9.06 | -2.14 | -20.61 | -0.64 |
| 4 | -7.50 | -2.06 | 26.45 | 0.85 |
| 5 | -10.74 | -2.86 | -40.91 | -1.79 |
| 6 | -6.77 | -1.59 | -56.77 | -1.80 |
| 7 | -3.14 | -0.73 | -54.74 | -2.22 |
| 8 | -8.08 | -1.72 | -51.81 | -1.48 |

Panel F: Consumption expenditures

| $\tau$ | $\beta_\tau^{g,state}$ | tstat | $\beta_\tau^{m,state}$ | tstat |
|---|---|---|---|---|
| 0 | 0.00 | -0.71 | -0.02 | -1.17 |
| 1 | 0.00 | -1.23 | 0.03 | 1.16 |
| 2 | 0.00 | -1.08 | 0.01 | 0.51 |
| 3 | -0.01 | -1.32 | -0.01 | -0.20 |
| 4 | -0.01 | -2.34 | -0.06 | -1.73 |
| 5 | -0.01 | -1.73 | -0.07 | -1.92 |
| 6 | 0.00 | -0.75 | -0.06 | -1.82 |
| 7 | 0.00 | -1.36 | -0.07 | -2.88 |
| 8 | -0.01 | -3.75 | -0.09 | -2.87 |

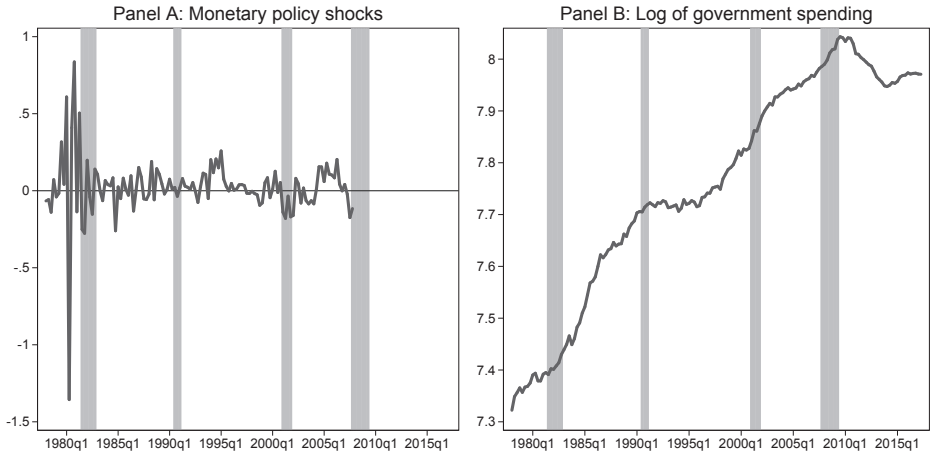
The table shows coefficients on the interaction terms $\beta_\tau^{g,state}$ and $\beta_\tau^{m,state}$ together with the corresponding t-statistics estimated from Equation 2.

Figure A.1: Aggregated survey measures from the Survey of Professional Forecasters



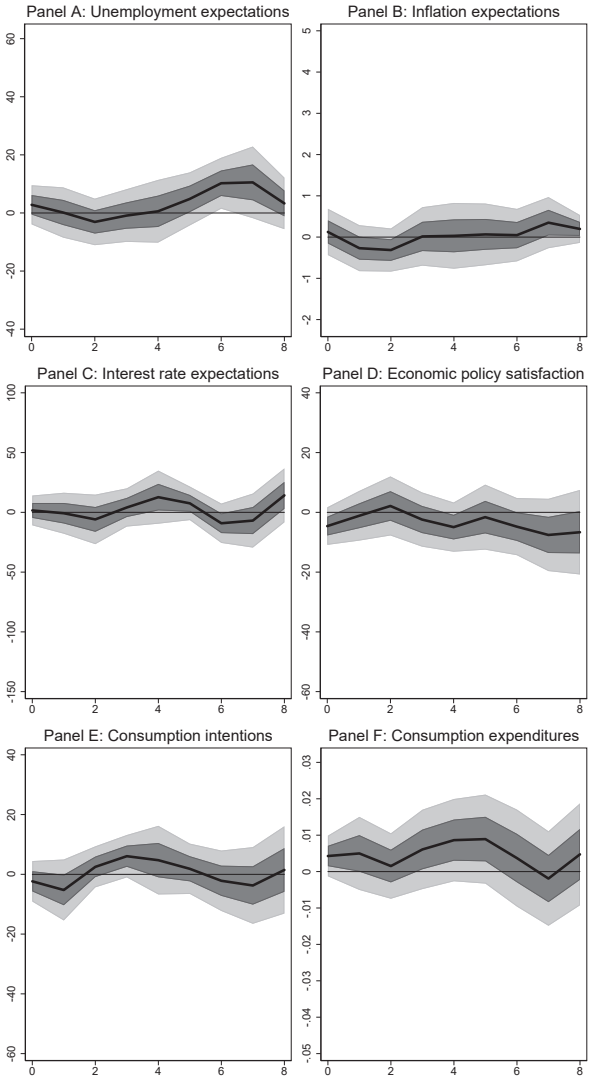

Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee. Expectations are average point estimates in percent.

Figure A.2: Measures of monetary policy and government spending



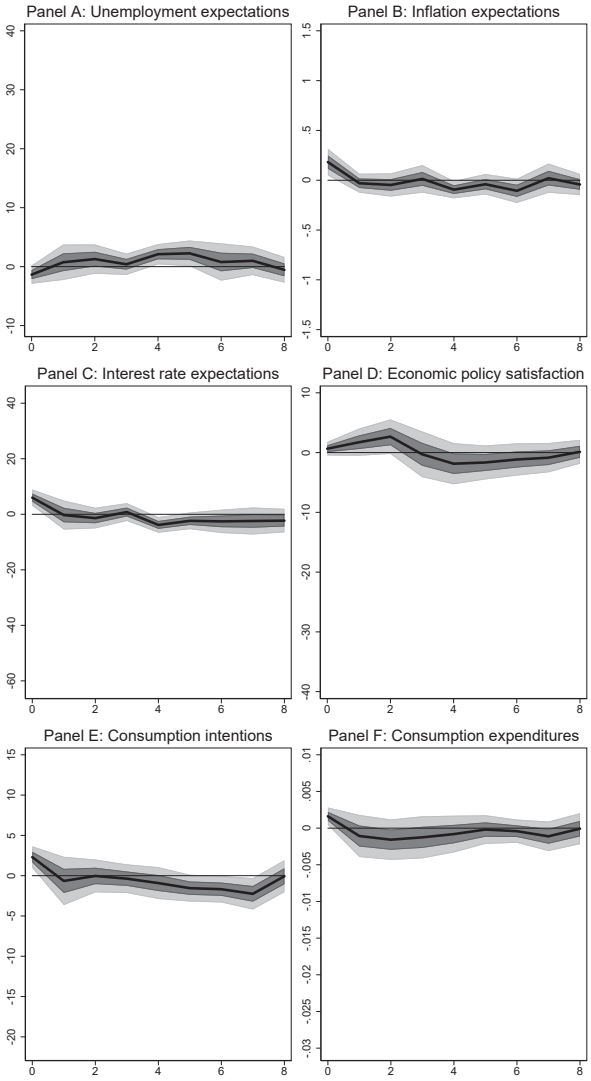

Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee.

Figure A.3: Consumer expectations responses to government spending shocks (linear model)



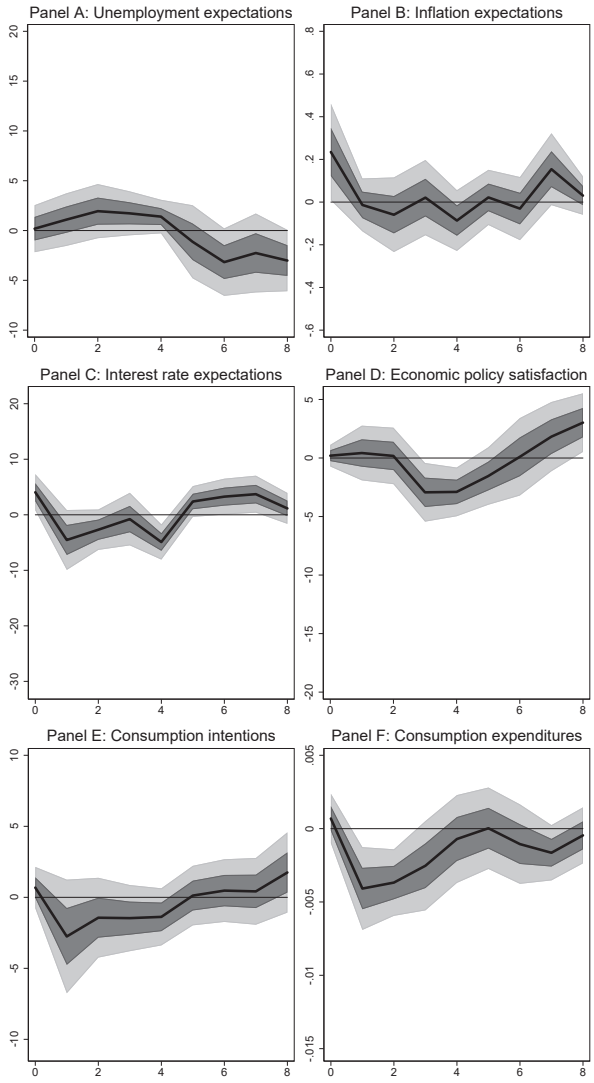

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure A.4: Consumer expectations responses to monetary policy shocks (linear model)



