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Consumers' updating, policy shocks and public debt: An empirical assessment of state dependencies*

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Short title: Updating, policy shocks and public debt

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Abstract

We assess the impact of fiscal and monetary policy shocks on US survey-based consumer expectations within states of low and high public debt. Following an unexpected increase in government spending, consumption intentions rise in the low-debt state and fall in the high-debt state. Overall, such a shock has adverse effects on expectations in high-debt states. Similarly, contractionary monetary policy shocks induce pessimistic expectations in the high-debt state but not in the low-debt state. The estimated responses suggest that higher public debt fuels considerations regarding its repayment, giving rise to state dependencies in the updating of expectations in response to both fiscal and monetary policy shocks.

Keywords: expectations, rational inattention, Ricardian, fiscal theory of the price level.

JEL Classification: E31, E52, E62, E63

1 Introduction

Expectations play a crucial role for human decision making in general and economic decision making in particular. We study how fiscal and monetary policy affect consumer expectations and sentiment depending on the level of public debt. The latter has become an increasing concern for policymakers in relation to, e.g., monetary policy shocks, after the previous crisis which saw a sharp rise in public debt-to-GDP ratios for many countries, and this might well be exacerbated in the aftermath of the current pandemic-induced global crisis. This concern can be understood within models that incorporate the government budget constraint where the response of forward-looking agents to policy actions depends on the extent to which they believe nominal public debt to be backed by future taxes (Leeper, 1991; Sims, 2011). Considerations about the repayment of public debt may involve anticipation of future inflation as suggested by the fiscal theory of the price level, or, alternatively, anticipation of fiscal consolidation efforts. It is conceivable that higher public debt fuels such considerations, giving rise to potential state dependencies in the updating of expectations in response to fiscal and monetary policy shocks.

We look at US survey expectations about inflation, unemployment and interest rates, as well as satisfaction with government policy, consumption intentions and actual consumption expenditures. To assess how monetary and fiscal policy shape the dynamics of these measures, we use state-dependent models in which the state is determined by the level of public debt. To evaluate exogenous effects of these policies on expectations, we consider Romer and Romer (2004) narrative monetary policy shocks along with government spending shocks in the spirit of Blanchard and Perotti (2002). We apply the Jordà (2005) local projections method, introducing interaction terms to allow impulse responses to vary according to the state of the economy. Using this method, we assess how fiscal and monetary policy affect expectations conditional on public debt levels. We also take account of state-dependence of fiscal and monetary policy due

to recessions. In all cases, we account for simultaneous effects of monetary and fiscal policy actions and for potential effects of macroeconomic variables and time trends on expectations.

We find evidence for the importance of public debt-related non-linearities in consumers' responses to monetary and fiscal shocks, accounting simultaneously for both fiscal and monetary policies and their interactions with the level of public debt.[1] By doing so, we observe a number of state-dependent patterns missed altogether in a linear model ignoring state-dependent effects. Several intriguing observations stand out.

Increased government spending in the high-debt state has effects on expectations consistent with an anticipated fiscal consolidation. Negative wealth effects lead to a fall in consumption intentions, beliefs that unemployment will rise, and dissatisfaction with economic policy. Notably, consumption intentions rise in the low-debt state but fall in the high-debt state and the same goes for consumer spending, suggesting that the government spending multiplier is positive in one state and negative in the other.[2] Furthermore, interest rate expectations rise in the low-debt state but fall in the high-debt state a few quarters after impact. One interpretation is that an increase in government spending in the high-debt state produces expectations of subsequent fiscal austerity combined with "passive" monetary policy in the sense of Leeper (1991). That is, when public debt levels are high, both the fiscal and monetary authorities are expected to be preoccupied with debt repayment considerations.[3]

Following an unexpected monetary tightening, consumers' expectations are affected in a distinct and adverse way in the high-debt state. Consumer buying attitudes and consumption spending fall persistently and consumers are evidently dissatisfied with this unexpected interest

[1] This is in the spirit of Sims (2011) who concludes that "there is no excuse for econometric models intended for monetary policy analysis to continue to omit serious treatment of fiscal behavior".

[2] Related to this, Perotti (1999), Corsetti et al. (2012) and Ilzetzki et al. (2013) find fiscal multipliers vary with public debt, suggesting state-dependent effects of fiscal policy.

[3] Leeper (1991) argues that in this case "each policy authority acts passively, as though it is constrained to balance the budget." In our case, the data implies that in response to a positive government spending shock in a state of high-debt, the monetary authority is expected to eventually lower the interest rate to ease the debt burden.

rate hike that raises the fiscal burden. Notably, unemployment expectations rise persistently in response to an unanticipated interest rate hike in the high-debt state but not in the low-debt state. The latter results suggest that the effect of monetary policy on expectations depends on the level of public debt, with higher levels plausibly fuelling debt-repayment considerations and bringing about pessimistic expectations. In the high-debt state, we also observe an overshooting pattern of interest rate expectations suggesting consumers expect the monetary tightening to be followed by a monetary expansion that will eventually lower interest rates to ease the fiscal burden, consistent with "passive" monetary policy.

Overall, our estimated responses to monetary and fiscal shocks in the high debt state relative to the low debt state are consistent with state dependencies arising due to inattention in states where the stakes are low, in a Ricardian setting where high public debt levels act as a trigger for consumers to start paying attention. This accords well with the point made by Sims (2010) that "in periods of economic disruption ... people may in fact devote a large fraction of their information-processing capacity to tracking economic signals". The level of public debt can act as a trigger for paying attention and/or for the expectation of regime switching if, facing relatively high debt, economic agents come to expect that the fiscal authority will undertake a consolidation so as to bring public finances back on a sustainable path in the spirit of Blanchard (1990), Bertola and Drazen (1993) and Sutherland (1997). We note that the often observed lack of response in states of low debt is of itself further evidence for the presence of rational inattention in relation to the level of public debt, in line with the point in Sims (2010) that "it is possible for optimal behavior to imply ignoring variation in some economic signals because the information costs of attending to it at all do not justify the returns from doing so".

Turning to the behavioral aspects involved in the updating of agents vis-à-vis fiscal and monetary policy shocks, two observations stand out. First, consumer expectations' responses are qualitatively similar to those of financial and economic experts in states of high debt but

rather different in states of low debt, in line with consumers becoming more sensitive to monetary and fiscal shocks when the stakes are high but being inattentive when the fiscal burden is low. Second, a positive government spending shock typically increases disagreement among respondents in the high-debt state and reduces this in the low-debt-state, and an unexpected monetary tightening increases disagreement among respondents in the high-debt state but not in the low-debt-state. The increase in disagreement only in the high-debt state is inconsistent with sticky information models such us Mankiw and Reis (2002) that imply a positive association between disagreement and any shock, as well as with noisy-information models without heterogeneity in signal-to-noise ratios that imply no response of disagreement to shocks.[4]

Our work relates to three main strands of literature. First, it is motivated by models where the government budget constraint affects equilibrium outcomes and agents' expectations. This applies, e.g., to models in the tradition of the fiscal theory of the price level such as Leeper (1991) and Sims (2011) where if forward-looking agents believe that newly issued public debt is not fully backed by future taxes, debt issue is inflationary and an interest rate hike from the monetary authority raises inflation as increases in nominal debt in the hands of the public unaccompanied by increases in expected future tax liabilities leave the public with higher wealth. The New Keynesian model in Leeper and Leith (2016) implies equilibrium outcomes result from interactions between monetary and fiscal policy and that both policies have a role in determining inflation and stabilizing government debt. They motivate state-dependent effects of monetary policy shocks related to policy regimes: the Central Bank stabilizes output and prices consistent with a Taylor rule in an "active" monetary policy regime and mainly stabilizes debt in a "passive" regime.[5] Along the same lines, in Bianchi and Ilut (2017) holdings of the public

[4] See Table 1 of Coibion and Gorodnichenko (2012) for a summary of the predictions of these models.

[5] A regime combining passive monetary policy with active non-Ricardian fiscal policy provides results along the fiscal theory of the price level, while a combination of active monetary/passive fiscal policies delivers typical monetarist new-Keynesian results for monetary policy. In the latter regime, the Central Bank pursues its price-level objective choosing its set of control variables freely unconstrained by government debt while the fiscal authority behaves passively to stabilize debt constrained by Central Bank actions. Finally, an active monetary/active fiscal regime is unstable and a passive monetary/passive fiscal one is subject to multiple equilibria.

debt generate wealth effects on aggregate demand, thus an unexpected increase in government spending determines a long-lasting increase in inflation within a passive monetary/active fiscal regime,[6] but has relatively small effects on inflation within an active monetary/passive fiscal regime where the fiscal authority is committed to raise taxes in the future to stabilize debt. Facing high debt, agents might anticipate a consolidation in the latter case. As Bianchi and Ilut (2017) allow for regime-switching, similar results are obtained if agents anticipate the regime to switch to an active monetary/passive fiscal one.

Related but distinct from the fiscal theory of the price level, Eusepi and Preston (2018) introduce an imperfect knowledge theoretical setting where holdings of the public debt are perceived as net wealth, giving scope for the scale of public debt to become relevant for inflation dynamics. Their model predicts wealth effects get larger as the average scale of issued debt rises, the opposite of what the fiscal theory of the price level predicts. In their model, an interest rate hike shock generates positive net wealth effects as it reduces the present value of future taxes, undermining inflation control. As these wealth effects rise with public debt, constrains on monetary policy are greater and responses to shocks more persistent and amplified when debt is higher. According to Eusepi and Preston (2018), unlike Sims (2011) and Bianchi and Ilut (2017), a passive fiscal regime and Ricardian equivalence is a reasonable description of the United States in the 1970's and non-Ricardian effects play only a minor role in determining the evolution of inflation and economic activity over this period.[7]

Second, our focus on survey expectations follows Coibion and Gorodnichenko (2012), Andrade and Le Bihan (2013), Carvalho and Nechio (2014), Coibion and Gorodnichenko (2015a), Dräger et al. (2016), Lamla and Vinogradov (2019) and others using survey data to study how

[6]Similarly, if debt size induces agents to expect debt monetization rather than higher future taxes, the inflationary effects of positive government spending shocks at high levels of debt are amplified.

[7]An estimated version of the Eusepi and Preston (2018) model shows that perceived net wealth did not play a key role in the 1970s or in the subsequent period of economic stability, reflecting the relatively low levels of public debt throughout the entire period they consider for the United States.

agents process macroeconomic developments. In particular, Coibion and Gorodnichenko (2012) use survey forecasts from consumers, firms and professionals to assess their validity, and find that in response to macroeconomic shocks "forecast errors consistently move in the same direction as the variable being forecasted" consistent with information rigidities that "differ little" for consumers, firms and professionals. Given the importance of consumers for the macroeconomy, we focus on consumers.[8]

Third, our approach is closely related to the recent literature pioneered by Auerbach and Gorodnichenko (2013), Tenreyro and Thwaites (2016), and Ramey and Zubairy (2018), which studies the effectiveness of fiscal and monetary policy depending on state of the economy. Two papers are particularly closely related to ours. Born et al. (2019) study the response of the sovereign default premium to fiscal policy depending on fiscal stress and find that austerity does not reduce the default premium in case of high fiscal stress. Our findings here imply an overall positive consumer reaction to a decrease in government spending. Alpanda and Zubairy (2019) study the effects of monetary policy on consumption conditional on private debt and find that while monetary policy is less effective when private debt is high, it exerts qualitatively similar effects on consumption irrespective of the level of private debt. Instead, considering public instead of private debt, we observe opposite effects of monetary policy on consumption depending on the level of public debt.

The next section describes the data at hand. Following that, we describe our state-dependent approach to jointly estimating the impact of monetary and fiscal policy actions on expectations and sentiment. The fourth section presents our results along with robustness analysis, and section five presents our findings in relation to disagreement among individual consumers. The last section concludes.

[8] As Yellen (2016) points out, "an unresolved issue concerns whose inflation expectations–those of consumers, firms, or investors–are most relevant for wage and price setting, a point on which theory provides no clear-cut guidance."

2 Data

2.1 Consumer expectations surveys

We consider survey data from the Michigan Survey. As of 1978, a minimum of 500 telephone interviews are documented each month by the Survey Research Center at the University of Michigan. The households are selected in a way such that the sample should be representative for the US population (Alaska and Hawaii are excluded from the surveys). Survey questions cover three areas: demographics, how survey respondents assess the prospects for their own financial situation, and how they view prospects for the economy in general. We use questions covering the latter.

These data are increasingly used to study expectations of the general public in a macroeconomic context (see e.g. Carvalho and Nechio, 2014; Coibion and Gorodnichenko, 2015b; Wong, 2015; Bachmann et al., 2015; Dräger et al., 2016), and are particularly well suited for our analysis. Respondents are households and their answers are presumably more representative for how people view economic developments, as compared to professional forecasters from other surveys.[9]

We focus on survey questions that give us an indication on how people assess the macroeconomic environment, how they view their personal real income and consumption plans, and how satisfied they are with economic policy. We capture people's notion about the macroeconomic environment with questions about how people view economic activity, interest rates, and inflation over the 12 months ahead. The Michigan Survey contains two types of survey questions, with quantitative and qualitative answers. For all questions, we use cross-sectional aggregates provided by the survey center.

[9] Coibion and Gorodnichenko (2015b) even argue that firms' expectations about economic activity and inflation are better approximated by household answers compared to answers from professional forecasters, since small and medium-sized enterprises usually have no professional forecasters on staff and are not likely to use professional forecasting services.

For expected inflation we use average point estimates provided by respondents elicited by the following question:

(A12) *'During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?* (A12b) *By about what percent do you expect prices to go (up/down) on the average, during the next 12 months?'*

The remaining questions we use are qualitative. To capture expectations about interest rates we use the following question:

(A11) *'No one can say for sure, but what do you think will happen to interest rates for borrowing money during the next 12 months – will they go up, stay the same, or go down?'*

This question does not refer to a specific rate and respondents may not specifically have the monetary policy rate in mind. However, provided that the monetary policy transmission mechanism performs sufficiently well, changes in borrowing rates should be related to changes in the policy rate. Hence, views about future monetary policy should be reflected, more or less, in answers to this question.[10]

The survey center aggregates individual qualitative answers using balance scores. In the case of expectations about future interest rates, the share of respondents that believe that interest rates go up is subtracted from the share of respondents that expect a decrease in interest rates. Hence, when interest rate expectations generally go up among respondents, this index goes down. For our purposes, this does not warrant an intuitive interpretation of the score. Therefore, we reverse the index such that it goes up when more respondents believe that interest rates increase.[11]

To proxy expectations about real economic developments in a broad sense, we consider unemployment expectations. The question capturing unemployment expectations reads:

[10] We note that to the extent that the link between borrowing rates and policy rates is weak over this period, this will lead to noisier estimates of the relation between monetary policy shocks based on the policy rate and expectations of the borrowing rate in Panel C in Figures 3 to 10.

[11] We subtract 100, multiply the difference between the two fractions by minus one, and add 100 again.

(A10) *'How about people out of work during the coming 12 months. Do you think that there will be more unemployment than now, about the same, or less?'*

Similar to interest rate expectations, the balance score of unemployment expectations provided by the survey center goes up when actually relatively less people worry about higher future unemployment. Hence, to facilitate an intuitive interpretation in our context, we reverse the index in the same way than for interest rate expectations. For the remaining questions we consider the indexes as provided by the survey center.

We study the adjustment of consumption intentions using the question:

(A18) *'About the big things people buy for their homes – such as furniture, a refrigerator, stove, television, and things like that. Generally speaking, do you think now is a good or bad time for people to buy major household items?'*

Finally, we proxy satisfaction with economic policy with the following question:

(A9) *As to the economic policy of the government – I mean steps taken to fight inflation or unemployment – would you say the government is doing a good job, only fair, or a poor job?*

As the macroeconomic data we use, in particular government spending data, are only available with quarterly frequency, we aggregate the monthly balance scores and average point estimates for the expected inflation rate using quarterly averages.

Figure 1 shows the time series for the aggregated survey answers from January 1978 to mid 2017. Shaded areas indicate NBER recessions. All survey measures except inflation expectations are balance scores. According to Panels A and C, the balance scores for unemployment and interest rate expectations exceed the level of 100 in most periods. Survey respondents have a tendency to expect that borrowing becomes more expensive and that unemployment will rise. Panel B shows that the average expected point estimates for inflation declined strongly in the early 1980s with the onset of the Great Moderation and so did the variance. Panel D shows that consumers, on average, plan to increase current consumption spending although they tend

to be pessimistic about unemployment and interest rates. Panel E displays economic policy satisfaction below 100, on average. Overall, it appears that the survey measures exhibit cyclical behavior and, other than inflation expectations around 1980, do not exhibit any apparent trends in their variance. During recessions, consumers tend to expect higher unemployment and lower interest rates, intend to consume less, and are dissatisfied with economic policy. Patterns are less clear for inflation expectations during recessions. To take account of such cyclicality, we control for recessions and macroeconomic developments in the regression analysis.

2.2 Financial and economic experts expectations surveys

The SPF elicits survey answers from a group of approximately 40 private sector economists from financial and research institutions who conduct forecasts about key macroeconomic variables. Respondents fill out a questionnaire form and provide point estimates for a number of variables and various forecasting horizons ranging from one quarter to 10 years on a quarterly basis. Note that while the Michigan Survey asks for qualitative forecasts of unemployment and interest rates, the SPF elicits point estimates.

We use the cross-sectional averages provided by the Federal Reserve Bank of Philadelphia. Specifically, we use the three quarter ahead forecast for the headline CPI inflation rate (denoted CPI5 in the SPF dataset), the three-month Treasury bill rate (TBILL5), and the unemployment rate (UNEMP5). Data about the expected T-Bill rate and the expected CPI inflation rates are available from the third quarter of 1981 while the expected unemployment rate is available since 1968. In the estimations with SPF data, we generally use data beginning with 1981, third quarter.

Figure A.1 in the appendix displays the time series of average expectations of professionals for 1981:Q3-2017:Q2, together with NBER recessions. During recessions, respondents tend to expect the unemployment rate to go up and the inflation rate and the T-Bill rate to go

down. To a large extent, these dynamics correspond to the pattern observed for consumers in Figure 1. However, in the case of experts, we observe an apparent downward trend for inflation expectations in Panel B and interest rate expectations in Panel C. In line with this, we control for time trends in all our estimations.

2.3 Measuring the state of public finances

To construct a measure of the state of public finances we consider the debt-to-GDP ratio. More specifically, we use the seasonally adjusted quarterly total federal public debt as percent of GDP to select states of relatively high public debt. However, rather than considering the rather volatile raw time series or simply selecting states using a threshold and a corresponding dummy variable, we assume a smooth transition process driving the state selection. Following Granger and Teräsvirta (1993), we employ the logistic function and evaluate the backward-looking seven quarter moving average of the debt-to-GDP ratio, which we denote z_t:

$$F(z_t) = \frac{exp(\theta \frac{z_t - c}{\sigma_z})}{1 + exp(\theta \frac{(z_t - c)}{\sigma_z})} \tag{1}$$

where c sets the proportion of the sample the economy is located in either state and σ_z is the standard deviation of the state variable z. In our case c is selected so that approximately two-thirds of the distribution of z is in a state of low debt. Figure 2 shows $F(z)$ together with the debt-to-GDP ratio. The parameter θ determines how much time the state variable spends close to the $[0, 1]$ bounds of the process. Higher values move the model closer to a discrete regime-switching setup. We set θ to 3 which gives an intermediate degree of intensity to the regime switching. The smooth transition process is parameterized along the lines of Auerbach and Gorodnichenko (2013), Tenreyro and Thwaites (2016) and Ramey and Zubairy (2018).[12]

[12] We consider a different specification of the smooth transition process in the robustness section.

2.4 Fiscal and monetary policy shocks

We consider measures for monetary and fiscal policy shocks that have been frequently used in the literature. To study the effects of monetary policy we consider narrative shocks along the lines of Romer and Romer (2004). As the latter shocks are available only from 1978q1 to the early 2000's, we use an extended series up to 2007q4 for our benchmark specifications. These shocks are innovations to monetary policy unrelated to changes in the macroeconomic environment. The intuition is to use forecasts available to the FOMC members (i.e. Greenbook forecasts) to purge changes in the policy rate from the systematic component. Specifically, we consider changes in the intended Federal Funds rate that are orthogonal to the information set of FOMC members. That is, using the Romer and Romer (2004) specification, we regress the changes in the intended Federal Funds rate on Greenbook forecast data, and retain the residuals. These monetary policy innovations are available at a monthly frequency whereas most of the data we use is only available at a lower frequency. We transform this monthly series using quarterly averages. We show the time series of the monetary policy shock in Figure A.2 in the appendix. As we can see, there had been some large shocks in magnitude around 1980, but otherwise these series does not exhibit any obvious changes in variance.

As the identification of monetary policy shocks is complicated by the ZLB, we consider data until 2007q4 in the benchmark specification. To extend our sample until 2012q4 for our robustness analysis that includes the crisis years we use an extended series of monetary policy shocks until 2012q4 in the spirit of Romer and Romer (2004) along the lines of, e.g., Alpanda and Zubairy (2019), that is constructed from a shadow short rate as in (Krippner, 2015) instead of intended changes in the Federal Funds rate. Specifically, we splice the Federal Funds rate with Krippner's Shadow Short rate in 2009q4 and use this measure as a dependent variable in the same regression from which we recovered the original Romer and Romer (2004) monetary

policy shocks. The sample for this regression is restricted by the availability of Greenbook forecasts only made available with a delay.[13]

Following previous literature, we consider the sum of real public consumption expenditure and real gross government investment in log-levels as a measure of government spending. To evaluate changes in government spending we employ the Blanchard and Perotti (2002) identification scheme. This identification scheme is based on the assumption that within-quarter government spending does not *contemporaneously* respond to macroeconomic variables. Blanchard and Perotti (2002) justify this assumption by pointing out that institutional procedures imply that the adjustment of government spending in response to business cycle fluctuations is implemented with a certain lag so that at high enough frequency, i.e. within a quarter, there is little or no response of fiscal policy to such fluctuations. Since the set of controls in Equation (2) below includes lagged values of GDP and government spending in addition to current government spending, the shock is simply given by the coefficient of current government spending which amounts to the arguably exogenous shock from the Blanchard and Perotti (2002).[14]

To take account of potential anticipation effects not fully captured by our identification scheme, in the robustness analysis we utilize changes in a purged measure of government spending. We purge this measure by regressing government spending on expectations about spending elicited from the SPF. We then utilize the residuals from this regression instead of the raw government spending series in our local projections (see e.g. Ramey (2011) and Auerbach and Gorodnichenko (2012) for similar approaches). This further handles any anticipation effects that might result into endogeneity biases and in particular, simultaneity issues between our shock and the state variable, potentially arising, e.g., from a looming consolidation.

[13]We also consider the Wu and Xia (2016) shadow rate as an alternative monetary policy measure. We thank Max Breitenlechner for providing us data and codes to construct the monetary policy shocks used in Breitenlechner and Scharler (2020).

[14]We show the time series of the log of government spending in Figure A.2 in the appendix. In the regressions below we control for a linear and a quadratic time trend to take account of the upward trend in government spending.

3 Econometric approach

A suitable approach to study how fiscal and monetary policy affect expectations conditional on the sustainability of public finances is the local projections method of Jordà (2005). This framework is very flexible and allows the dynamics of impulse responses to vary according to the state of the economy by introducing interaction terms.[15] The Jordà method requires estimation of a series of regressions for each horizon τ. We fit the following model to the data, allowing for state-dependence and the simultaneous evaluation of the effects of government spending and monetary policy shocks[16]

$$\begin{aligned} x^e_{t+\tau} = \alpha_\tau + \beta^m_\tau MP\ shock_t + \beta^g_\tau G_t + \sum_{s=1}^{2} \gamma_{\tau,s} x^e_{t-s} + \delta'_{\tau,\mathbf{s}} \mathbf{X}_{t-s} \\ + F(z_{t-1})(\alpha^{state}_\tau + \beta^{m,state}_\tau MP\ shock_t + \beta^{g,state}_\tau G_t + \\ + \sum_{s=1}^{2} \gamma^{state}_{\tau,s} x^e_{t-s} + \delta^{state'}_{\tau,\mathbf{s}} \mathbf{X}_{t-s}) + \kappa_\tau t + \lambda_\tau t^2 + \epsilon_{t+\tau}. \end{aligned} \tag{2}$$

The dependent variable is in each case one of the survey measures described in Section 2. For example, we consider survey-based consumers' expectations regarding economy-wide inflation, unemployment and interest rates. The state variable indicating the state of public finances is captured by the smooth transition function $F(z_{t-1})$, which we evaluate at 0 and 1 (high debt). The $MP\,shock$ is a Romer and Romer-type interest rate hike surprise and G captures an unexpected increase in government spending as described in section 2.4. Control variables are used in order to capture the state of the business cycle one quarter before people provide survey answers. More specifically, we include the logarithm of real GDP, the CPI inflation rate, and

[15] Auerbach and Gorodnichenko (2013) were the first to use this technique to estimate state-dependent fiscal models, employing it in their analysis of fiscal multipliers in recessions and expansions. This approach has become one of the primary tools to study state-dependent effects of shocks (see e.g. Jordà et al., 2013; Tenreyro and Thwaites, 2016; Ramey and Zubairy, 2018).

[16] Accounting for the effects of monetary and fiscal policy simultaneously, helps avoid biased estimation of the separate impact of each of these shocks on expectations.

the Federal Funds rate as control variables in addition to the lagged dependent one.[17] We also include a recession dummy controlling for NBER recession dates as well as lagged values of the monetary policy shock and government spending. The inclusion of these variables effectively purges government spending from its systematic component. Throughout, we use the lagged value of $\mathbf{X}$ to alleviate endogeneity issues. As macroeconomic data is released with a certain lag, $\mathbf{X}_{t-1}$ may even proxy agents' information set more accurately than $\mathbf{X}_t$. In addition, we control for a linear as well as a quadratic trend.

One complication associated with the Jordà method is the serial correlation in the error terms induced by the successive leading of the dependent variable. To take account of this, we use the Newey-West correction of the standard errors. The impulse response functions (IRFs) presented below in a state of low-debt are just the sequences of the estimated β_τ^m and β_τ^g coefficients, where the coefficients on the interaction terms in Equation (2) are evaluated at $F(z_{t-1}) = 0$. In the high-debt state $F(z_{t-1}) = 1$ and the IRFs to monetary and fiscal shocks respectively are the sequences of $(\beta_\tau^m + \beta_\tau^{m,state})$ and $(\beta_\tau^g + \beta_\tau^{g,state})$.

4 Results

4.1 Responses of consumer expectations to fiscal and monetary policy shocks

4.1.1 Baseline Results

We now consider the impulse responses of consumer expectations to positive government spending shocks and to interest rate hike shocks arising from our estimation exercise described in the previous section, using a sample from 1978q1 to 2007q4. Figure 3 shows IRFs of the Michigan Survey measures to government spending shocks together with one and two standard error bands, corresponding approximately to the 68 and 96 percent confidence intervals. We describe

[17] Whether we only include the lagged dependent or a set of lagged expectations measures in the regression does not appear to affect our results. Thus, we control only for the lagged dependent.

responses as significantly positive or negative if they fall within the 96 percent confidence interval. However, when a response falls within the 68 percent confidence interval we refer to it as positive or negative noting that such a response implies a probability of at least 84 percent (and less than 98 percent) that it is indeed positive or negative, rendering it "marginally significant". These are responses to a one-standard-deviation shock in government spending. Specifically, as government spending shows an upward trend over the past decades, the standardization of shocks refers to detrended values of the log of government spending. Similarly, Figure 4 presents the impulse responses to monetary policy shocks. These IRFs show the reaction of consumers to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate. In every figure, Panels A, B and C refer to the respective responses of expectations regarding unemployment, inflation and interest rates. Panel D shows the response of consumers' satisfaction with economic policy, Panel E portrays the response of consumption intentions and Panel F shows the response of actual consumption spending. In each panel, the left column shows the IRFs in the low-debt state and the right column shows the IRFs in the high-debt state.

Considering state dependencies, we find typically stronger and often different responses of consumers' expectations to fiscal and monetary shocks in the high-debt state as compared to the low-debt state.[18] We describe these results next.

Fiscal shocks

Consumers' reactions to government spending shocks inside the low-debt state in the left column of Panels A to F in Figure 3 are not as pronounced and are often statistically indistin-

[18]We note that the linear model exhibits less action, with impulse responses to shocks derived from it often fluctuating around zero, especially in response to fiscal shocks. The IRFs for the linear model without state-dependencies, setting $F(z_{t-1})$ in Equation (2) to zero, are shown in Figures A.3 and A.4 in the appendix for fiscal and monetary policy shocks respectively.

guishable from zero.[19] In the high-debt state, responses to an increase in government spending in the right column of Panels A to E in Figure 3 are rather pronounced as compared to responses within the low-debt state. As shown in the right column of Panel A, in the high-debt state consumers expect higher unemployment five to eight quarters after the shock hits. The response of inflation expectations in the right column of Panel B in the high-debt state is positive on impact, at one and at seven quarters out, and significantly so at four quarters after impact. The response of interest rate expectations is positive on impact but negative between three to five quarters out and significantly negative by six quarters after impact in the right column of Panel C. This significant fall of interest rate expectations in the sixth quarter after impact in the high-debt state is in sharp contrast to the positive response of interest rate expectations over the same horizon in the low-debt state. As inflation expectations respond positively to the fiscal shock in the high-debt state, this fall in interest rate expectations might be explained by consumers believing the primary role of the Fed in the high-debt state is to ease the fiscal burden by lowering interest rates, rather than believing the Fed follows a standard Taylor rule.

The response of economic policy satisfaction in the high-debt state in Panel D is significantly negative upon impact, at four and five quarters out, and remains negative at six quarters out. Importantly, in the high-debt state consumers cut back their buying attitudes after a positive government spending shock. Consumption intentions respond negatively throughout the eight quarter horizon in the right column of Panel E and significantly so upon impact and at one, four to six, and eight quarters out.[20] This significant fall in consumption intentions in response

[19] Unemployment expectations in Panel A do not respond significantly to the government spending shock. Inflation expectations in Panel B respond negatively one and four quarters out and positively by eight quarters out. Interest rate expectations in Panel C respond negatively at two quarters out and then positively at three to six quarters out and significantly so eight quarters after impact. Satisfaction with economic policy responds negatively at three, six and eight quarters after impact and significantly so at seven quarters out in Panel D. In Panel E, we observe consumption intentions responding positively on impact, two, four and five quarters out, and significantly so three quarters after impact, and in Panel F consumption spending responds positively on impact and quarters one, two, three and five, and significantly so for quarters four and eight.

[20] This accords with Geiger et al. (2016) who find that people cut back on consumption, increasing precautionary saving in response to expansionary fiscal policy in an unsustainable fiscal environment.

to higher government spending in times of relatively high debt is in stark contrast with the rise in consumption intentions during times of low debt. Consistent with the direction and timing of the response of consumption intentions, actual consumption spending responds negatively, with a lag, throughout quarters three to six and significantly so in quarters seven and eight, as shown in Panel F. The latter results imply that the government spending multiplier is positive in one state and negative in the other.

Overall, an unexpected increase in government spending in times of relatively high debt appears to lead consumers to anticipate a fiscal consolidation. Our results are consistent with consumers expecting fiscal but also monetary authorities to be concerned about the fiscal burden.[21] This is suggested, in particular, by the responses of interest rate expectations, satisfaction with government policy, consumption intentions and consumption expenditures.

To assess whether responses are significantly different in low versus high-debt states, we look at the t-statistics on the coefficient of the interaction term $\beta_\tau^{g,state}$ which are presented in detail in Table A.1 of the appendix. We observe values well above an absolute value of 1.96 for several horizons in the case of consumption intentions and consumption expenditures. In these instances, we reject the null that the responses in low-debt versus high-debt states are identical beyond the 95 percent confidence level, at least for several periods. There is also some clear evidence of statistical significance for interest rate expectations and for satisfaction with economic policy. For inflation expectations, the t-statistic exceeds the value of 1.65 in some instances, with values as high as 1.95, so that it is only marginally significant. We do not reject the null of equal responses for unemployment expectations.

Monetary shocks

The responses of consumer expectations and attitudes to an interest rate hike surprise

[21] That is, the response of consumer expectations to government spending shocks is consistent with a passive monetary/passive fiscal policy regime.

inside the low-debt state, shown in the left column of each panel of Figure 4, are not as strong in magnitude compared to the responses in the high-debt state.[22] In the high-debt state, we observe pronounced reactions of consumer expectations in response to monetary policy shocks consistent with the notion that consumers are sensitive to changes in the policy rate when public debt is relatively high. In the case of unemployment expectations, we observe different signs of the responses depending on the state in which the shock occurs in, beginning at about five quarters out. For example, unemployment expectations in the right column of Panel A go up and significantly so six quarters after impact while they respond significantly negative in that same quarter in the low-debt state. Unemployment expectations in the high-debt state also respond positively at one, two, five, seven and eight quarters after impact. The response of inflation expectations in the high-debt state in Panel B is positive on impact, at two, and at four quarters out, but then becomes negative in the sixth quarter after impact.