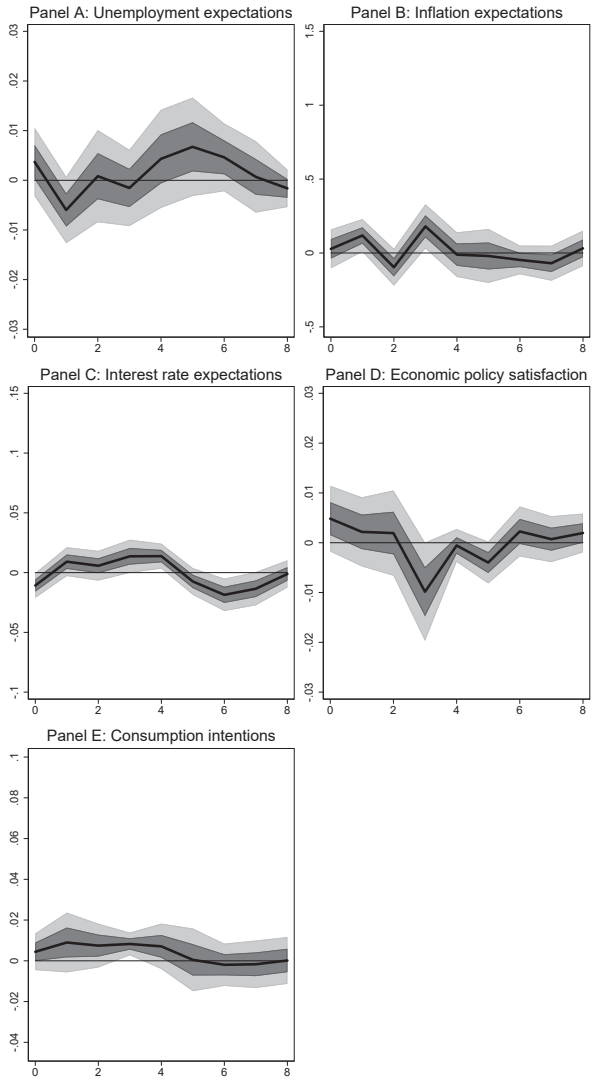

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure A.5: Consumer expectations responses to monetary policy shocks in the low-debt state (zoomed in)




Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure A.6: Responses of standard deviations to monetary policy shock in the low-debt state (zoomed in)




Inflation expectations are average point estimates in percent, all other survey measures are balance scores. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

## Appendix B: Robustness checks

### Government spending purged from anticipation effects

Previous literature provides some evidence indicating that the Blanchard and Perotti (2002) government spending shocks may be anticipated to a certain extent (Ramey, 2011). Thus, we purge these derived "shock" measures from anticipation effects, and evaluate the sensitivity of the responses to shocks in this purged government spending series.

We purge the government spending series from expected changes by regressing this at $t$ on forecasts of government spending for $t$ elicited at $t-1$,[1] retain the residuals from this regression, and use them as the government spending measure in Equation 2.[2] The corresponding IRFs are shown in Figure B.1 in the online appendix. We note that the sample for the underlying estimations is 1981q4 to 2007q4 as government spending forecasts are available beginning with 1981q3.

Comparing Figure B.1 with the baseline estimation shown in Figure 3, we again observe stronger responses to government spending shocks in the high-debt state as compared to the low-debt state. Moreover, along the lines of the baseline estimation, responses have opposite signs in the low versus the high-debt state in several instances.

In the low-debt state, unemployment expectations in the left column of Panel A are largely unaffected with the exception of the impact period and the sixth quarter after impact. Inflation expectations (Panel B) respond negatively on impact and then positively in the fifth and eight quarter out, significantly so in the latter case. Interest rate expectations (Panel C) go up significantly in the fourth quarter after impact and are positive in the fifth and eighth quarter out. Economic policy satisfaction (Panel D) is unaffected on impact, but the IRF is negative from the first to the seventh quarter, with the exception of the sixth. The IRFs of consumption

[1] As a measure of government spending forecasts, we use the mean forecast of three quarters ahead real federal government consumption expenditures and gross investment.

[2] We additionally control for a linear trend.

intentions (Panel E) are in positive territory on impact, and in the first, fourth, fifth and eighth quarters, significantly so in the first quarter. These responses in the low-debt state are qualitatively similar to the baseline estimation. A similar picture emerges from the IRFs of actual consumption (Panel F), which significantly goes down in quarter one and is otherwise indistinguishably different from zero until quarter six in which we observe a negative response followed by a positive reaction in quarter eight.

We also find consumers' updating in response to government spending shocks to be qualitatively similar compared to the baseline in the high debt state, but observe some differences in the dynamics of the responses. Compared to the baseline, unemployment expectations in the right column of Panel A also go up in the fourth quarter, but the increase is only temporary. Inflation expectations (Panel B) go up significantly on impact, remain above the long-run mean in quarter one and slightly overshoot in quarter eight. Compared to the baseline, the increase in inflation expectations is thus rather short-lived in the high-debt state. Interest rate expectations (Panel C) respond similarly to the baseline. After an initial increase, interest rate expectations fall below zero. But the maximum impact occurs in the fourth, not in the sixth quarter as in the baseline. Interest rate expectations are significantly negative in the fourth quarter and remain below zero until quarter six. Policy satisfaction (Panel D) responds negatively on impact and in the fourth quarter, as in the baseline, but the IRF is otherwise indistinguishable from zero, and even positive in quarter seven. Thus, as compared to the baseline, economic policy satisfaction responds less strongly in the high-debt state. In line with the baseline estimation, consumption intentions (Panel E) respond negatively throughout and significantly so on impact, the first, third, fourth and eight quarters. Similarly, actual consumption (Panel F) goes down in quarters two, five, seven and eight.

Considering the t-statistics on the interaction term, $\beta_{\tau}^{g,state}$, we can reject the null of equal responses to government spending shocks for all survey measures but unemployment expecta-

tions, and we can reject the null for actual consumption. Overall, we conclude that our results are robust to using government spending purged from anticipation effects.

**Alternative specification of the transition process of the public debt state**

The parameterization of the smooth transition process is geared towards tracing out periods during which the economy is in a high or unsustainable state of public finances. We assume that the US economy is located in a normal state of healthy public finances most of the time and that periods of high-debt are somewhat exceptional. In the baseline specification, we calibrate the parameter that governs the portion of the sample located in the high-debt state, $c$, to the 66th percentile of the distribution of the backward-looking seven quarter moving average of the debt-to-GDP ratio. To evaluate the robustness of our analysis with respect to this parameter, we also experiment with other calibrations.

Figures B.2 and B.3 in the online appendix show the responses using a slightly different specification of $c$. We calibrate $c$ with the 75th percentile of the distribution of the backward-looking seven quarter moving average of the debt-to-GDP ratio. Our results are not affected by this alternative specification of $c$ with the responses virtually unchanged. This is also reflected by the t-statistics on the interaction terms, $\beta_{\tau}^{g,state}$ and $\beta_{\tau}^{m,state}$, that are of similar orders of magnitude compared to the baseline estimation. For government spending shocks, we can now reject the null of equal responses of inflation expectations at the 95 percent confidence interval whereas in the baseline the difference was only marginally significant.

To further investigate the effects of the threshold specification we estimate the model using several threshold around the baseline specification. Specifically, we use thresholds from the 50th to the 75th percentile (in 5 percent steps) of the distribution of the backward-looking seven quarter moving averages of the debt-to-GDP ratio. The corresponding impulse response functions are shown in Figures B.4 and B.5. It appears that the exact parameterization of the

threshold $c$ in Equation (2) does not affect our results. Mean responses calculated from various alternative thresholds are within the confidence bands of the baseline estimation. Notably, the vast majority of responses is well within a one-standard error range from the median responses using the 66th percentile as cutoff, which we used in the baseline specification.

**Estimating the effects of monetary policy shocks using monthly data**

While the survey data for consumers and the monetary policy shocks are available with monthly frequency, data on government spending are quarterly. We thus perform our estimations with quarterly data. To evaluate the influence of a potential aggregation bias and to exploit the higher frequency, we replicate the baseline estimation using monthly data available for monetary policy shocks.[3]

Figure B.6 shows the IRFs to monetary policy shocks. Consistent with the baseline estimation shown in Figure 4, we find more muted and often different responses in the low as compared to the high-debt state.