Moreover, there is a pronounced and significant overshooting pattern of interest rate expectations in the high-debt state evident in the right column of Panel C. Interest rates go up significantly on impact and one quarter after the shock, but then start falling with the responses turning negative at five quarters out and significantly so six to eight quarters after impact. This is in sharp contrast with the positive response of interest rates between the fifth and eighth quarters after impact in the low-debt state. In the high-debt state but not in the low-debt state, consumers appear to expect the monetary tightening to be only temporary and to be followed by a monetary expansion. This is consistent with respondents believing that in

[22]To make this clearer, we show a zoomed-in version of the IRFs in the low-debt state in Figure A.5 of the appendix. In Panel A, unemployment expectations go up two to four quarters out, then fall significantly at six quarters after impact and the response remains negative seven and eight quarters out, significantly so in the latter case. In Panel B, inflation expectations go up significantly on impact and again at seven quarters out after having fallen at four quarters out. The response of interest rate expectations in Panel C is significantly positive on impact, and then turns negative at one and two and significantly so four quarters after impact, before becoming significantly positive five to seven quarters out and remaining positive even eight quarters after impact. Moreover, in Panel D, satisfaction with economic policy goes down between two and five quarters after impact and significantly so in the third and fourth quarter out, but then goes up in the seventh quarter and turns significantly positive by the eighth quarter out. Consumption intentions shown in Panel E, rise on impact but fall one quarter after impact remaining in negative territory until four quarters out, before turning positive again by the eighth quarter out, and consumption spending falls significantly one to three quarters out in Panel F.

times of high debt the primary role of the central bank is to ease the fiscal burden, and thus expecting the Fed to eventually lower interest rates after the initial hike consistent with passive monetary policy in the sense of Leeper (1991).

The responses of consumer attitudes suggest that a monetary tightening induces negative sentiments in the high-debt state. Satisfaction with economic policy in the right column of Panel D falls significantly on impact and at five and eight quarters out, and also responds negatively at one, two, four and seven quarters out. Consumption intentions in Panel E go up on impact but then respond negatively at two, three, and five to eight quarters out, significantly so in the seventh quarter after impact. The fall in both of these measures even two years after the shock is in contrast with their rise for the same horizon in the low-debt state, and suggests that the burden of debt is perceived to matter for macroeconomic outcomes when public debt is high. Consistent with consumption intentions, consumption spending in Panel F responds significantly negative to a monetary policy shock in quarters four to eight.[23] Interestingly, effects of monetary policy conditional on public debt differ compared to non-linearities associated with private debt. Using a similar empirical setup, Alpanda and Zubairy (2019) find that private debt mitigates the effects of monetary policy on consumption, but does not reverse them.

Comparing the responses in the low-debt versus the high-debt states, it is striking that all survey measures systematically react more strongly in times of relatively high public debt. In fact, as shown in Table A.1 of the appendix, we can reject the null that the responses to monetary policy shocks are identical for consumption spending and for all survey measures but inflation expectations, at least for several horizons, where we observe t-statistics on the

[23]We present a number of robustness checks for both fiscal and monetary policy shocks in appendix B. For instance, since changes in government spending may be anticipated we replicate the baseline estimation with government spending purged from anticipation effects using government spending forecast data (see Figure B.1). We also consider an alternative specification of the transition process of government debt with a higher cutoff (Figures B.2 and B.3 for fiscal and monetary policy shocks respectively), and with multiple cutoffs (Figures B.4 and B.5 for fiscal and monetary policy shocks respectively). Moreover, we re-estimate our baseline model using monthly data (not available for the fiscal shock) and show the resulting IRFs to monetary policy shocks in Figure B.6. These checks support the robustness of our main findings.

coefficient of the interaction term $\beta_{\tau}^{m,state}$ above an absolute value of 1.96. This suggests that the reaction of consumers to monetary policy shocks in high versus low public debt states is distinctly different, consistent with them being forward looking agents that pay attention to and worry about debt repayment in high-debt states, perceiving the burden of public debt as a drag on macroeconomic outcomes.

That the reaction is often greater in high-debt states as compared to low-debt states suggests that rational inattention might be at play here, with consumers paying more attention to shocks occurring when the stakes are high thus reacting more to these when public debt is high. After all, fiscal and monetary policies are likely seen to affect sustainability, refinancing, and repayment of government debt more in times of high debt so that consumers might easily perceive themselves as more directly affected by these policy shocks in high-debt states of nature. Thus, a high level of public debt might act as a trigger inducing consumers to become attentive.

4.1.2 Additional state dependencies

Adding a second state variable to capture recessions

Non-linear effects of monetary and fiscal policy shocks on economic activity are at the center stage of a recent and growing strand of literature. Empirical evidence suggests that how macroeconomic variables respond to fiscal and monetary policy developments critically depends on whether the economy is in a state of economic slack or not (Tenreyro and Thwaites, 2016; Ramey and Zubairy, 2018). As public debt tends to go up in times of economic distress it is conceivable that the state-dependent effects we observe in the low-debt and high-debt states are in fact associated with economic slack. To account for this, we add an additional state capturing NBER recessions through a dummy variable. Following Bernardini and Peersman (2018), we augment Equation (2) and control for an additional non-linearity associated with

recession periods. This effectively purges the public debt state and the interaction terms from recession effects. We consider the following regression equation that adds interactions with the state of economic slack, $I^{2nd\ state}$, to the debt-level state considered in the baseline:

$$
\begin{aligned}
x^e_{t+\tau} = \alpha_\tau + \beta^m_\tau MP\ shock_t + \beta^g_\tau G_t + \sum_{s=1}^{2} \gamma_{\tau,s} x^e_{t-s} + \delta'_{\tau,\mathbf{s}} \mathbf{X}_{t-s} + \\
F(z_{t-1})(\alpha^{state}_\tau + \beta^{m,state}_\tau MP\ shock_t + \beta^{g,state}_\tau G_t + \\
\sum_{s=1}^{2} \gamma^{state}_{\tau,s} x^e_{t-s} + \delta^{state'}_{\tau,\mathbf{s}} \mathbf{X}_{t-s}) + I^{2nd\ state}_{t-1}(\alpha^{2nd\ state}_\tau + \beta^{m,2nd\ state}_\tau MP\ shock_t + \\
\beta^{g,2nd\ state}_\tau G_t + \sum_{s=1}^{2} \gamma^{2nd\ state}_{\tau,s} x^e_{t-s} + \delta^{2nd\ state'}_{\tau,\mathbf{s}} \mathbf{X}_{t-s}) + \kappa_\tau t + \lambda_\tau t^2 + \epsilon_{t+\tau} \qquad (3)
\end{aligned}
$$

The IRFs to monetary and fiscal shocks from estimating Equation (3) are respectively the sequences of $(\beta^g_\tau + \beta^{g,state}_\tau)$ and $(\beta^m_\tau + \beta^{m,state}_\tau)$ shown in Figures 5 and 6. Our results are mostly robust to the inclusion of this second state and the respective interaction terms capturing additional non-linearities in expectations' responses. Comparing Figure 5 to our benchmark Figure 3 for government spending shocks and Figure 6 to Figure 4 for monetary shocks, the shapes of the impulse responses are strikingly similar for government spending shocks[24] and usually quite similar for monetary policy shocks. To assess whether responses to an unexpected increase in government spending are significantly different in low-debt versus high-debt states, we consider t-statistics on the coefficient of the interaction term $\beta^{g,state}_\tau$. We find these are significantly

[24]The main difference in the response of unemployment expectations to an unexpected increase in government spending as compared to the benchmark in Figure 3, is that they now go down in the second quarter and up in the sixth quarter after impact in the low-debt state in the left column of Panel A in Figure 5. Otherwise, these IRFs look remarkably similar to the baseline ones. For inflation expectations IRFs in Panel B, the single difference as compared to the benchmark is that they no longer go up in the eighth quarter after impact in the low-debt state in Figure 5. Moreover, interest rate expectations now go up on impact in the low-debt state in the left column of Panel C, and no longer go up on impact nor down at three and four quarters out in the high-debt state in the right column, retaining nevertheless the same exact shapes as compared to the benchmark IRFs. As compared to the benchmark, policy satisfaction in the high-debt state does not respond significantly in the fourth and fifth quarters out in the right column of Panel D in Figure 5, with the shape of the IRF otherwise visibly identical to the benchmark. Furthermore, as compared to the benchmark, consumption intentions responses in Panel E are now significant in the fourth and fifth quarter and negative in the seventh quarter out in the low-debt state, and no longer respond negatively in the second quarter after impact in the high-debt state, while retaining again the same exact shapes as compared to the benchmark IRFs. Finally, the response of consumption spending in Figure 5 closely resembles the response in Panel F of Figure 3.

different for several quarters for inflation and interest rate expectations, policy satisfaction, consumption intentions and actual consumption, but not for unemployment expectations.

We describe the main differences arising from adding the recession state in comparison to our baseline in response to a monetary shock next. Following an interest rate hike surprise, the response of unemployment expectations in the low-debt state is never significantly different than zero in the left column of Panel A of Figure 6 as opposed to the benchmark in Figure 4. The response of unemployment expectations in the high-debt state in the right column of Panel A exhibits certain differences relative to the baseline, with the most pronounced significantly positive response now occurring in the fourth rather than in the sixth quarter out and no longer positive in the seventh and eighth quarters out. The IRF of inflation expectations to monetary policy shocks in the low-debt state in the left column of Panel B differs substantially from the baseline, with significantly negative responses in the fourth and eighth quarters out, negative ones in the second, third and sixth quarter out, and no positive responses whatsoever. In the high-debt state, the response of inflation expectations is even more evidently positive in Figure 6 than in the baseline. While we no longer get a significantly positive response on impact, the response remains positive in the second and fourth quarters out and is now significantly positive even eight quarters after impact, without ever entering into negative territory. The recession state specification makes clear than in response to an interest rate hike surprise, inflation expectations go up in the high but not in the low-debt state, with the difference between the low and high-debt states now being statistically significant. The positive response of inflation expectations in the high-debt state is thus no fluke due to the absence of a recession state in our baseline.

The IRF of interest rate expectations in Panel C of Figure 6 is now similar to the benchmark in the low-debt state, with only minor differences in terms of timing. In the high-debt state, the IRF is almost identical to the benchmark as interest rate expectations still go up initially

and then fall into negative territory at five to eight quarters out. Policy satisfaction in Panel D of Figure 6 now responds negatively only for the second and third quarters out and becomes positive by the fifth quarter after impact, earlier than in the benchmark in the low-debt state. In the high debt state, policy satisfaction responds negatively at all horizons except in the third quarter out exactly as in the benchmark, but now somewhat more strongly and significantly between four and eight quarters after impact.

The response of Consumption intentions in Panel E of Figure 6 in the low-debt state is no longer positive on impact and eight quarters out nor negative at four quarters out. In the high-debt state, the response of consumption intentions is still negative five to eight quarters out as in the benchmark but is no longer positive on impact nor negative at two and three quarters out. Finally, the response of Consumption expenditures in Panel F of Figure 6 portrays a significant fall on impact and until three quarters out in the low-debt state, and a fall between four and eight quarters out in the high-debt state, as was the case in Panel F of Figure 4. Coefficients on the interaction terms, $\beta_{\tau}^{m,state}$, are significant at the 95 percent level for several periods for interest rate expectations and economic policy satisfaction in addition to inflation expectations, but, again, not for unemployment expectations nor for consumption intentions and consumption spending in this case.

Adding a second state capturing the pre- and post 1990 periods

Next, we account for a possible break associated with the pre- and post-1990 periods. Several reasons come to mind regarding why the second half of the sample could be subject to structural differences affecting the formation of expectations. For example, information about macroeconomic developments has become more precise, more easily accessible, and faster, through technological advances and the spread of the internet. Moreover, in the wake of the so-called Great Moderation, macroeconomic volatility declined. At the same time, beginning with the early 1990s recession the US experienced persistently higher levels of the debt-to-GDP ratio

(see Figure 2). To make sure that our measure of public debt is not confounded by a structural break associated with post 1990 developments, we consider a second state variable in Equation (3) in the form of a dummy that switches in the third quarter of 1990, the beginning of the early 1990s recession.

Figures B.7 and B.8 in the appendix show the responses. Overall, our main findings remain after adding the pre- and post 1990 dummy. In particular, we observe that in response to unexpected positive government spending shocks and interest rate hike surprises, consumers become increasingly pessimistic over future macroeconomic developments in the high-debt state but not in the low-debt state, suggesting this result is indeed driven by variation in our state variable capturing transitions from relatively high to low public debt levels rather than by a structural break around 1990.

In response to a government spending shock, the basic results distinguishing high from low-debt states remain for inflation expectations (negative in low versus positive in high-debt states) and consumption intentions (positive in low versus negative in high-debt states). For consumption spending, the results now become even more clear-cut with responses from the second to the eighth quarter out positive in the low-debt state and negative in the high-debt state, pointing to striking differences across these states of nature. However, there are evident differences relative to the benchmark for unemployment expectations responses which become significantly negative by the eighth quarter out in the low-debt state, and for the first several quarters in the high-debt state although they still go (significantly) up by the eighth quarter out in this case. Evident differences relative to the baseline also exist for interest rate expectations in the high-debt state as these no longer respond negatively at any horizon, and for economic policy satisfaction in both states but especially so in the low-debt state where this now goes up (instead of down) beginning in the second quarter. We still reject the null of equal responses to government spending shocks in the low and high-debt states at the 95 percent level, at least

for some periods, for unemployment and inflation expectations as well as for policy satisfaction, consumption intentions and consumption expenditures, but not for interest rate expectations.

For monetary policy shocks, responses in the low and high-debt states are significantly different at least for some periods for unemployment expectations, interest rate expectations, policy satisfaction, consumption intentions and consumption expenditures, but not for inflation expectations. While evident differences relative to the benchmark exist in a number of cases, the main findings from our benchmark specification remain. Unemployment expectations still go up six to eight quarters after impact in the high-debt state and down in the low-debt state, interest rate expectations still exhibit overshooting going up and then down in the high-debt state, and consumption spending, consumption intentions and policy satisfaction still eventually go down in the high-debt state and up in the low-debt state. Importantly, inflation expectations still go up in the high-debt state and now go down evidently in the low-debt state. Thus, in response to an interest rate hike surprise our main findings remain after adding a second state variable to allow for a break pre- and post 1990.

To further check the robustness of our estimated responses to fiscal and monetary policy shocks in relation to the period under study, we also re-estimated these for the period since 1990. Although the shorter sample expectedly makes estimates noisier, our main results are mostly unchanged qualitatively and quantitatively. As shown in Figure B.9 in the appendix, in response to a government spending shock, inflation expectations eventually go up in the high-debt state, economic policy satisfaction goes down in the high-debt state, consumption intentions go down in the high-debt state and so does actual consumption spending. The estimated response of the interest rate is especially noisy in this smaller sample while unemployment expectations still go up eventually in the high-debt state but only after having fallen between one and three quarters out. In response to an interest rate hike shock in Figure B.10, unemployment and inflation expectations still go up in the high-debt state while consumption intentions and consumption

spending still go down in the high-debt state. While noisier than in the baseline, interest rate expectations still rise and then fall in the high-debt state and economic policy satisfaction still tends to go down in the high-debt state.

Adding the zero lower bound state and extending the sample

We now explore the sensitivity of our results with respect to extending the sample length to 2012q4.[25] Up to this point we used data for 1978q1-2007q4 to avoid the Great Recession that brought about a prolonged period of low interest rates close to or at the zero-lower bound (ZLB).[26] As the transmission of fiscal and monetary shocks could easily be affected (Krugman, 1998; Eggertsson and Woodford, 2003; Eggertsson and Krugman, 2012), we account for the possibility of such a structural break, noting however that the question eliciting interest rate expectations in the Michigan Survey asks for expectations over borrowing rates which remained well in positive territory during the ZLB period.

To construct the policy shocks we use the Federal Funds rate spliced with the Shadow Short rate (SSR) suggested by Krippner (2015) in 2009q1 as the dependent variable in the first-stage regression in place of intended changes in the Federal Funds rate (FFR).[27] What we do here resembles Alpanda and Zubairy (2019), among others, that use a similar approach to extend the Romer and Romer (2004) policy shocks. We use a dummy variable that switches in 2009q1 and takes the ZLB into account in a manner that resembles regression Equation (3) where we added a state for economic slack.

We show the smooth transition function capturing the state variable z_t along with the

[25] We stop at 2012q4 since green book forecasts needed in order to identify policy shocks in the spirit of Romer and Romer (2004), are published with a delay.