The dynamics of the responses in the low debt state shown in the left column of each panel, resemble the baseline estimation to a large extent. Unemployment expectations (Panel A) go up in response to the shock before they go back to the long-run mean and slightly overshoot after one year. Inflation expectations (Panel B) go up one month after the shock hits, then go back to the long run mean before they turn negative at around one year and finally recover after almost two years. Interest rate expectations (Panel C) exhibit similar dynamics compared to the baseline and largely follow the dynamics of inflation expectations. The IRF of policy satisfaction (Panel D) goes down on impact until three months out, revolves around the zero line and goes back into negative territory between six and eighteen months out. Consistent with

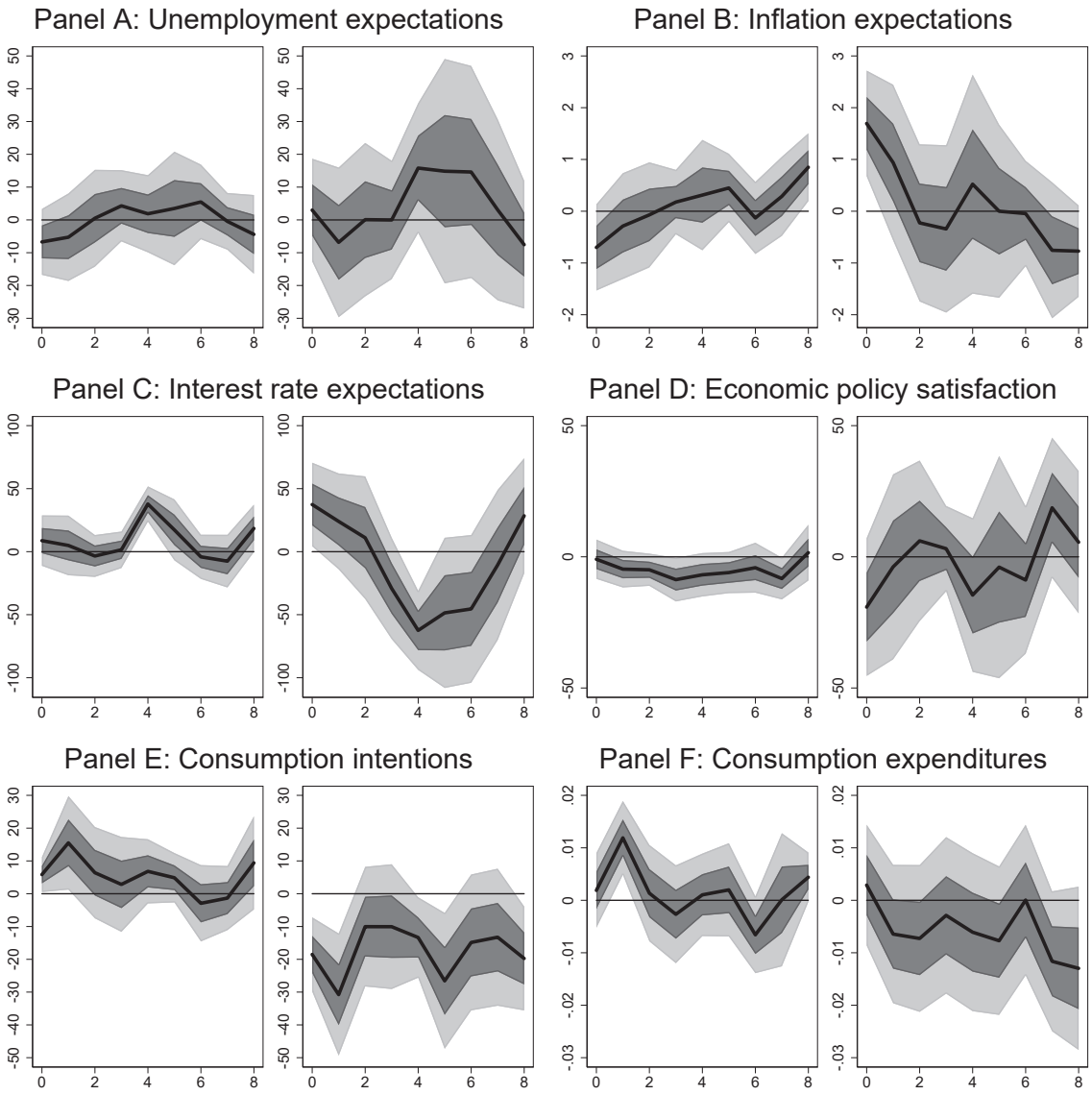
[3] All explanatory variables but real GDP and our measure of public debt are available with monthly frequency. Instead of real GDP, we now use the unemployment rate as a measure of output. The public debt state variable is converted to the monthly frequency by employing the Litterman (1983) temporal dis-aggregation method. In the specification of the regression model, we use lags up to six months instead of the two quarters used in our baseline.

the baseline, the IRF of consumption intentions (Panel E) turns negative shortly after the shock hits, remains in negative territory for approximately one year and then reverts to the long-run mean. Similarly, actual consumption (Panel F) goes down significantly during the first months after the shock before it reverts to its long-run mean approximately one year after impact.

In the high debt state, the dynamics of the responses are again qualitatively similar to the baseline. However, we observe some differences with respect to the dynamics of the responses. The responses of unemployment expectations in the right column of Panel A rise on impact, while in the baseline estimation unemployment expectations go up one quarter after the shock hits. The IRFs then revolve around the zero line between three and eighteen months out, before going up again. This is in line with the baseline. Inflation expectations (Panel B), are rather unresponsive within one year after impact, which is in contrast to the baseline estimation. However, approximately one year after the shock hits, we observe a marked but temporary increase in inflation expectations. This spike roughly coincides with what we see for the baseline estimation. The IRF of interest rate expectations in Panel C does not go up on impact as in the baseline estimation but gradually increases and turns positive six months after impact. The IRF becomes indistinguishable from zero between seven and twelve months out, and then drops into negative territory after one and a half year. This is consistent with the baseline estimation. The IRF of policy satisfaction in Panel D is in negative territory in the third and from the eighteenth to the twenty-fourth month out. However, the negative effects of monetary policy shocks on policy satisfaction are overall less pronounced compared to the baseline estimations. Consumption intentions (Panel E) fluctuate around zero before turning negative approximately one and a half year after the shock hits. Even though the drop is slightly deferred compared to the baseline, it resembles the baseline results. A qualitatively similar picture emerges from the IRF of actual consumption (Panel F) even though the fall in actual consumption after approximately one year is more significant and more persistent.

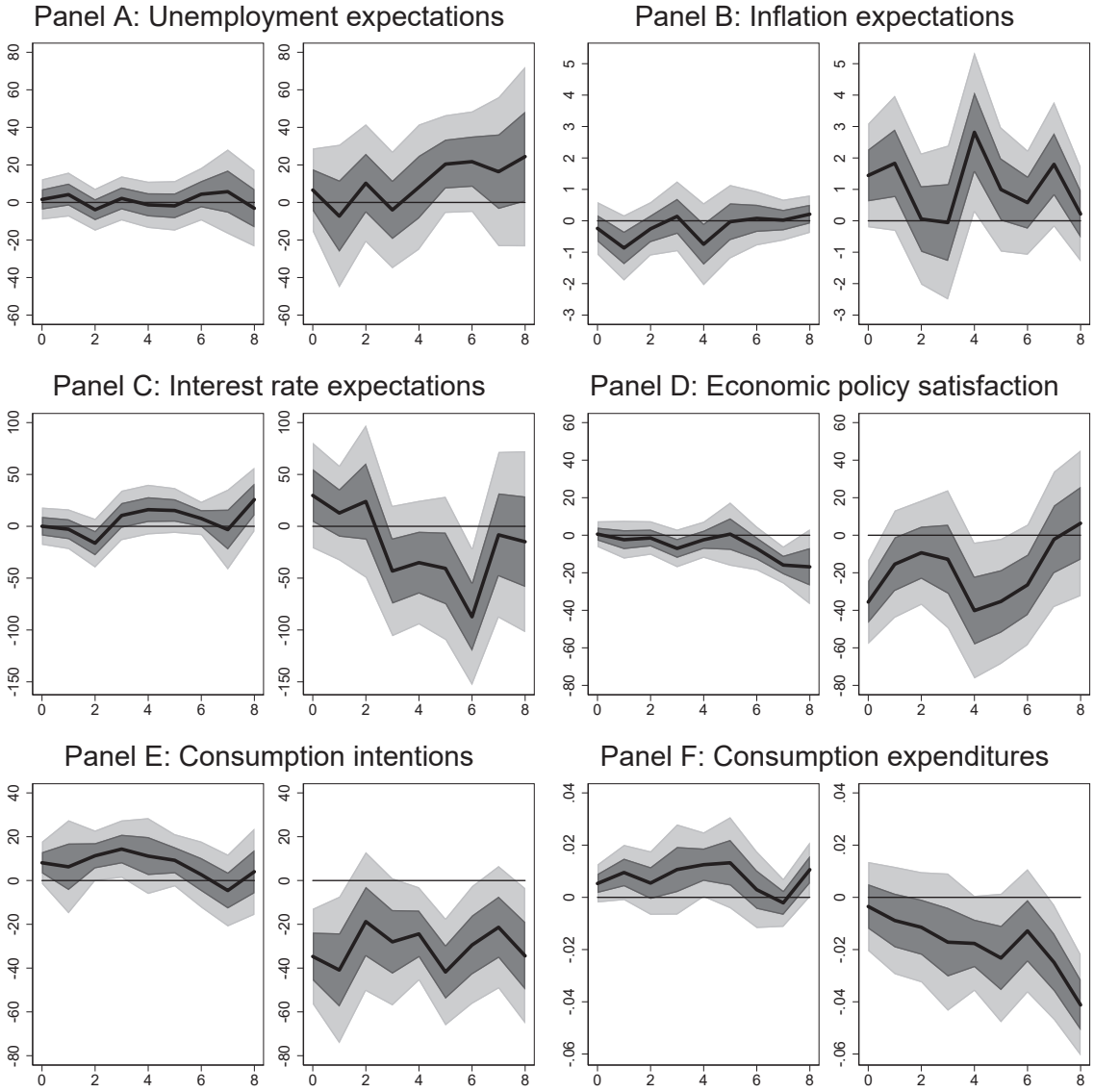
Considering the t-statistics on the interaction terms, $\beta_{\tau}^{m,state}$, we can reject the null of equal responses for all survey measures including inflation expectations and for realized consumption, at least for several periods. This corroborates the robustness of our results.