[26] One channel through which the ZLB can affect the transmission of shocks is via the real interest rate and the forward-looking IS curve: when nominal interest rates are constrained by the zero-lower bound, shocks affect inflation expectations while nominal interest rates remain constant.

[27] The SSR is the shortest maturity rate estimated from a term-structure model that suitably takes account of the discontinuity in nominal interest rates at the ZLB. It is essentially equal to the FFR in conventional monetary policy environments, but can turn negative when the short term nominal interest is bounded by zero as it captures the effects of unconventional monetary policy, say quantitative easing, on longer-maturity interest rates.

debt-to-GDP ratio in Figure B.11 in the appendix. Figures B.12 and B.13 show the responses of consumer expectations to government spending and monetary shocks. The responses of consumer expectations are remarkably similar to our baseline. We observe more pronounced effects of the shocks in the high-debt state with the expectations measures reacting in the same way as previously to both government spending and monetary policy shocks. We observe only minor quantitative differences in the responses to the monetary shock as compared to the baseline.[28] Moreover, responses to government spending shocks in the low versus the high-debt state are significantly different for unemployment and inflation expectations as well as for policy satisfaction, consumption intentions, and actual consumption, at least for some periods, but not for interest rate expectations. In the case of monetary policy shocks, we find statistically different responses between the low and high-debt states for unemployment and interest rate expectations, consumption intentions, and policy satisfaction, but not for inflation expectations and actual consumption.

In addition, we repeat the above estimation exercise including the zero-lower bound period using now the Wu and Xia (2016) shadow rate measure. As we can see in Figures B.14 and B.15 of the appendix where we plot the estimated impulse responses to a positive government spending shock and an interest rate hike shock respectively, all results remain qualitatively and quantitatively unchanged relative to the baseline estimation and relative to estimates using the Krippner (2015) shadow rate shown in Figures B.12 and B.13 of the appendix.

4.2 Responses of professionals' expectations

Responses of unemployment, inflation expectations, and interest rate expectations for professional forecasters to government spending shocks and to interest rate hike shocks are shown

[28] The positive response of unemployment expectations to the monetary policy shock in the high-debt state is no longer strongly significant in the sixth quarter out in Figure B.13 unlike in Figure 4. Inflation expectations in the high-debt state no longer fall at any horizon. We also observe a less pronounced rebound effect for interest rate expectations in the high-debt state with the fall that follows the initial rise no longer strongly significant in the eighth quarter after impact.

respectively in Panels A, B and C of Figures 7 and 8. The sample for the underlying estimation is 1981q3 to 2007q4.

Looking at Figure 7, the IRFs of experts' expectations in the low-debt state in the left column of each panel indicate significant reaction to government spending shocks in a number of cases, more so than it was the case for consumers.[29] In the high-debt state, the IRF of experts' unemployment expectations in the right column of Panel A in Figure 7 shows that four quarters after the shock hits, experts revise expectations about future unemployment upwards and significantly so by the eighth quarter out, closely resembling the response of consumers in Figure 3 but different than the response of experts in the low-debt state. Interest rate expectations in the high-debt state in Figure 7 eventually fall by the fourth and more evidently by the sixth quarter out resembling the IRF for consumers in Figure 3. Inflation expectations in the high-debt state still go up on impact and in the first three quarters in this case, but then fall by the fifth and sixth quarters out while these went up for consumers over the same horizon, consistent with a Taylor rule linking inflation rate expectations with interest rate expectations in the case of experts in contrast to what we found earlier for consumers. Interestingly, differences of experts' expectations in the low- versus high-debt states are less pronounced as compared to consumers, in terms of statistical significance. For all three survey measures of expectations elicited from experts, the interaction terms $\beta_{\tau}^{g,state}$ are not significantly different from zero at the 95 percent confidence interval, reflecting that responses to the fiscal shock in the high-debt state are not distinctly different to the responses in the low-debt state in the case of experts. However, for some periods, t-values exceed absolute values of 1.65 for all measures suggesting differences still exist if only marginally significant ones.

In response to an interest rate hike surprise, unemployment expectations fall significantly

[29] Unemployment expectations in the left column of Panel A go up significantly on impact, inflation expectations in Panel B fall significantly three and seven quarters out and rise significantly at eight quarters out, and interest rate expectations in Panel C go up significantly at eight quarters out which was also the only instance we got any significant effect for consumers in any quarter shown in Panels A, B or C of Figure 3.

on impact and at two quarters out and rise eight quarters after impact in the low-debt state shown in the left column of Panel A in Figure 8, with this IRF very different than the IRF for consumers in Figure 4. Inflation expectations rise significantly upon impact and in the seventh quarter in Panel B in the low-debt state, resembling the response of consumers. Moreover, the response of interest rate expectations is positive at most horizons in the low-debt state in Panel C, never going into negative territory unlike the case of consumers in Figure 4. Taken together, these responses suggest experts interpret an interest rate hike shock in the low-debt state as a positive signal for an expansionary movement along the Phillips curve in the first two quarters.

The responses of experts' expectations in the high-debt state in the right column of Figure 8 uncover differences relative to the low-debt state while closely resembling those of consumers. In the right column of Panel A, experts gradually revise unemployment expectations upwards with responses significantly positive by the sixth quarter after impact, in contrast to the significant fall in unemployment expectations on impact and two quarters out in the low-debt state and similar to the response of consumers in Figure 4. Inflation expectations in the high-debt state in Panel B go up one to three quarters out but then fall, with responses turning significantly negative in the sixth and seventh quarters after the shock, with the IRF shape resembling that for consumers in Figure 4 and different than in the low-debt state in the left column of Figure 8. Similarly, after initially rising, interest rate expectations tend to fall by quarter six in the high debt state in Figure 8, resembling what happens for consumers in Figure 4. The response of inflation and interest rate expectations is consistent with a Taylor rule linking these two series in the case of experts. We note that differences of experts' expectations in the low versus high-debt states are less pronounced as compared to consumers. The coefficient on the interaction term $\beta_{\tau}^{m,state}$ is insignificant for interest rate expectations and significant for unemployment and inflation expectations at the 95 percent level.

Overall, in the high-debt state, we observe similarities between the responses of consumers

and experts, supporting the prevalence of rational inattention motives in the updating of consumer expectations. That is, in high-debt states, consumers responses are closer to those of professionals as in this case they have a higher incentive to keep track of monetary or fiscal developments, but when the stakes are low, experts exhibit more significant responses than consumers to fiscal and monetary policy shocks.[30]

5 The impact of fiscal and monetary shocks on disagreement

To evaluate dispersion or disagreement among consumers, we run regressions with cross-sectional standard deviations of the consumer survey measures as dependent variables.[31] We follow Coibion and Gorodnichenko (2012) in using the cross-sectional standard deviations as a measure of disagreement. To obtain cross-sectional standard deviations of survey answers we resort to micro-level data. We then use the individuals' answers to each of the survey questions introduced in section 2.1 to compute the cross-sectional standard deviation across individual respondents for each survey question.[32] Figures 9 and 10 show the responses of these second moments of the survey variables to government spending shocks and monetary policy shocks respectively.

Looking at the responses to fiscal policy shocks in the low-debt state in the left column of each panel in Figure 9, the standard deviation is either unaffected or falls with some exceptions, notably in the case of economic policy satisfaction where it tends to go up.[33] The right column

[30] As professional forecasters get paid to "pay attention" to the macroeconomy, they are more likely to pay attention and thus respond to shocks even in low-debt states.

[31] One reason that could potentially drive this dispersion is rising uncertainty among respondents precipitated by fiscal and monetary developments.

[32] Qualitative answers, e.g. in the case of unemployment expectations 'more', 'about the same', and 'less', are coded as $[-1, 0, 1]$.

[33] The standard deviation of unemployment expectations falls at one and three to seven quarters out, significantly so at four and six quarters after impact. The standard deviation of inflation expectations falls in negative territory on impact and one to seven quarters out, and significantly so four quarters after impact. The response of the standard deviation of interest rate expectations is positive on impact and at two quarters out, but turns negative four and eight quarters after impact. Moreover, the standard deviation of consumption intentions falls on impact and until the fifth quarter out but then rises seven quarters after impact. Finally, the standard deviation of economic policy satisfaction increases one, three, four, five and seven quarters after impact in the low-debt state.

in each panel of Figure 9 shows responses of second moments of consumer expectations regarding unemployment, inflation and interest rates, as well as consumption intentions and policy satisfaction, in the high-debt state for fiscal policy shocks. Strikingly, we observe a pronounced increase in the standard deviation of each of the three expectations measures and consumption intentions in the high-debt state. The standard deviation of unemployment expectations falls on impact and in the third quarter out, but responds positively in the fifth to eighth quarter out, significantly so in the sixth and eighth quarter after impact. The standard deviation of inflation expectations responds positively on impact and from the third to the eighth quarter after impact, and significantly so in the seventh quarter out. The response of the standard deviation of interest rate expectations is slightly negative on impact and one quarter out, but turns positive from the third to the sixth quarter and significantly so in the latter case. The response of the standard deviation of consumption intentions is significantly positive on impact and in the first quarter out as well as in the fifth and sixth quarters after impact, and is also positive in the fourth, seventh and eighth quarters out. By contrast, the standard deviation of economic policy satisfaction falls from one to eight quarters after impact and is significantly negative from one to four quarters and seven quarters out.

We consider the response of the standard deviation of each of the three expectations measures as well as consumption intentions and economic policy satisfaction, to a monetary policy shock next. Looking at the left column of each panel in Figure 10,[34] we observe that, overall, the responses of the standard deviations of these survey measures are relatively small and not systematically or persistently positive in response to the monetary policy shock in the low-debt

[34]Figure A.6 in the appendix shows a zoomed-in version of these.

state.[35]

In the right column of each panel in Figure 10, we present responses of second moments of consumer expectations regarding unemployment, inflation and interest rates, as well as consumption intentions and policy satisfaction in the high-debt state for monetary policy shocks. We observe a pronounced increase in the standard deviation of each of the three expectations measures, consumption intentions and policy satisfaction in the high-debt state a few quarters after the shock hits. The standard deviation of unemployment expectations in Panel A responds negatively on impact and at one and two quarters out but the response turns positive by the sixth quarter out and significantly so in the seventh quarter after impact. The standard deviation of inflation expectations in Panel B responds positively in one, two, and four to eight quarters after impact and significantly so in the fifth quarter out. The response of the standard deviation of interest rate expectations is significantly negative on impact and at one quarter after impact, but then rises and turns significantly positive by the fifth quarter out and remains so six to eight quarters after impact. Moreover, the response of the standard deviation of consumption intentions is negative on impact but turns positive one to three quarters out and significantly so five to seven quarters after impact. Finally, the response of the standard deviation of economic policy satisfaction is negative on impact and one quarter after impact, but then rises becoming positive in the third quarter out and significantly so by the seventh quarter after impact.

Notably, in line with the visual evidence contrasting low versus high-debt states in the left

[35]The response of the standard deviation of unemployment expectations in Panel A is positive on impact, falls into negative territory in the first quarter out, turns positive in the fourth to sixth quarters out, and then becomes negative again in the eighth quarter out. The response of the standard deviation of inflation expectations in Panel B is significantly positive one and three quarters after impact, but negative at two, six and seven quarters out. The response of the standard deviation of interest rate expectations in Panel C is relatively small but significantly negative on impact and at six quarters out, negative at five and seven quarters out, and positive at one to four quarters out, significantly so in the fourth quarter out. The response of the standard deviation of consumption intentions appears minute but is positive on impact and between one and four quarters after impact, and significantly so in the third quarter out. Finally, the response of the standard deviation of economic policy satisfaction in Panel E is positive on impact and at six and eight quarters out, but significantly negative in the third and fifth quarters after impact.

and right columns of Figures 9 and 10, we can reject the null of equal responses in the low and high-debt states for all survey measures for both monetary and government spending shocks, at least for several periods.

Overall, the responses in Figures 9 and 10 indicate that monetary and fiscal policy induce a considerable amount of uncertainty in the expectations' formation process of consumers in the high-debt state. This is in line with the notion that monetary and fiscal policy are perceived to affect public debt sustainability more directly in times of relatively high public debt which in turn can make consumers more uncertain about the future. We note that increased dispersion (i.e., disagreement) among consumers in response to fiscal and monetary policy shocks in the high-debt state and decreased dispersion in the low-debt state is not consistent with sticky information models such us Mankiw and Reis (2002) that imply a positive association between disagreement and any shock, nor with noisy-information models without heterogeneity in signal-to-noise ratios that imply no response of disagreement to shocks.[36]

6 Conclusion

We have set out to understand the state-dependent impact of monetary and fiscal policies on macroeconomic expectations. Based on our findings, consumer expectations' responses to policy shocks are evidently stronger in magnitude and dispersion among respondents greater, in high-debt as compared to low-debt states. Our findings imply that in order to understand the response path of consumer expectations to policy shocks, it is necessary to take state-dependent effects into account in theoretical modeling and econometric estimation alike. As

[36]Noisy-information models assuming a fixed amount of capacity allocated to monitoring economic variables imply noise rises with variability and the accuracy of forecasts does not improve as variability increases, given also that agents "cannot choose to pay more attention at certain times" (Mankiw and Reis (2010)). Rational inattention models linking higher uncertainty with higher marginal returns from forming accurate forecasts, imply capacity is reallocated to allow increased accuracy when variability is higher. This could potentially reconcile why we observe stronger responses in periods of high-debt where we also observe greater dispersion among consumers that might reflect higher uncertainty.

expectations are key to how fiscal and monetary policy propagate in the economy, the finding of state-dependent responses of consumers' expectations to policy shocks has implications for the type of macroeconomic theory models we should be considering as well as for the actual conduct of fiscal and monetary policy.

Certain striking responses become apparent in states of high-debt. Notably, there is a significant fall in consumption intentions in response to higher government spending that is in stark contrast with the significant rise in consumption intentions in low-debt states. A rise in government spending in the high debt-state induces consumers to expect a contraction, consistent with an anticipated future fiscal consolidation combined with passive monetary policy as interest rate expectations fall a few quarters after impact. Consumers appear forward-looking in that they anticipate future fiscal austerity and thus cut back consumption intentions and raise unemployment expectations. We also find that in high-debt states, contractionary monetary policy shocks induce pessimistic expectations consistent with the notion that the burden of debt is a drag for macroeconomic outcomes. Notably, unemployment expectations rise persistently in response to contractionary monetary policy shocks in the high-debt state but not in the low-debt state. Furthermore, consumers appear to believe that a monetary tightening in times of high debt will be followed by a monetary expansion that will eventually lower interest rates, consistent with passive monetary policy and the belief that a primary role of the central bank in times of high debt is to stabilize public debt.

Importantly, considering public instead of private debt, we observe opposite effects of monetary policy on consumption depending on the level of public debt whereas Alpanda and Zubairy (2019) find that while monetary policy is less effective when private debt is high, it exerts qualitatively similar effects on consumption irrespective of the level of private debt.

Interestingly, the results obtained for consumer expectations in the high-debt state resemble those obtained for experts more closely than in the low-debt state. This resemblance in high-

debt states for consumers and professionals, who are after all paid to be attentive, is indicative of consumers being relatively more attentive to monetary developments when the stakes are high, in line with the emphasis on inattention in theoretical work over the past two decades. Importantly, an unexpected interest rate hike or a positive government spending shock typically raise disagreement among respondents in the high-debt state but not in the low-debt state. This is typically true for consumers' expectations regarding unemployment, inflation and the interest rate, but is also true for their consumption intentions. Increased disagreement among consumers in response to fiscal and monetary policy shocks in high-debt states and decreased dispersion in low-debt states is not consistent with sticky information models like Mankiw and Reis (2002) that imply a positive association between disagreement and any shock, nor with basic noisy-information models without heterogeneity that imply no response of disagreement.

Our finding that states of the world determined by the level of public debt imply very different impact of policy shocks, suggests that it is crucial to allow for state-dependence when assessing the impact of such shocks. It also points to the need for models that incorporate the government budget constraint so that the response of forward-looking agents to policy actions depends on the anticipation of the repayment of government debt. In such models, higher debt levels could fuel such considerations giving rise to the kind of state dependencies in the updating of expectations in response to fiscal and monetary policy shocks which we have found to be empirically important. Considerations about the repayment of public debt may involve anticipation of future inflation as suggested by the fiscal theory of the price level, or, alternatively, anticipation of fiscal consolidation efforts. Our results support the latter. That is, the estimated responses suggest that higher public debt fuels considerations regarding its repayment, giving rise to state dependencies in the updating of expectations in response to policy shocks consistent with the anticipation of a fiscal consolidation in states of high debt.

Overall, the state dependency we find here can arise due to inattention during states in which

the stakes are low relative to states in which the stakes are high, as in the noisy information model of Sims (2003) or Mackowiak and Wiederholt (2009), and in line with Sims (2010). Arguably, the stakes are higher during periods of relatively high public debt so that individuals could plausibly be more attentive and respond more strongly or even differently to a given policy shock within such states as compared to states of low debt.[37]

The state-dependent effects identified here based on the changing levels of public debt for the US over time, are likely to be even more important to consider for economies that exhibit greater heterogeneity and across higher mean debt levels among them. In this spirit, it would be useful to explore in future work the issue of state-dependence across European Union economies in order to assess state-dependent effects of policy shocks characterizing economies facing strikingly different public debt levels. More generally, the rise in public debt in many countries following the financial and sovereign debt crises as well as in the aftermath of the current pandemic-induced global crisis, render the study of the relation of public debt with monetary and fiscal policy transmission all the more urgent.

[37] Again, high public debt might induce consumers to be more attentive to policy shocks as these are likely to affect the sustainability, repayment and refinancing of public debt more directly in times of relatively high government debt, which in turn potentially affects consumers via a variety of channels.

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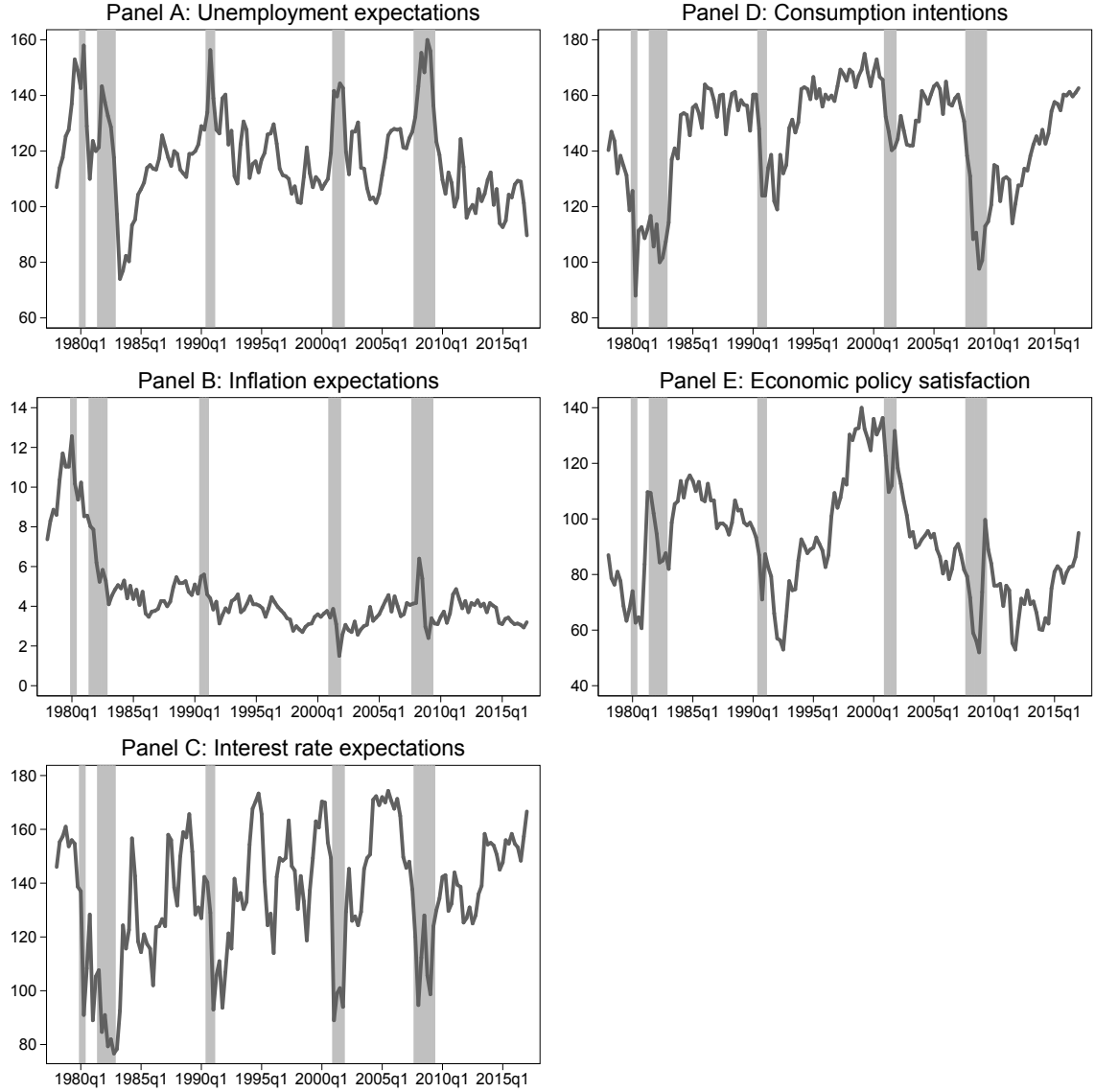
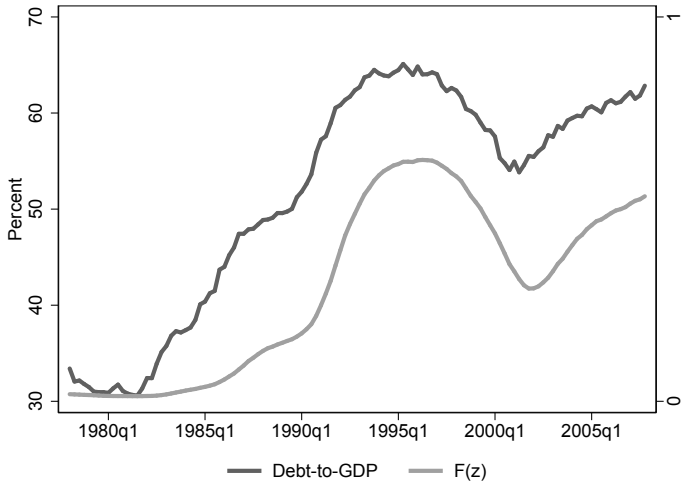
Figures

Figure 1: Aggregated survey measures from the Michigan Survey



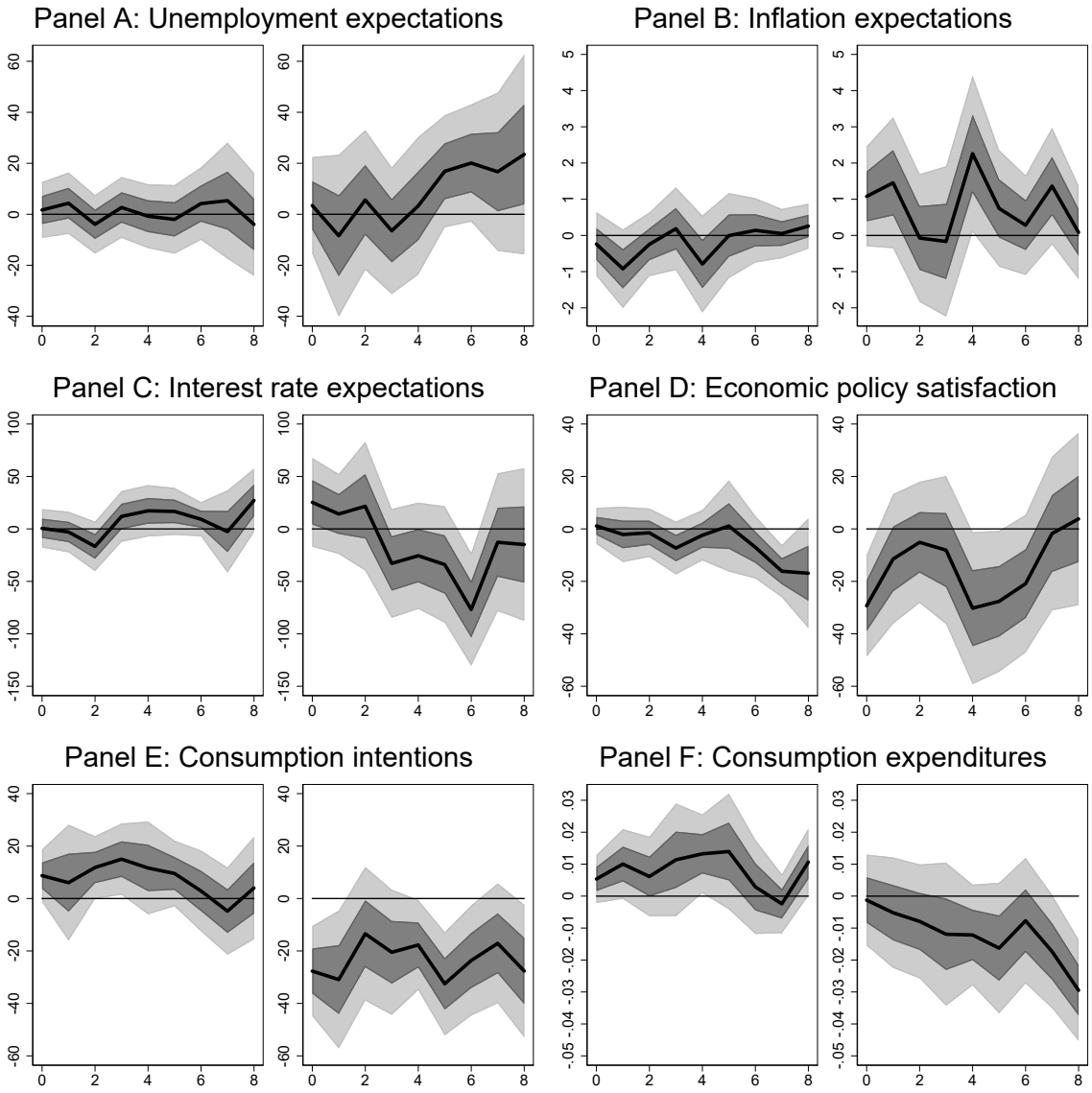
Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee. Inflation expectations are average point estimates in percent, all other survey measures are balance scores.

Figure 2: State variable



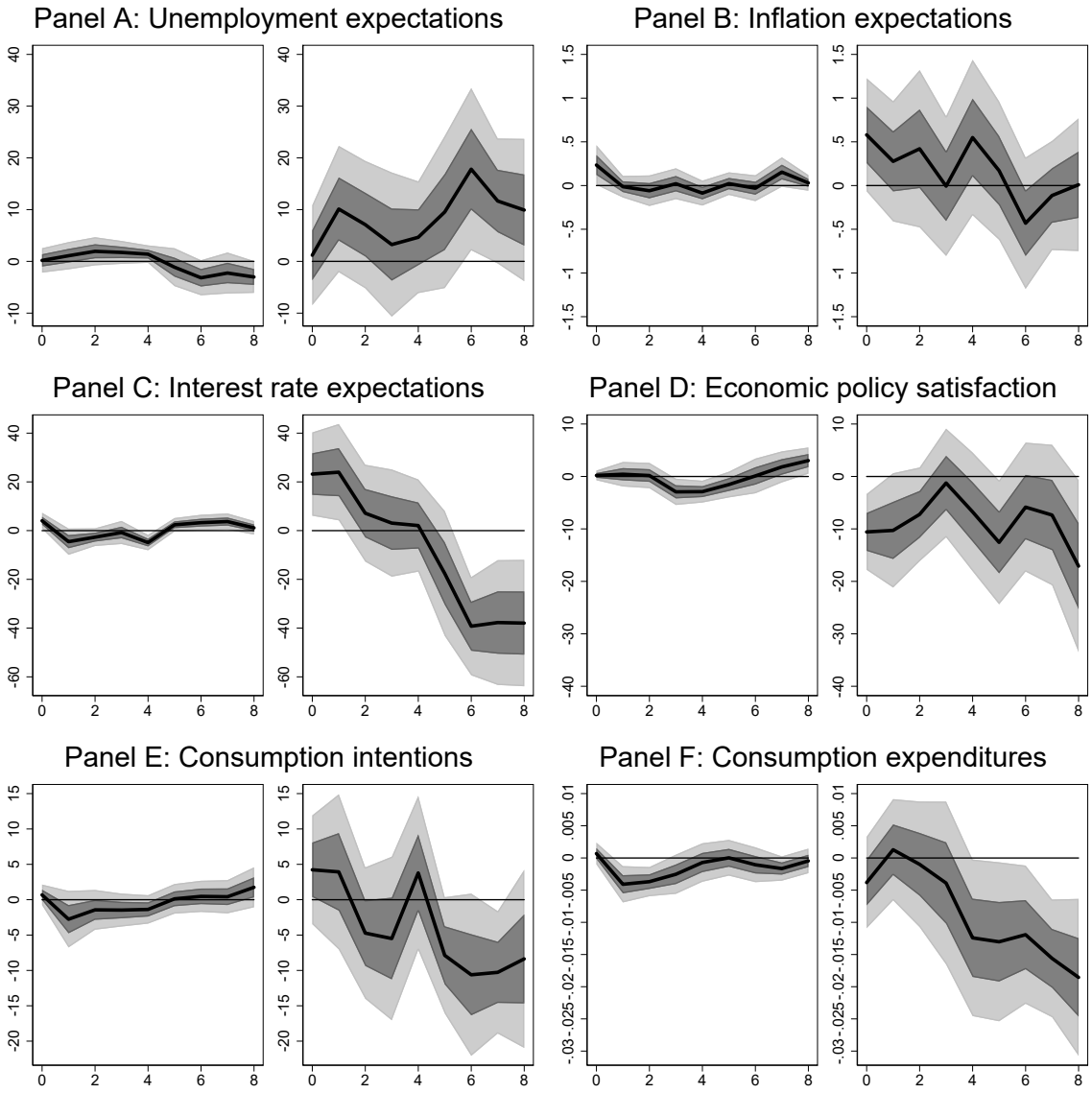
Notes: The figure shows the transition function $F(z)$ together with the debt-to-GDP ratio.

Figure 3: Consumer expectations responses to government spending shocks



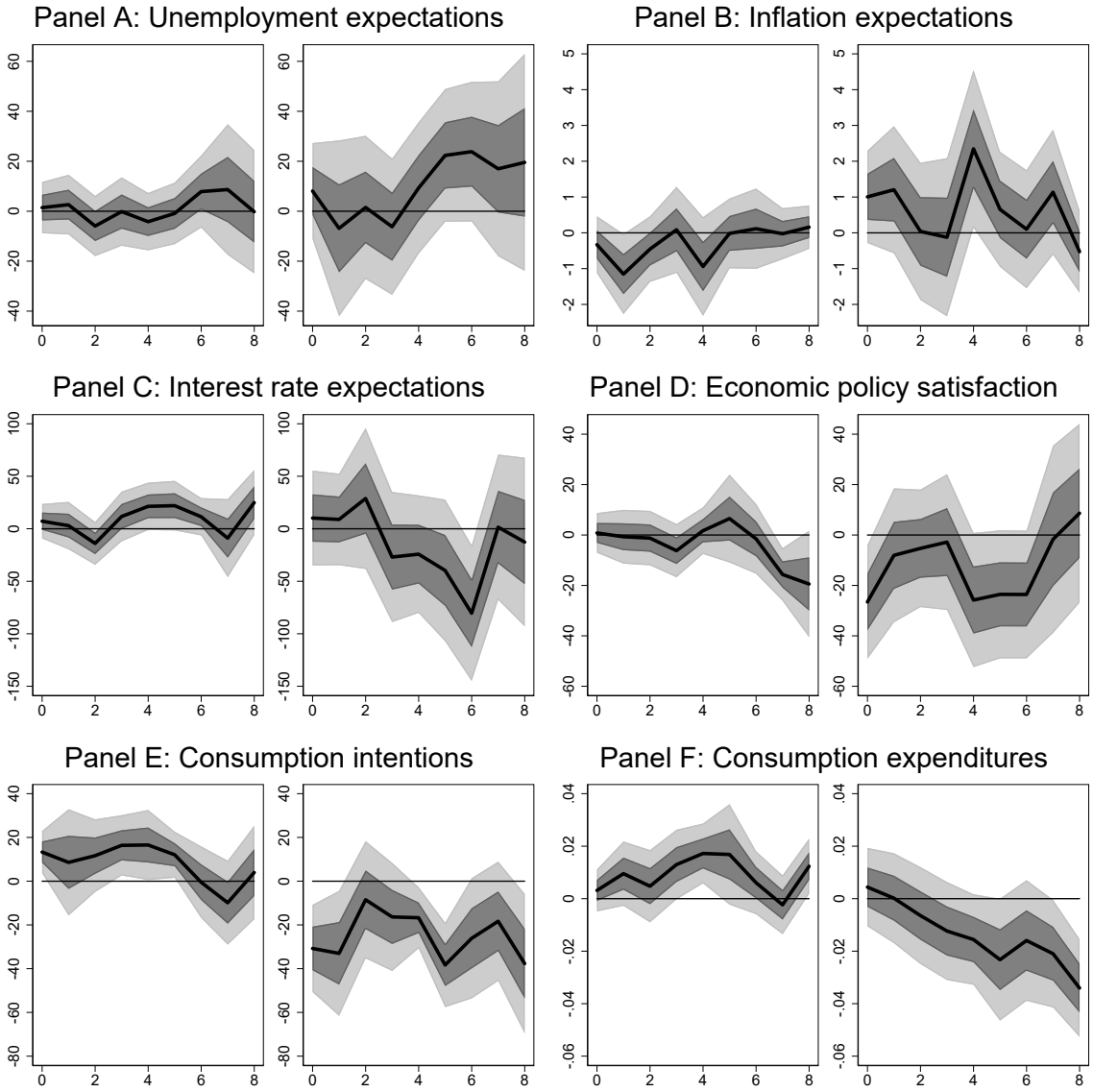
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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 4: Consumer expectations responses to monetary policy shocks