Figure B.1: Consumer expectations responses to government spending shocks purged from anticipation effects



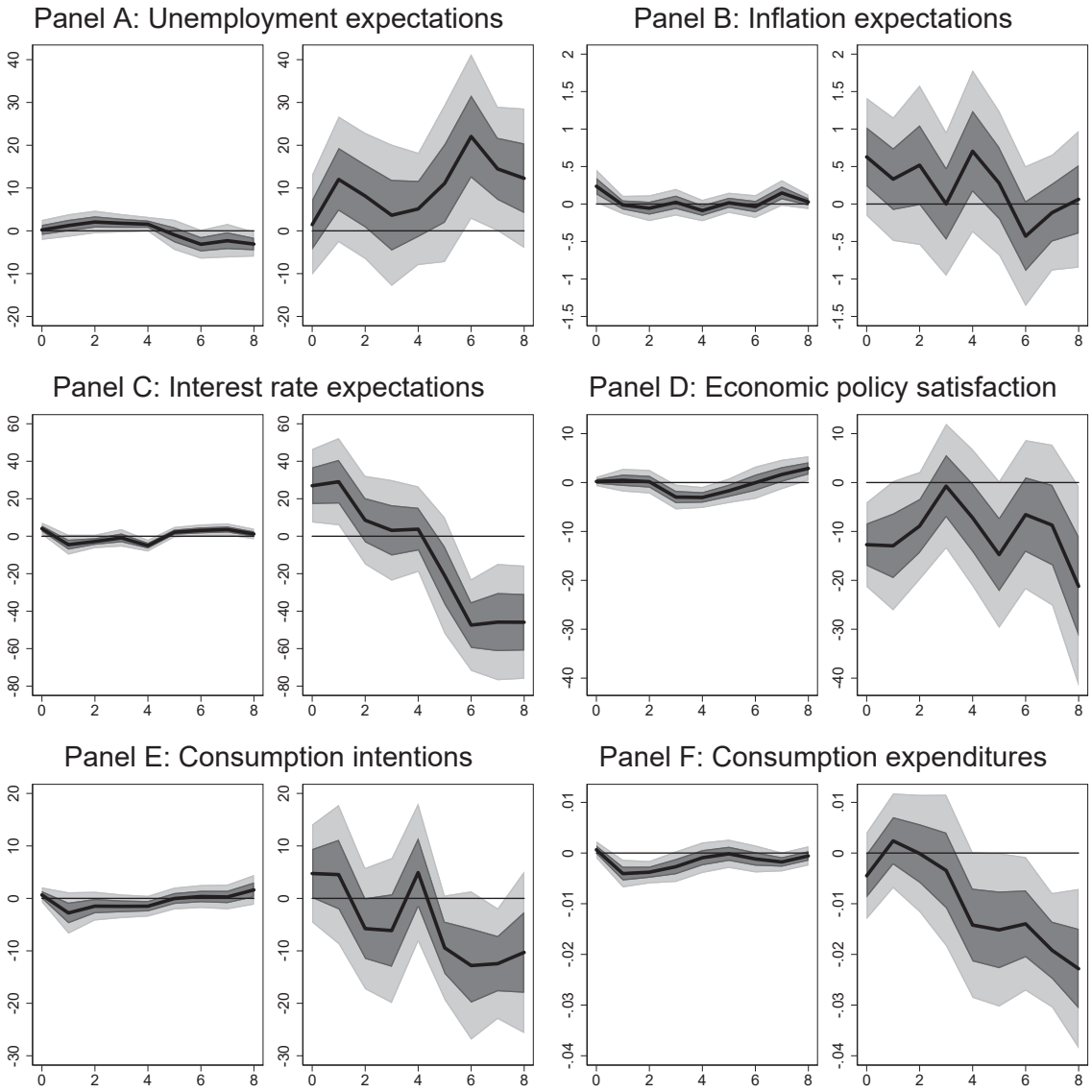

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.2: Consumer expectations responses to government spending shock (higher cutoff)



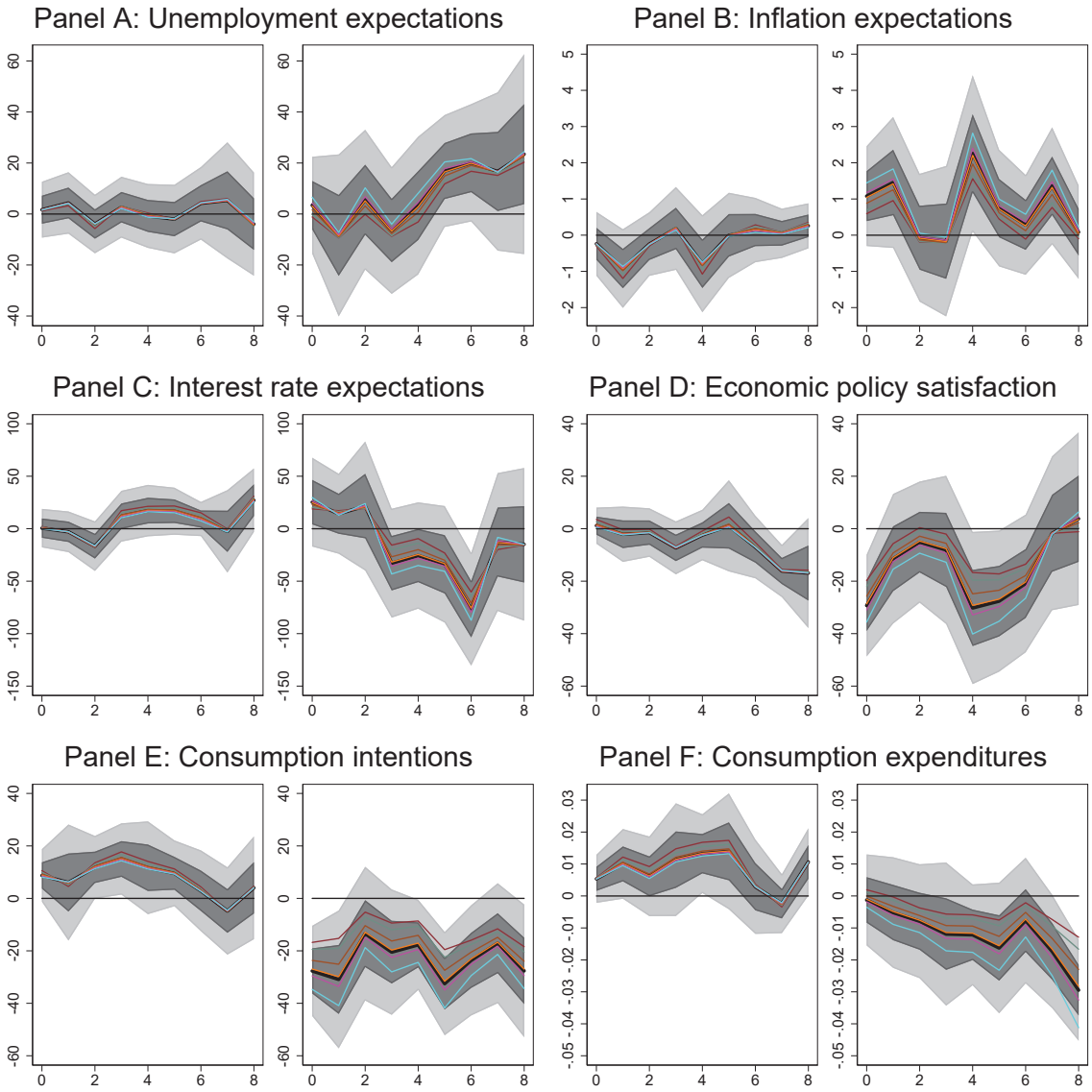

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.3: Consumer expectations responses to monetary policy shock (higher cutoff)