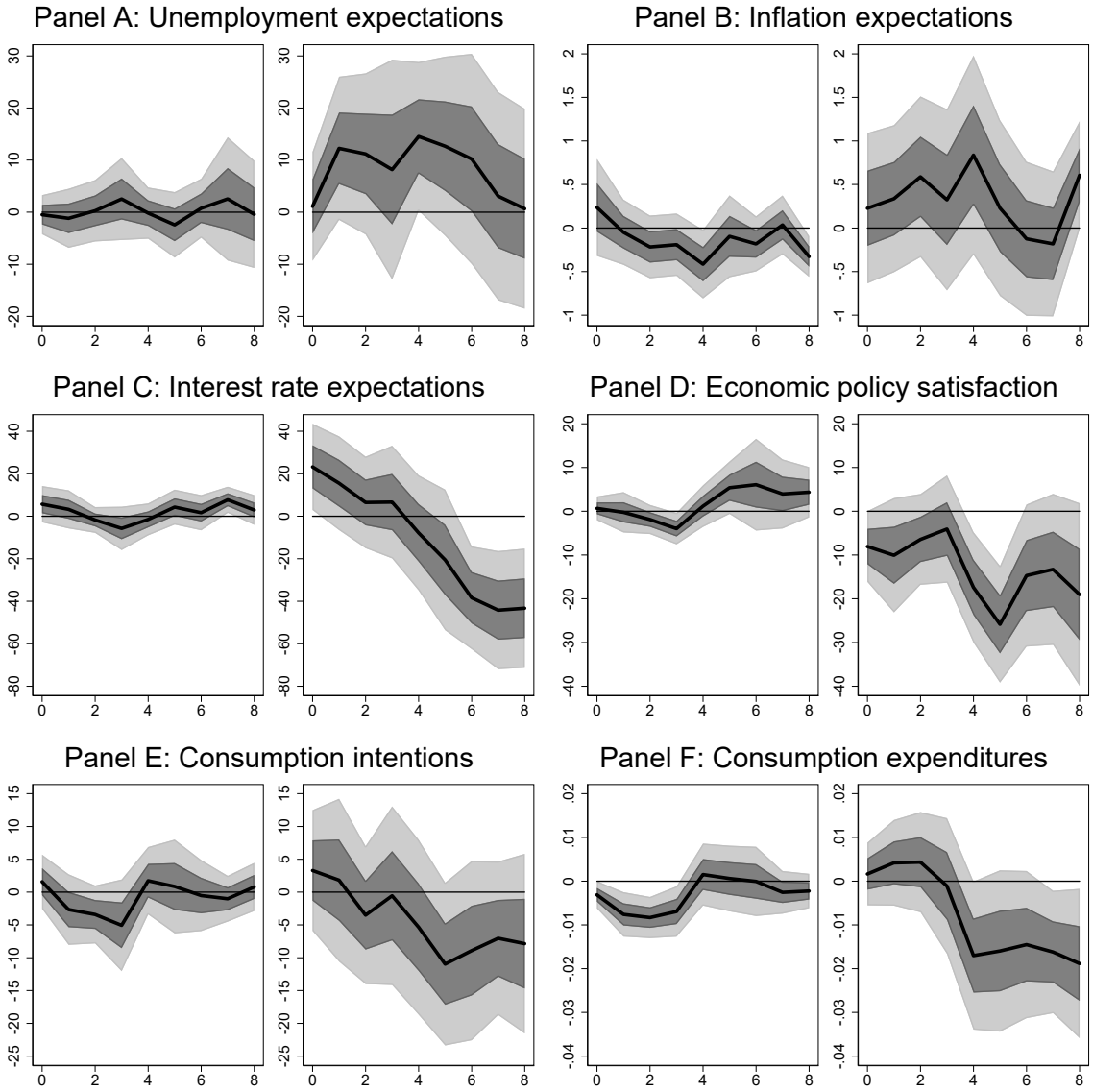
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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 5: Consumer expectations responses to government spending shocks (estimated with recessions states)



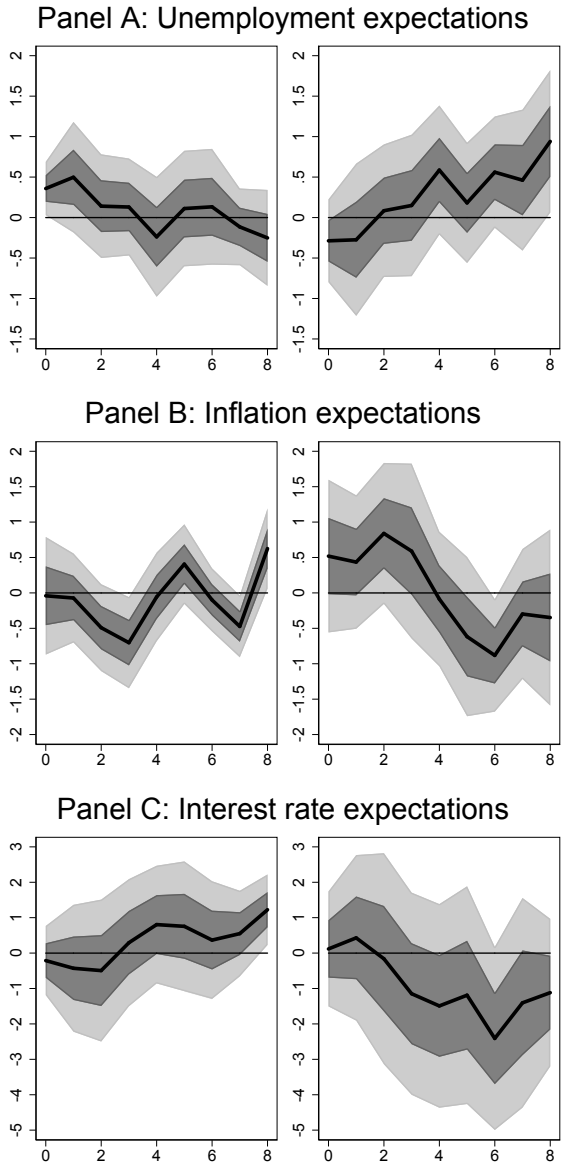
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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 6: Consumer expectations responses to monetary policy shocks (estimated with recessions states)



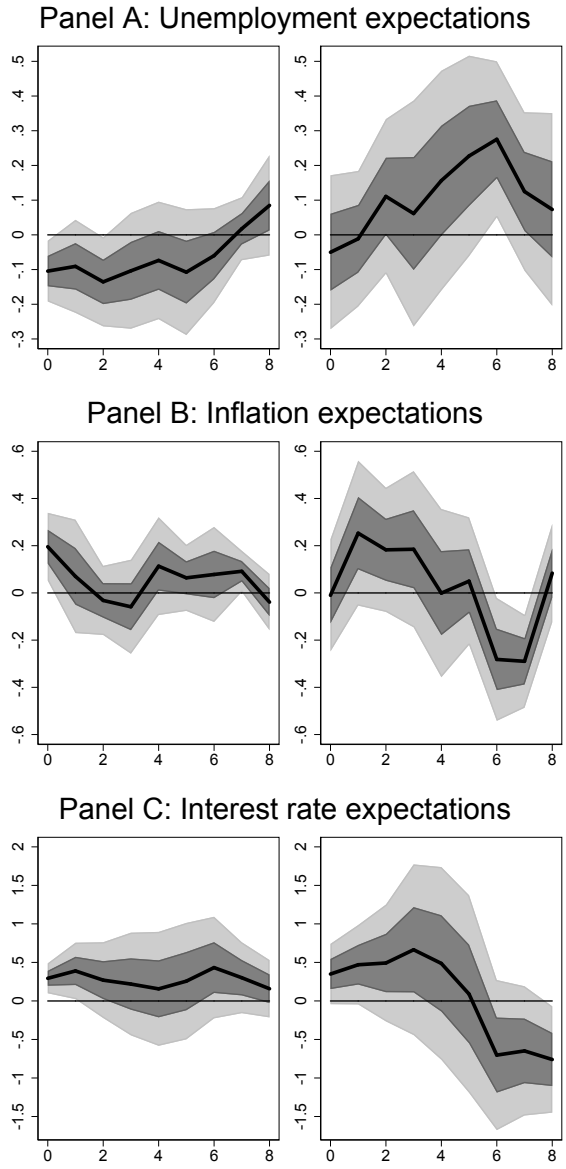
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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 7: Expert expectations: government spending shock



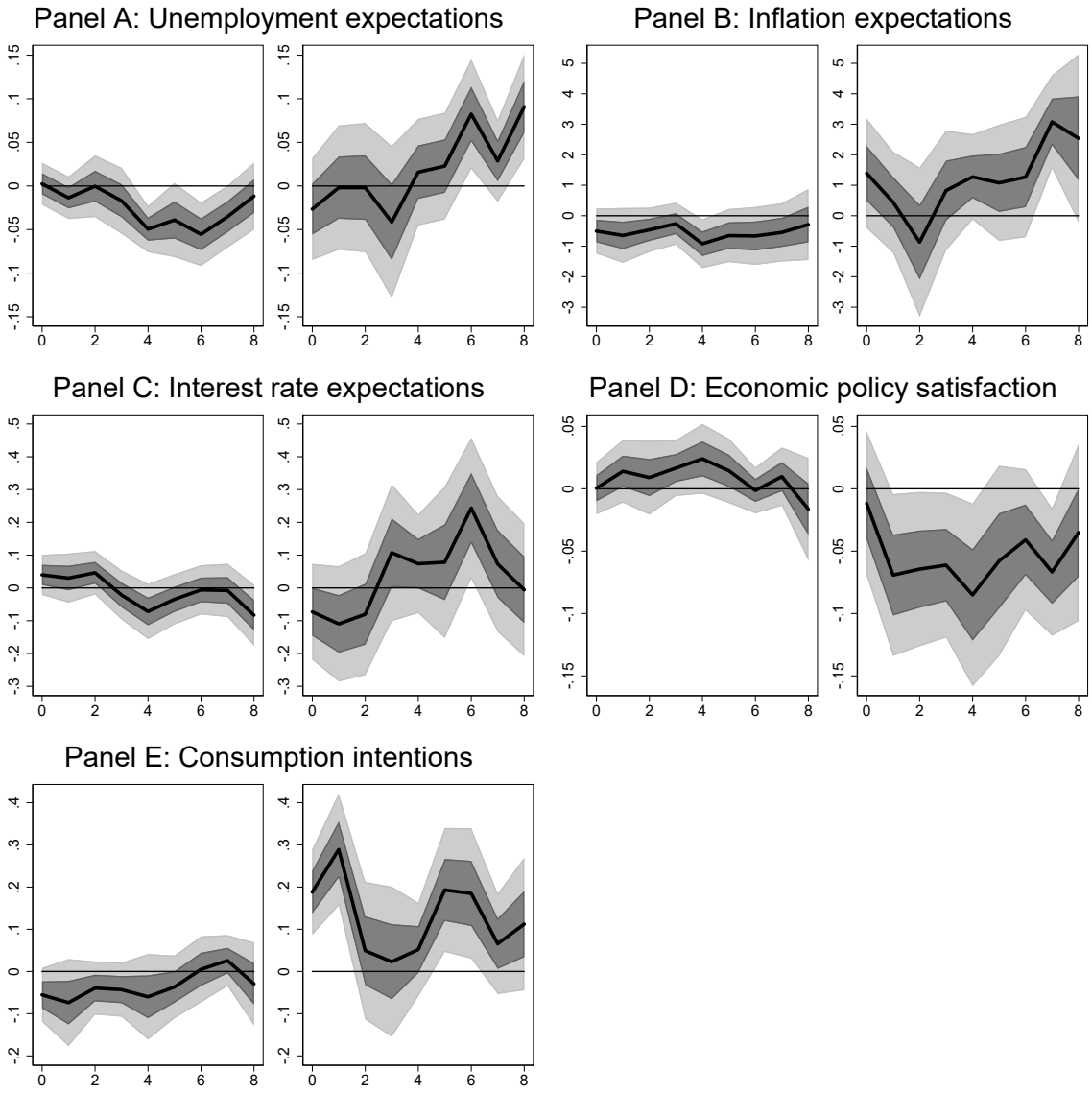
Notes: Expectations are average point estimates in percent. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard error bands. The horizontal axes is in quarters. In each Panel, the left column shows responses in the low-debt state and the right column responses in the high-debt state.

Figure 8: Expert expectations: monetary policy shock



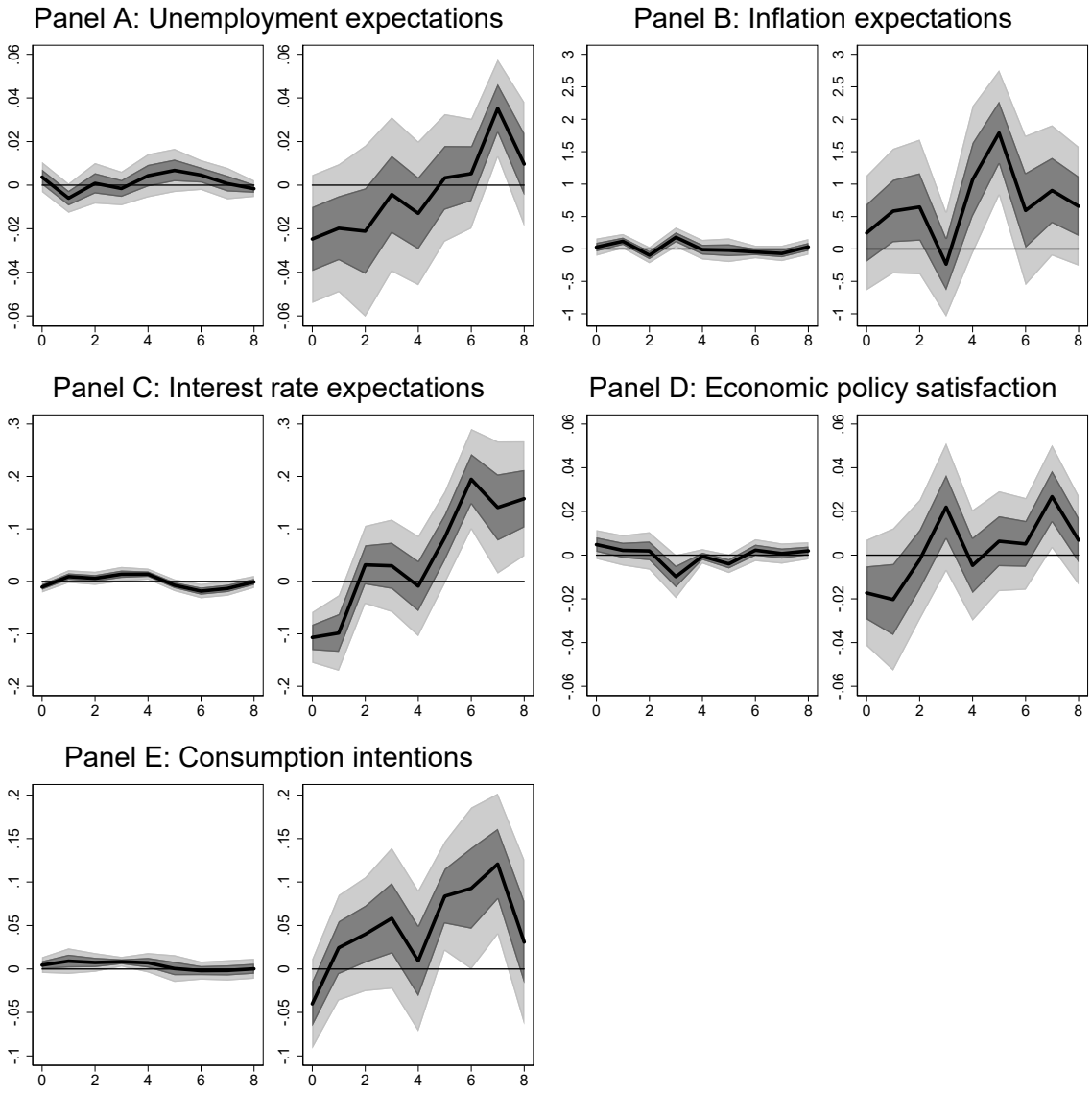
Notes: Expectations are average point estimates in percent. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended Federal Funds rate together with one and two standard error bands. The horizontal axes is in quarters. In each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

Figure 9: Responses of standard deviations to government spending shock



Notes: 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 (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 10: Responses of standard deviations to monetary policy shock



Notes: 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

Appendix A: Additional tables and figures

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

Panel A: Unemployment expectations

τ	$\beta_\tau^{g,state}$	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

τ	$\beta_\tau^{g,state}$	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

τ	$\beta_\tau^{g,state}$	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

τ	$\beta_\tau^{g,state}$	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

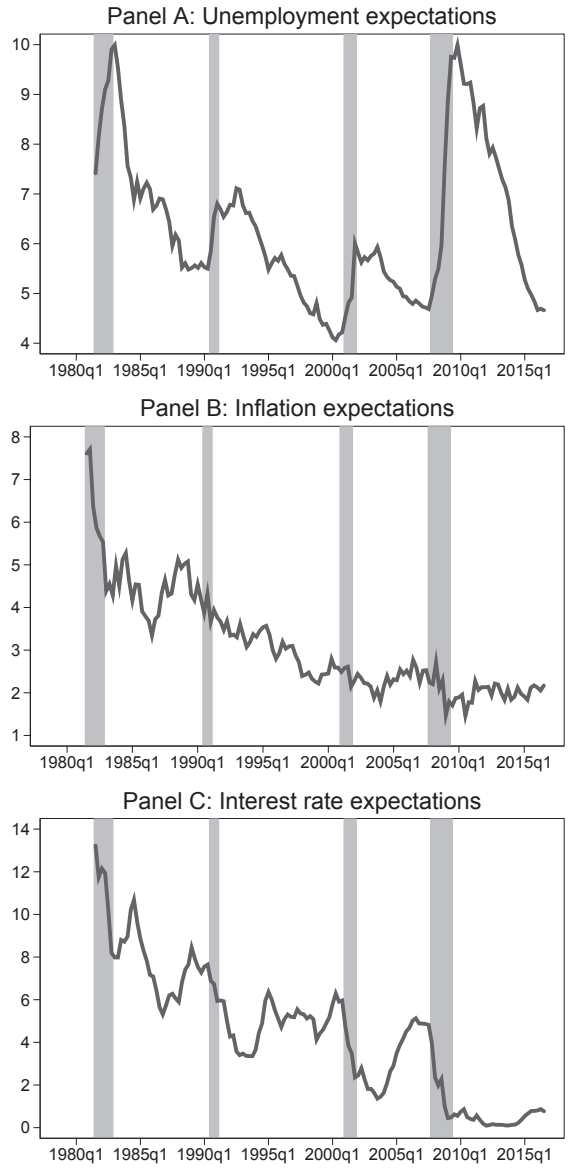
τ	$\beta_\tau^{g,state}$	tstat	$\beta_\tau^{m,state}$	tstat
0	-9.29	-3.06	18.17	0.87
1	-9.43	-1.63	34.26	1.00
2	-6.45	-1.50	-16.83	-0.61
3	-9.06	-2.14	-20.61	-0.64
4	-7.50	-2.06	26.45	0.85
5	-10.74	-2.86	-40.91	-1.79
6	-6.77	-1.59	-56.77	-1.80
7	-3.14	-0.73	-54.74	-2.22
8	-8.08	-1.72	-51.81	-1.48

Panel F: Consumption expenditures

τ	$\beta_\tau^{g,state}$	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

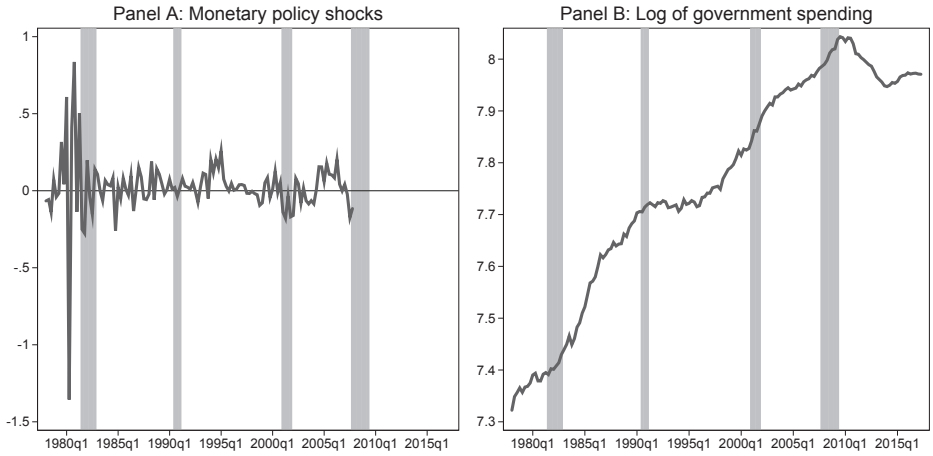
The table shows coefficients on the interaction terms $\beta_\tau^{g,state}$ and $\beta_\tau^{m,state}$ together with the corresponding t-statistics estimated from Equation 2.

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



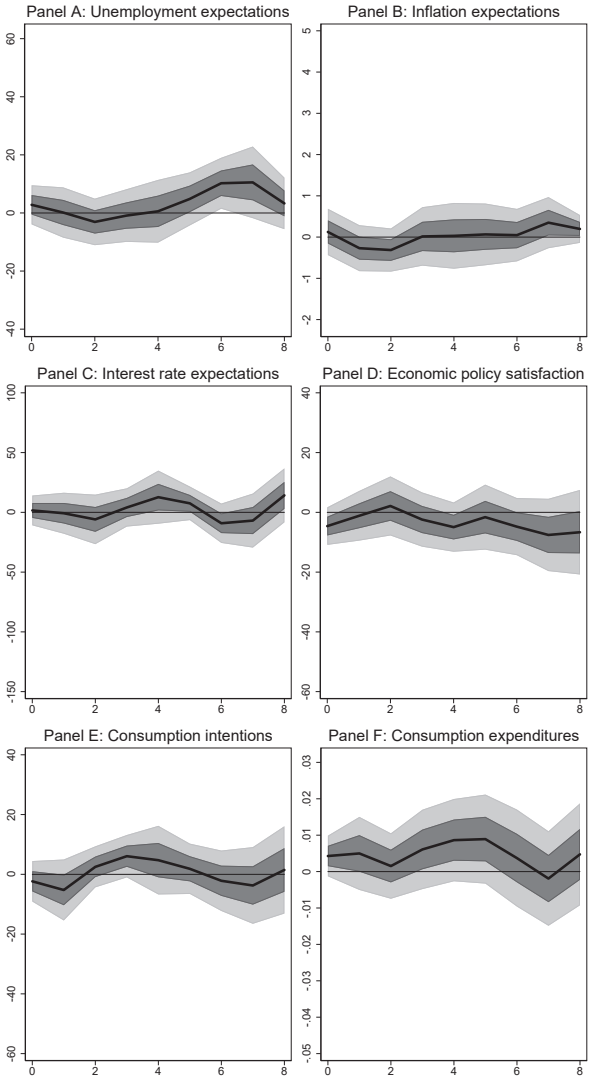
Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee. Expectations are average point estimates in percent.

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



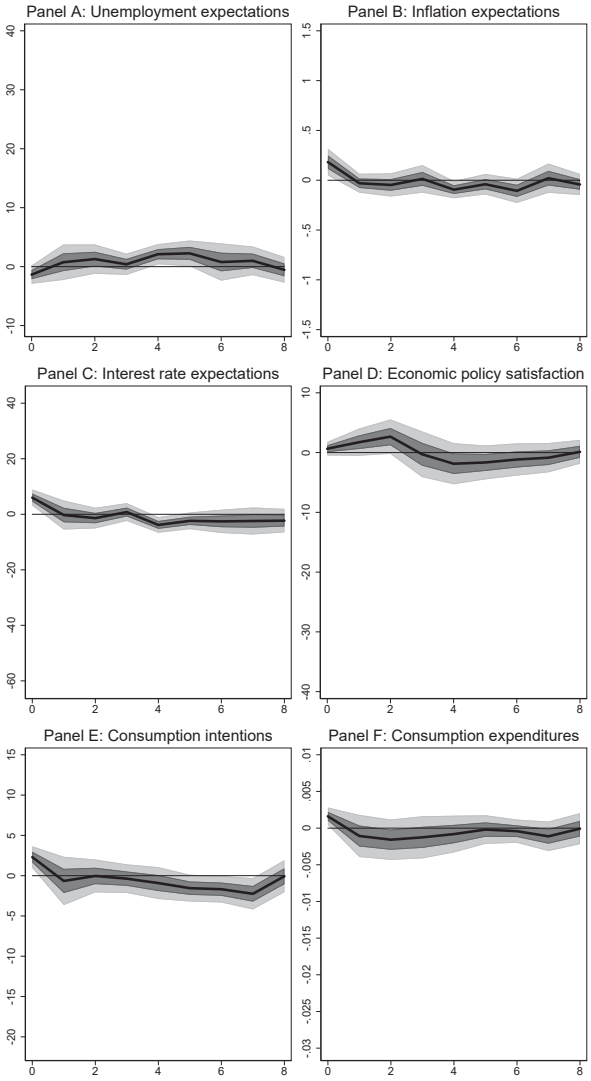
Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee.

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



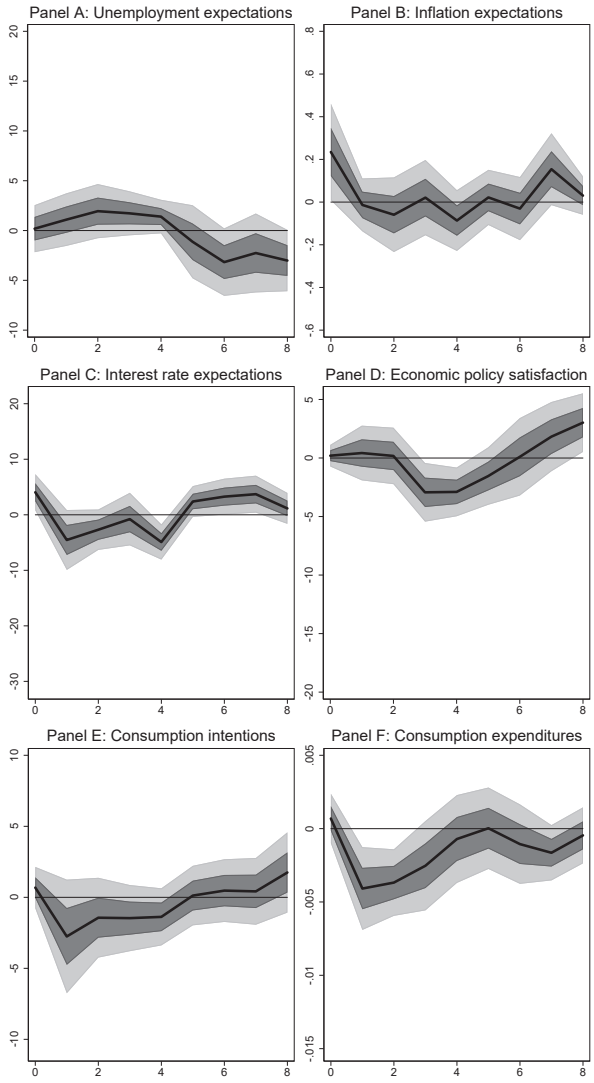
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



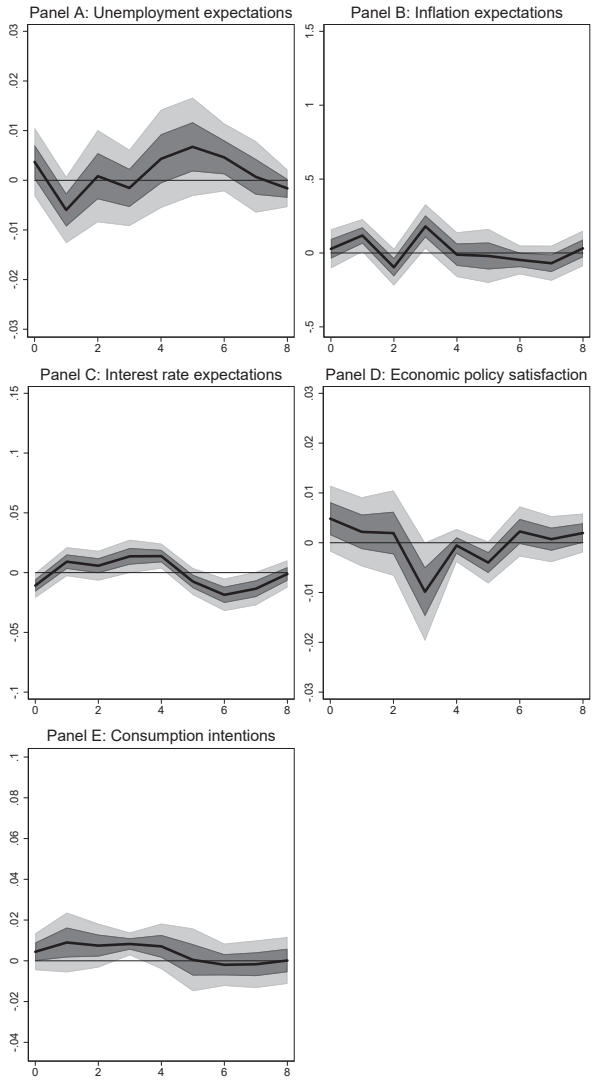
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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

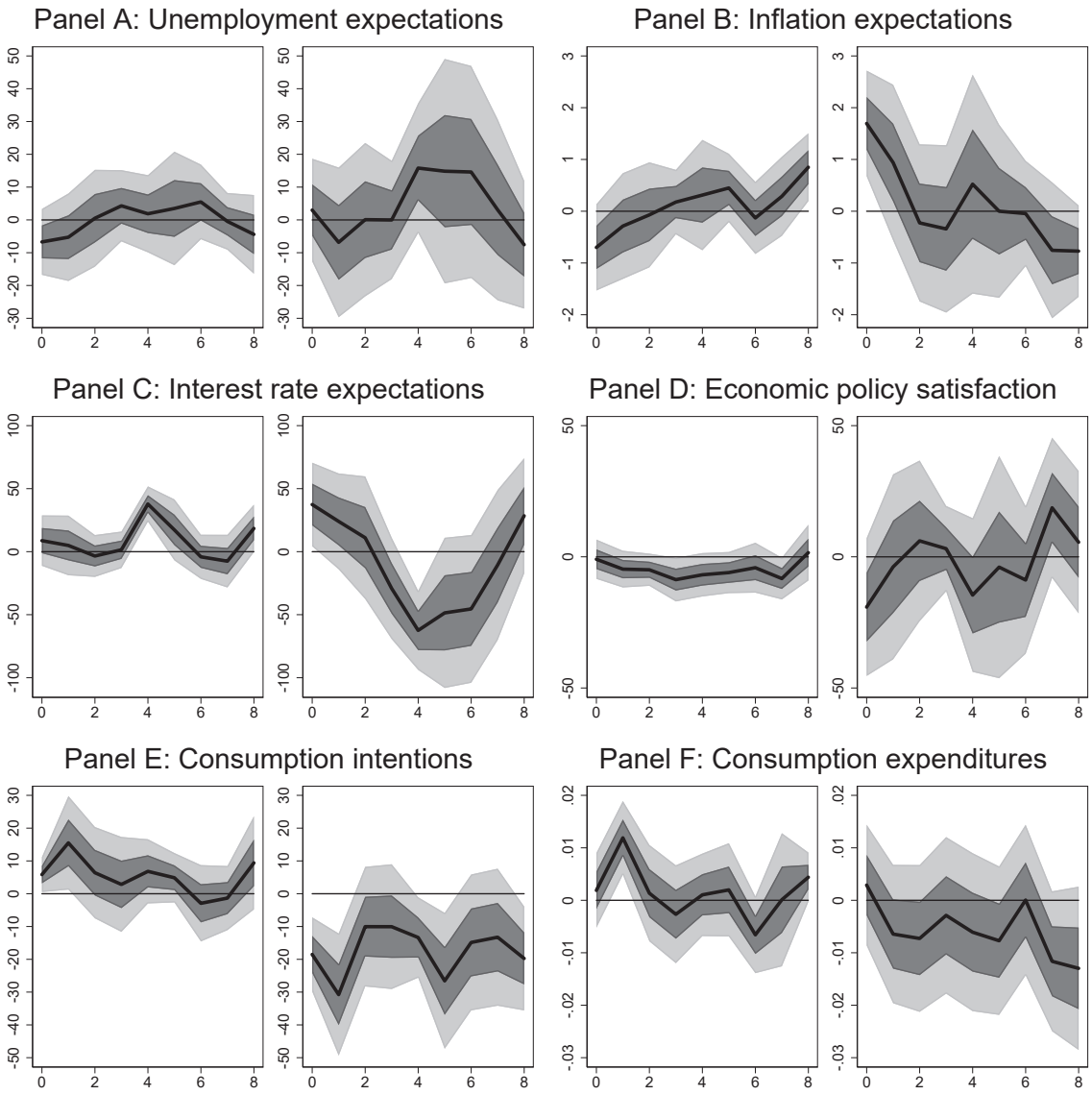
[3] All explanatory variables but real GDP and our measure of public debt are available with monthly frequency. Instead of real GDP, we now use the unemployment rate as a measure of output. The public debt state variable is converted to the monthly frequency by employing the Litterman (1983) temporal 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.