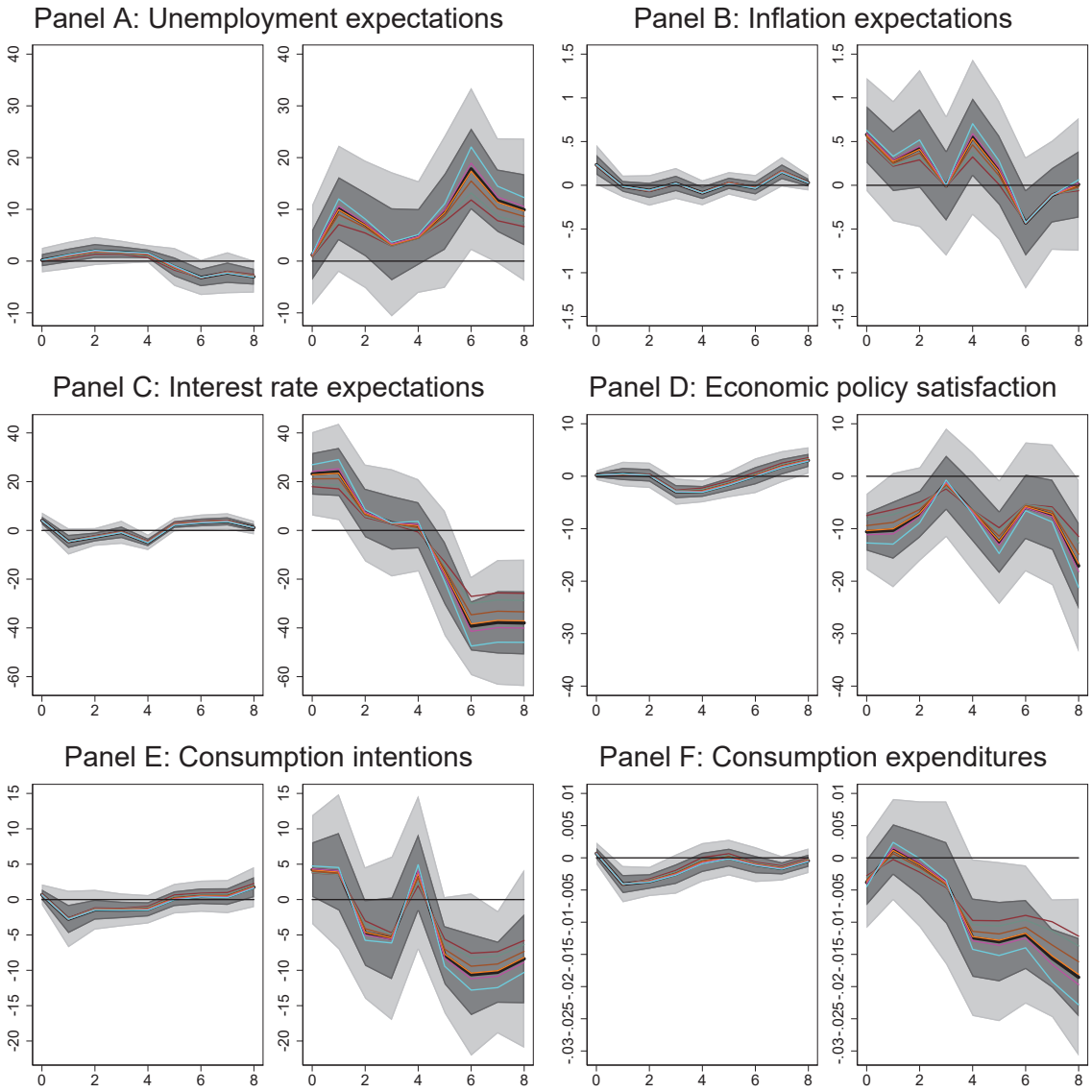

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.4: Consumer expectations responses to government spending shock (multiple cutoffs)



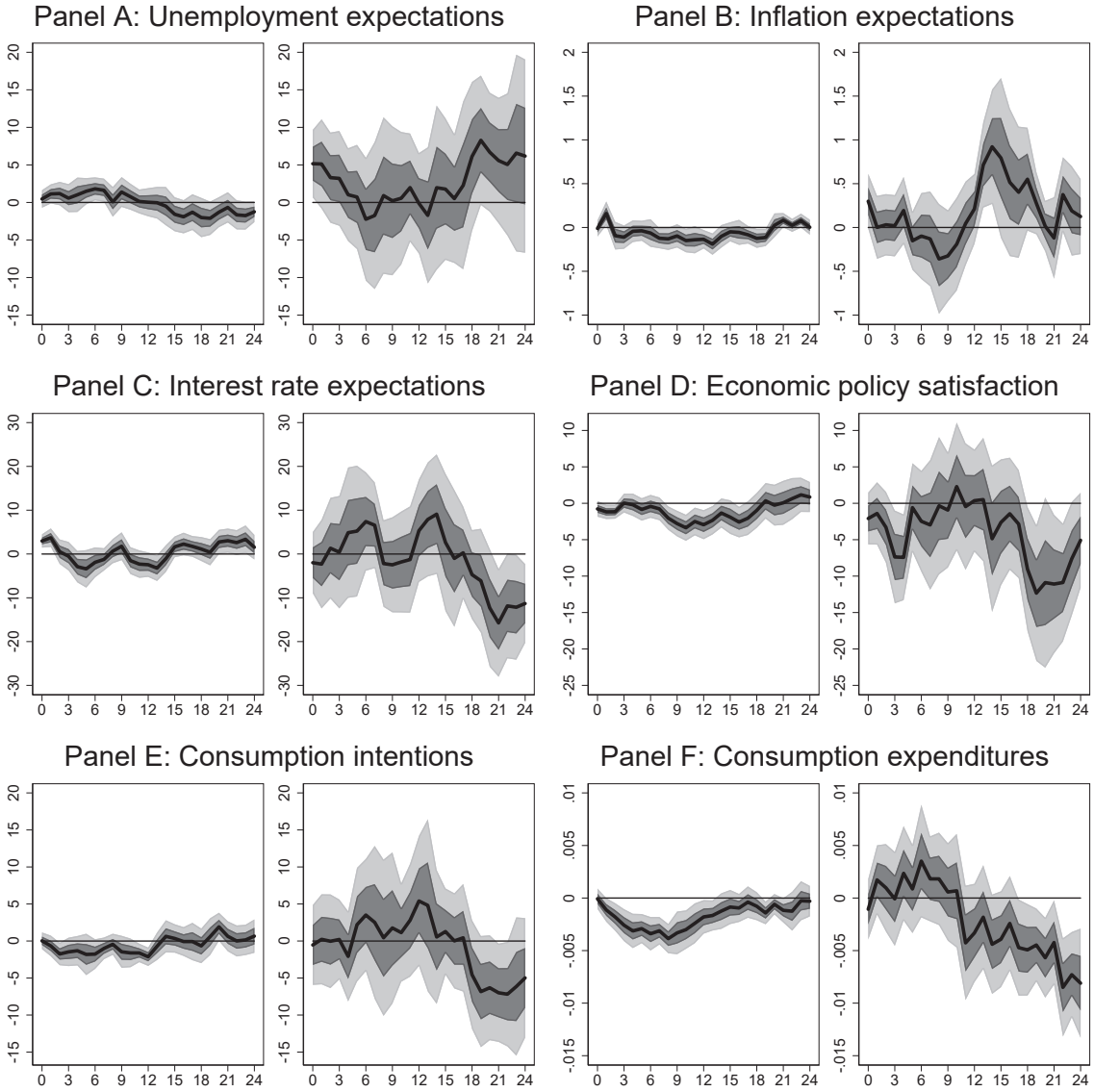

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending calculated for various thresholds together with one and two standard error bands from the baseline estimation. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.5: Consumer expectations responses to monetary policy shock (multiple cutoffs)



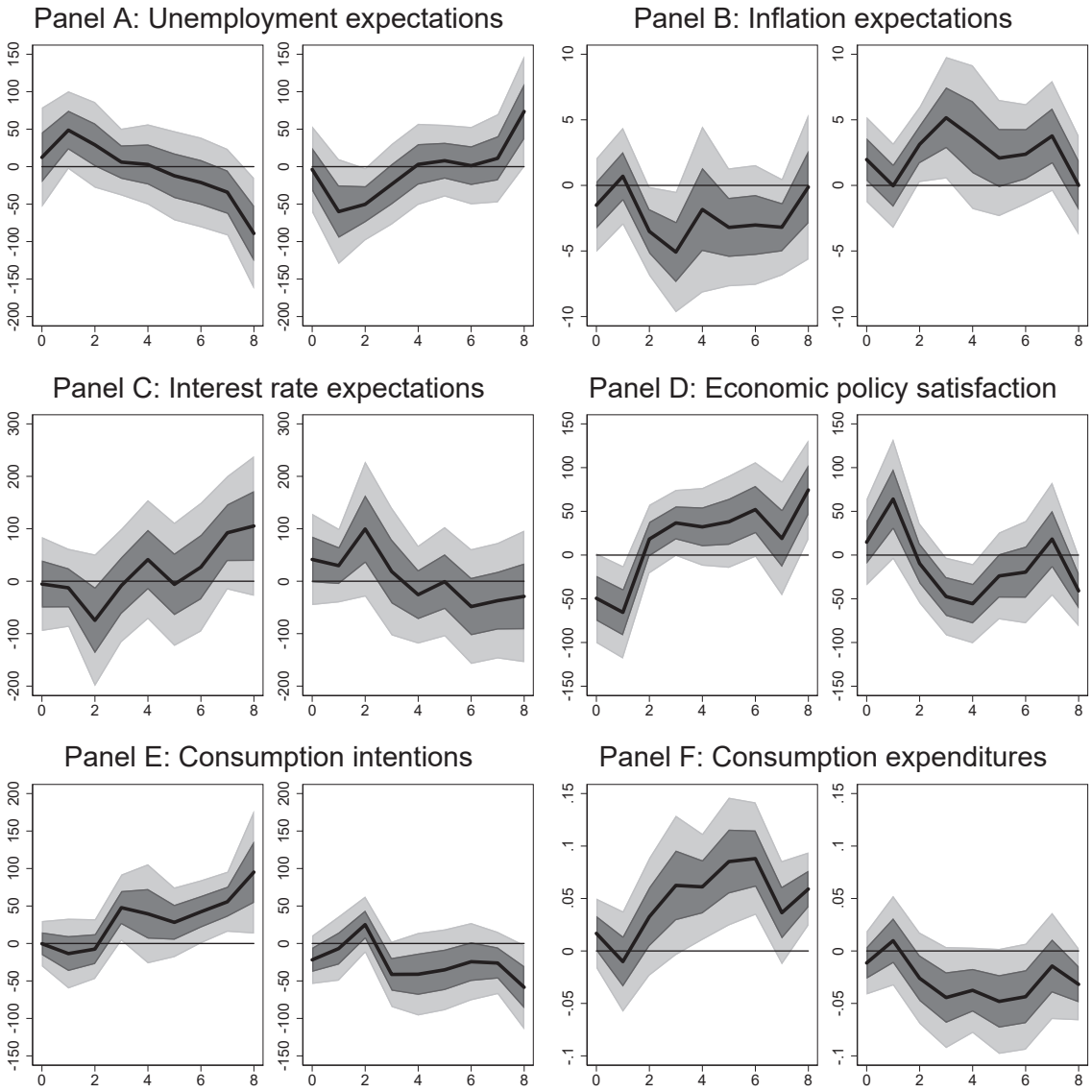

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate calculated for various thresholds together with one and two standard error bands from the baseline estimation. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.6: Consumer expectations to monetary policy shocks (estimation with monthly data)



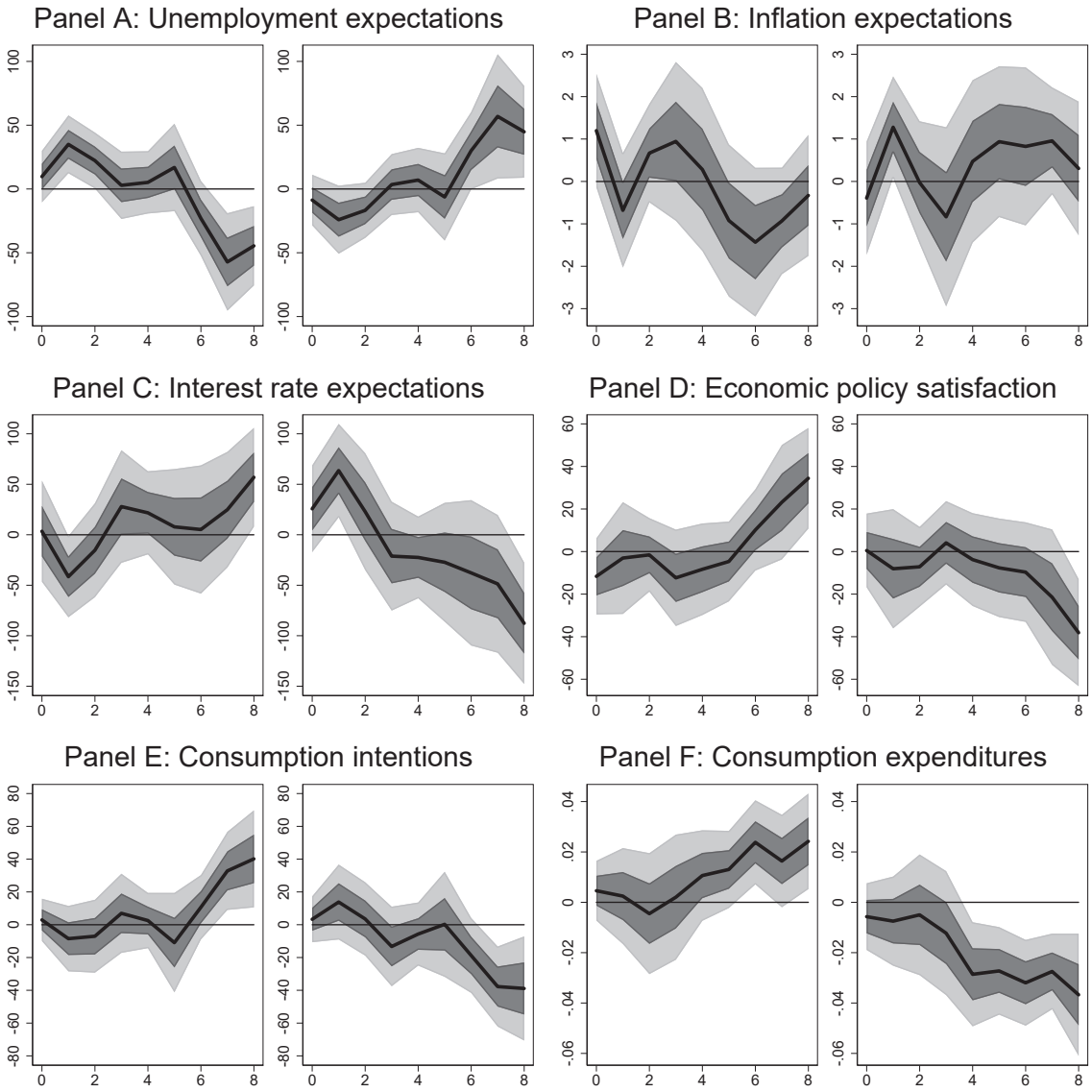

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in months. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.7: Consumer expectations responses to government spending shocks (estimated with pre and post 1990 states)



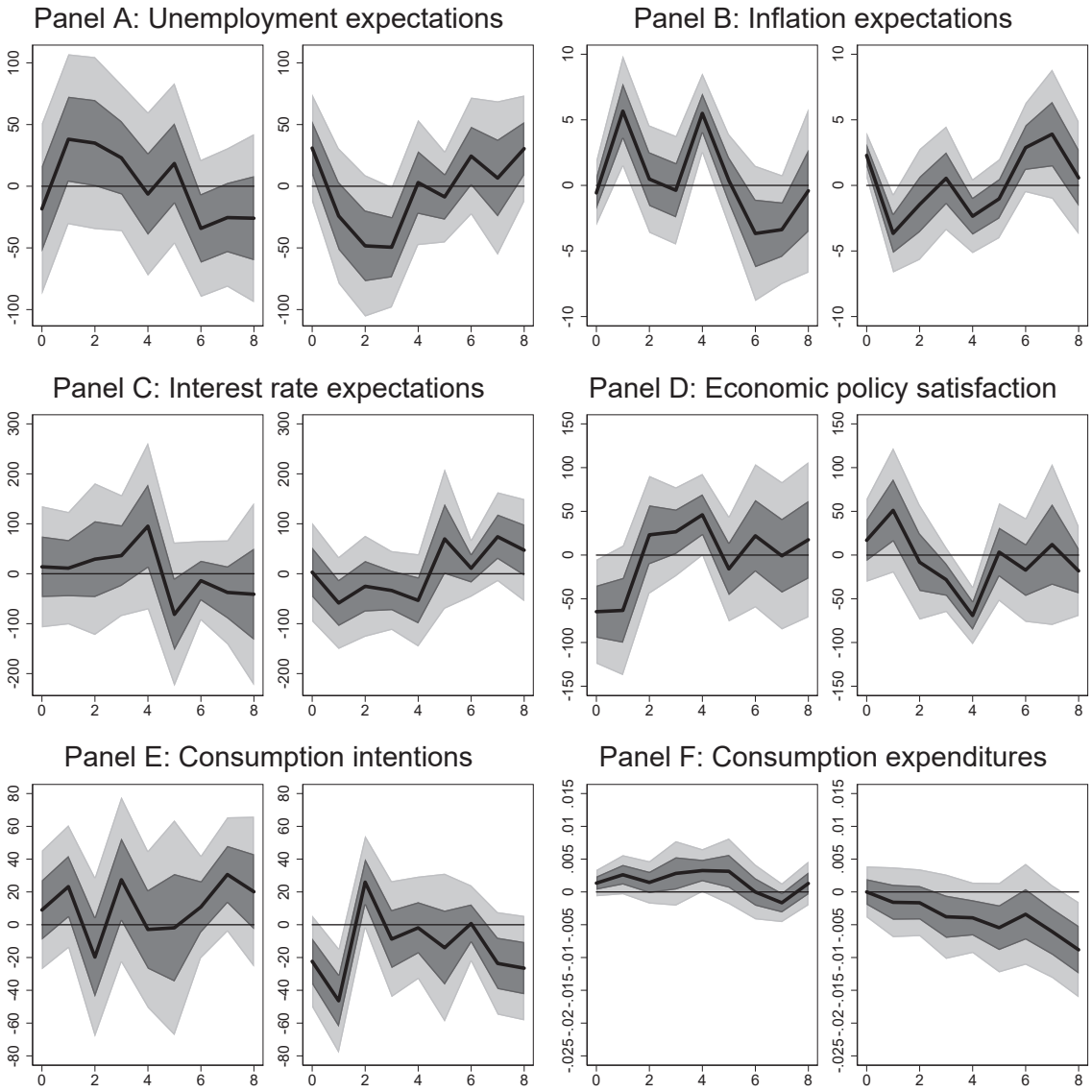

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.8: Consumer expectations responses to monetary policy shocks (estimated with pre and post 1990 states)



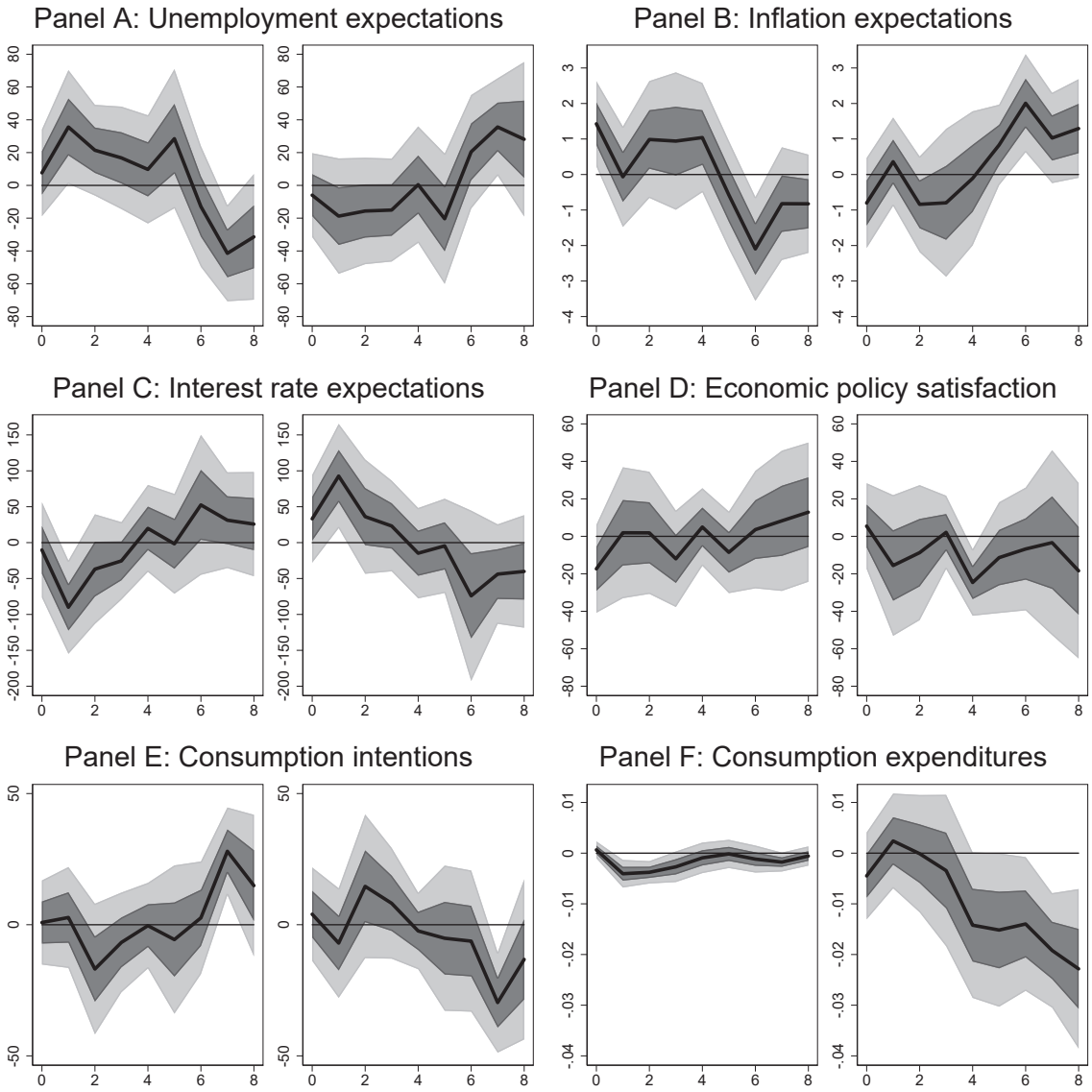

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.9: Consumer expectations responses to government spending shocks (estimated with post 1990 sample)



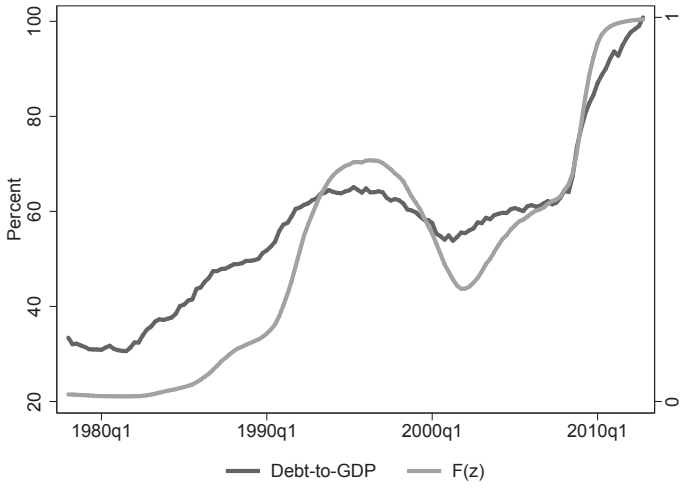

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.10: Consumer expectations responses to monetary policy shocks (estimated with post 1990 sample)



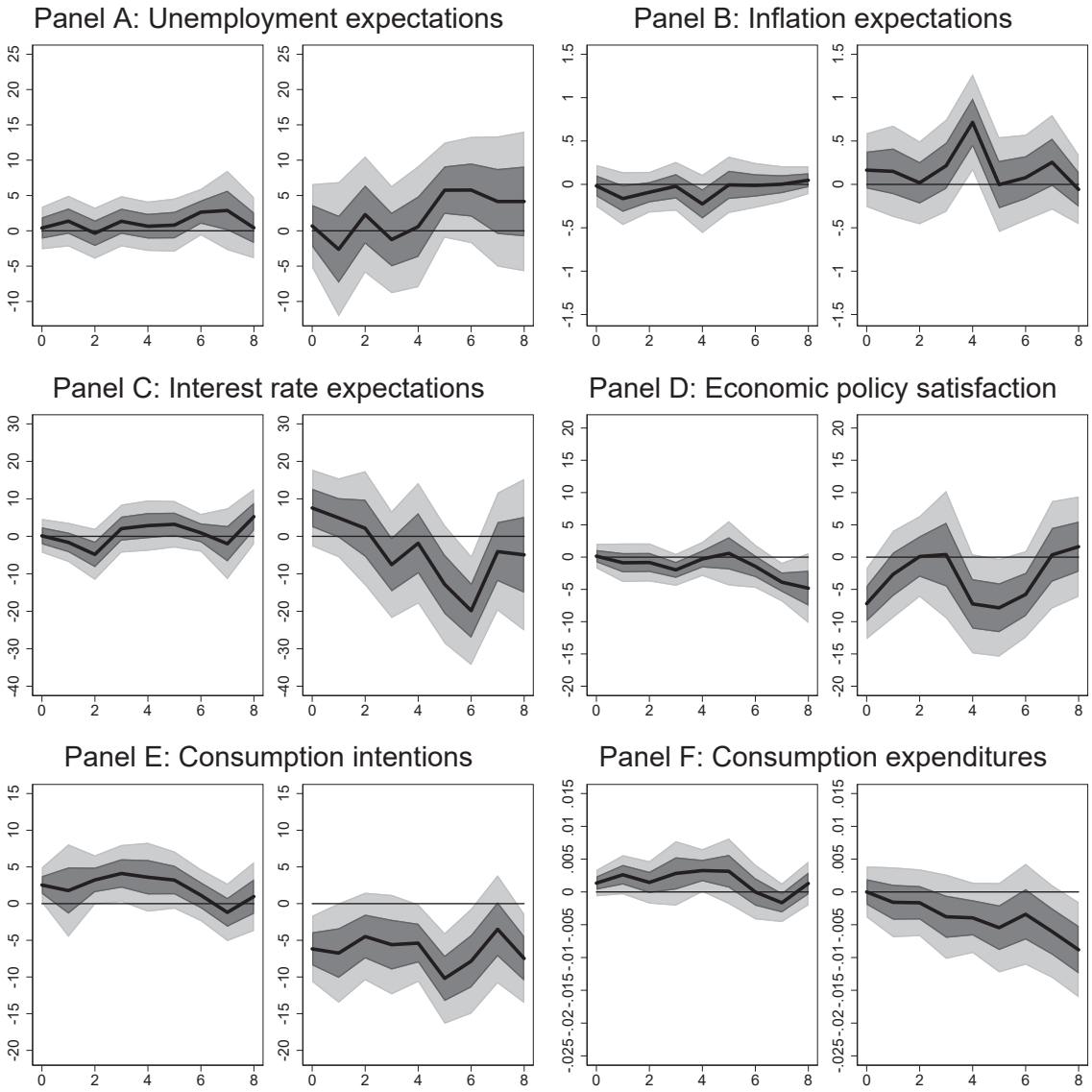

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.11: State variable



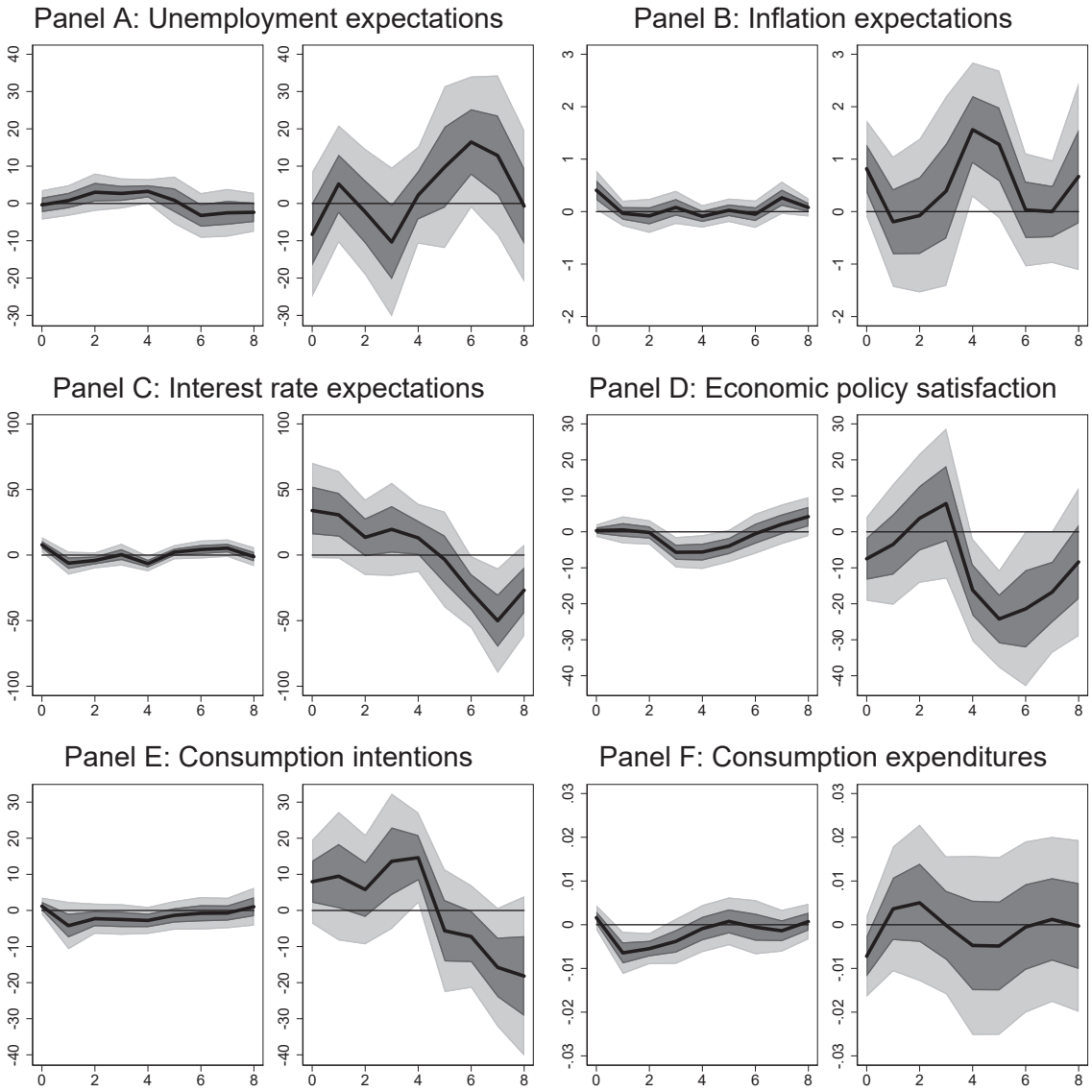

Notes: The figure shows the transition function $F(z)$ together with the debt-to-GDP ratio.

Figure B.12: Consumer expectations responses to government spending shocks (including zero-lower bound period)



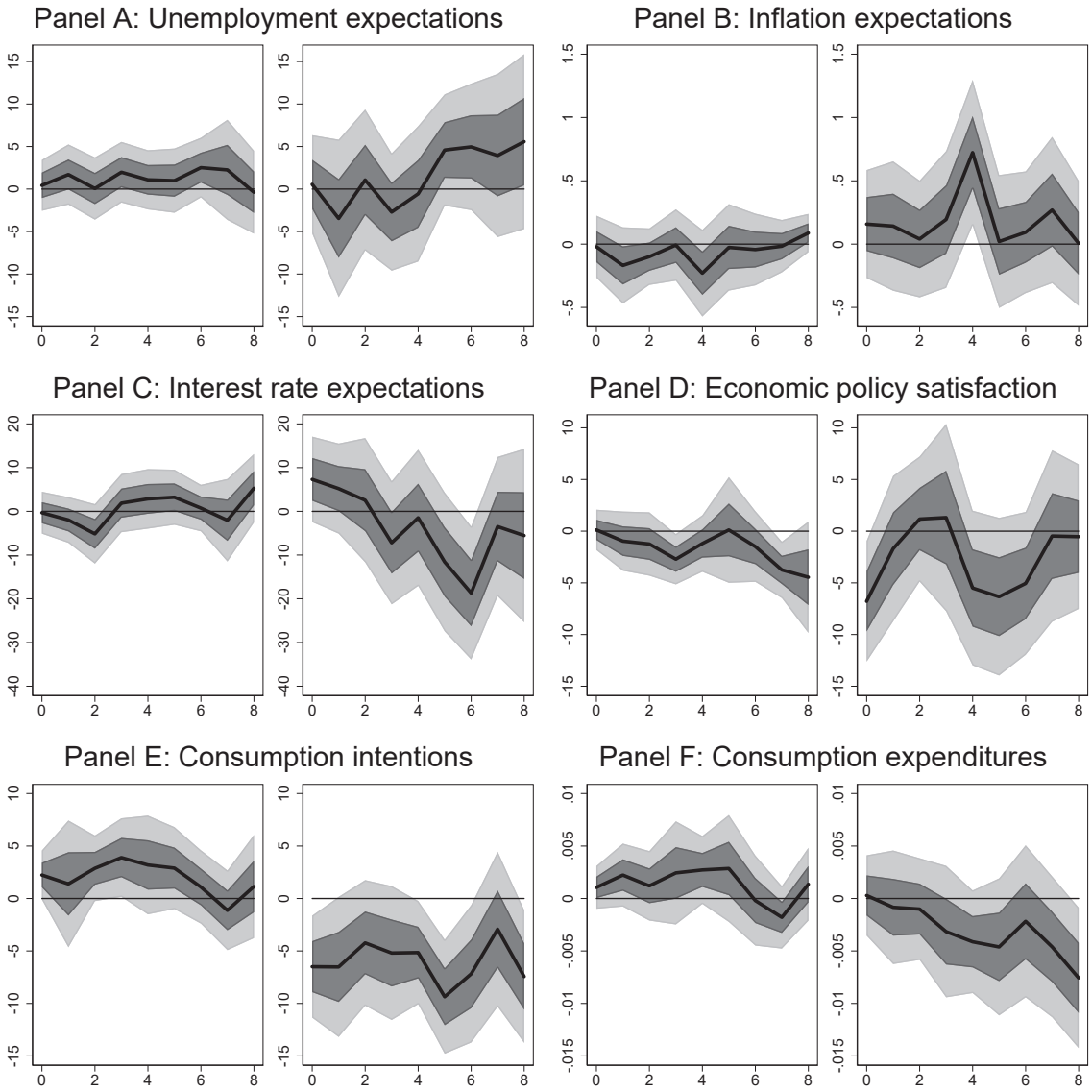

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.13: Consumer expectations responses to monetary policy shocks (including zero-lower bound period)



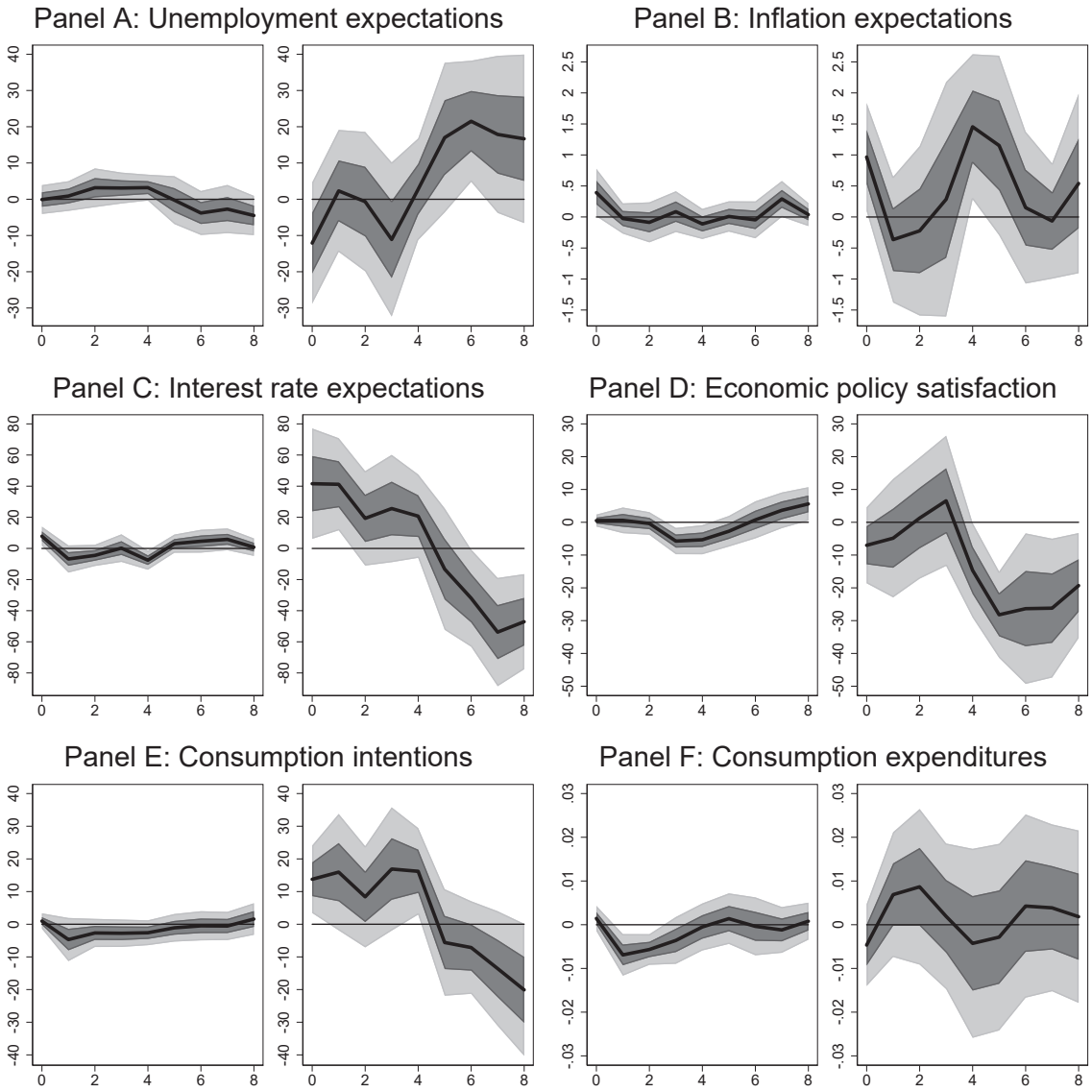

Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the Federal Funds rate spliced with the Krippner (2015) shadow rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.14: Consumer expectations responses to government spending shocks (including zero-lower bound period, MP measure by Wu and Xia (2016))




Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure B.15: Consumer expectations responses to monetary policy shocks (including zero-lower bound period, MP measure by Wu and Xia (2016))




Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the in the Federal Funds rate spliced with the Wu and Xia (2016) shadow rate together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.