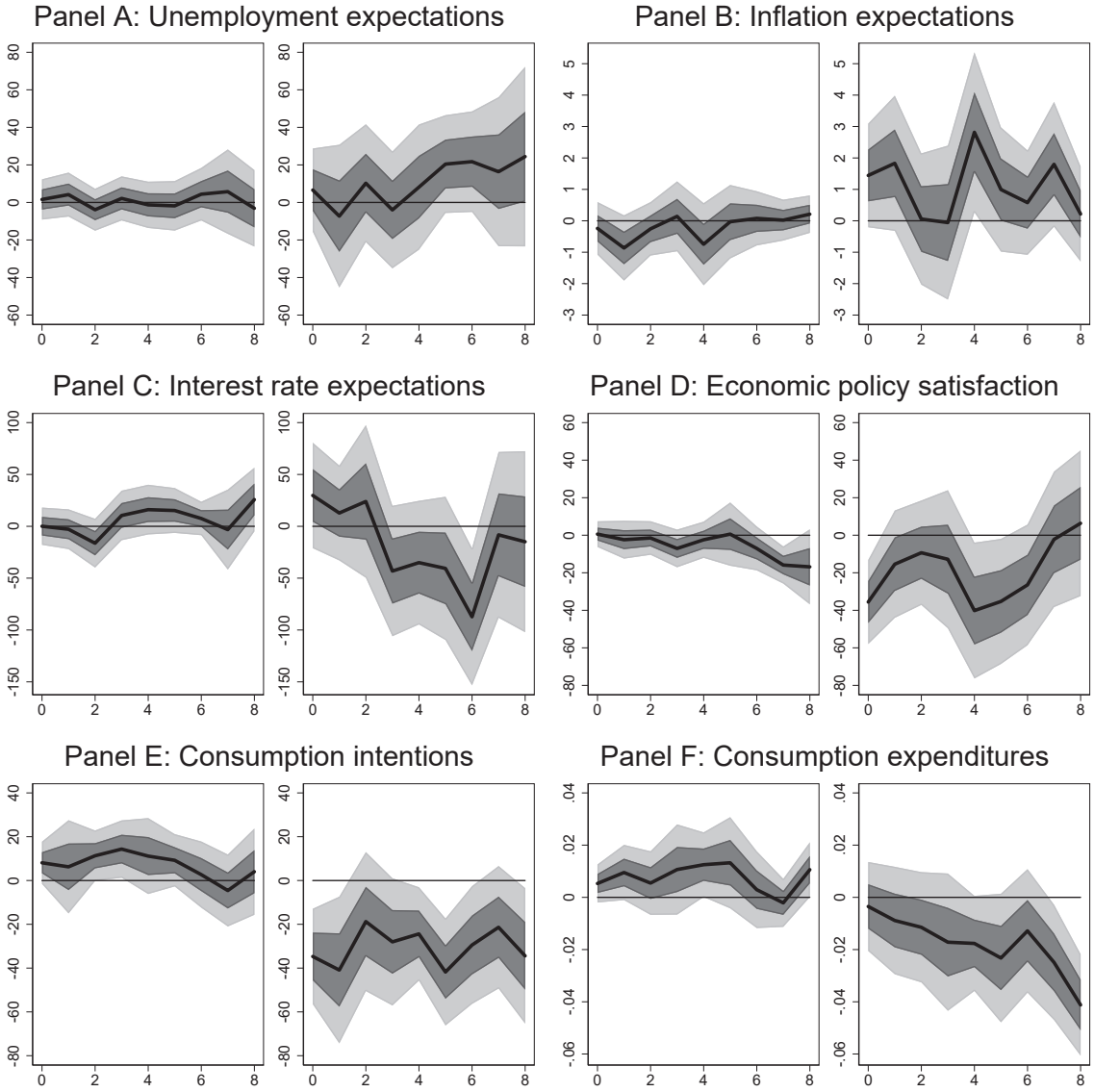
Considering the t-statistics on the interaction terms, $\beta_{\tau}^{m,state}$, we can reject the null of equal responses for all survey measures including inflation expectations and for realized consumption, at least for several periods. This corroborates the robustness of our results.

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



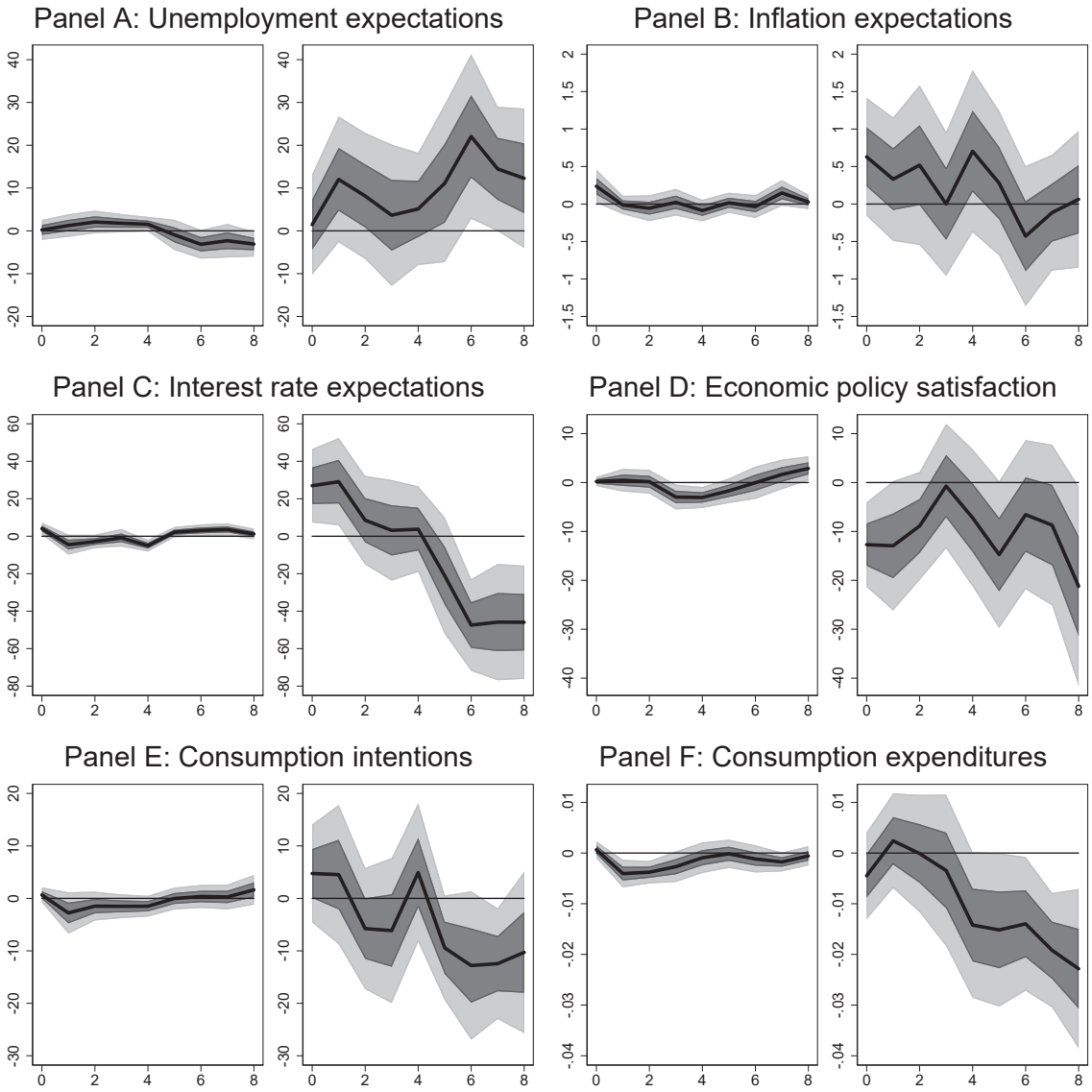
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



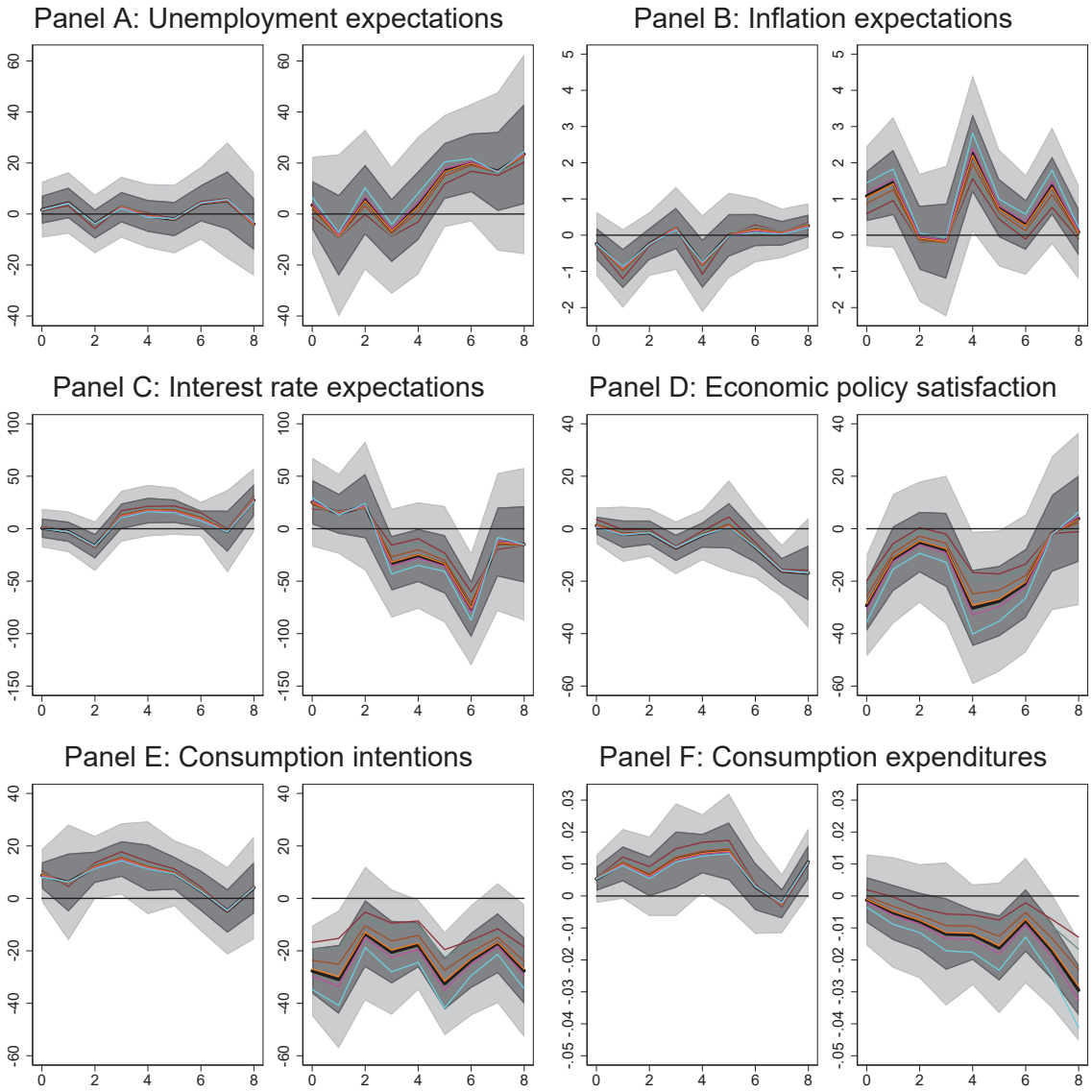
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



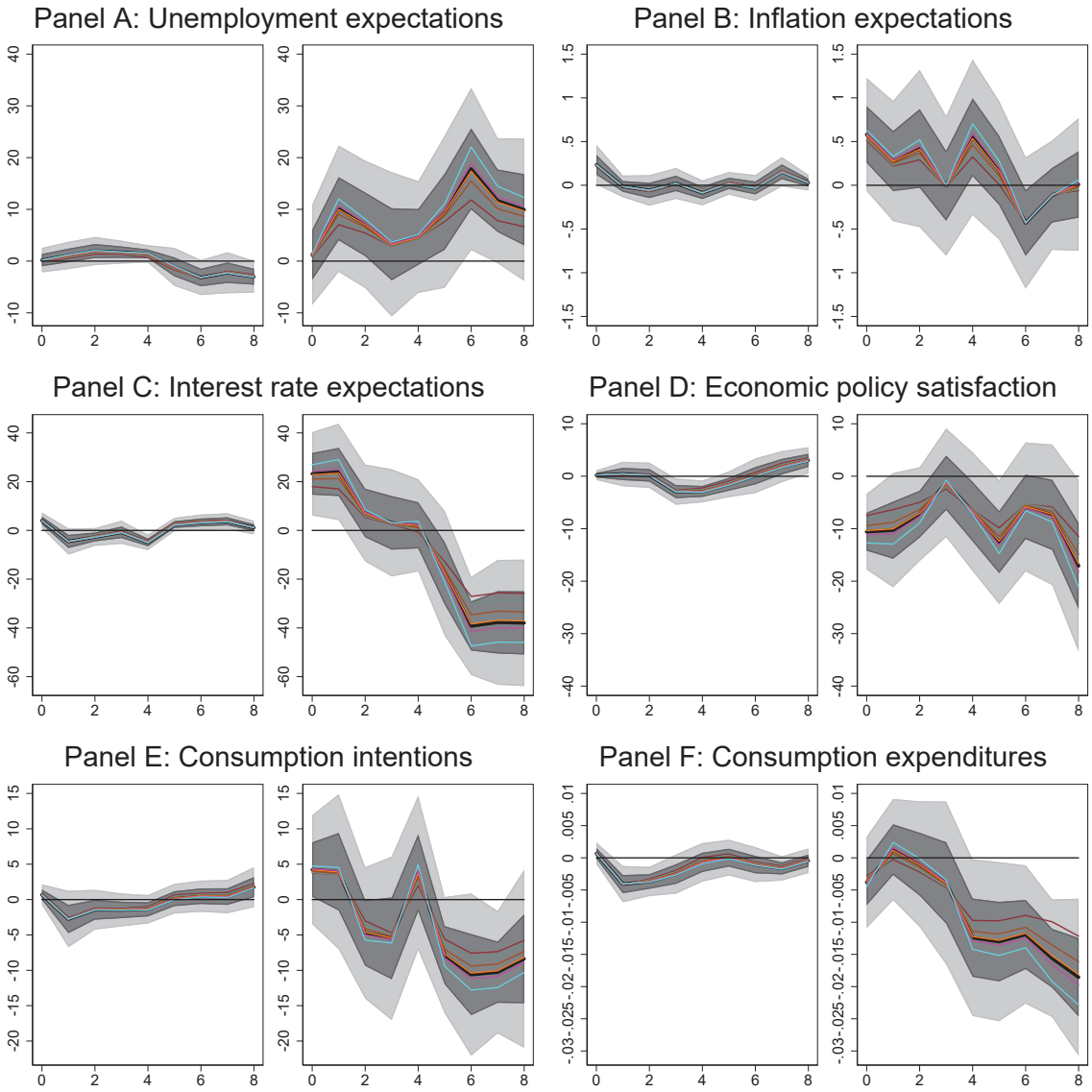
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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)



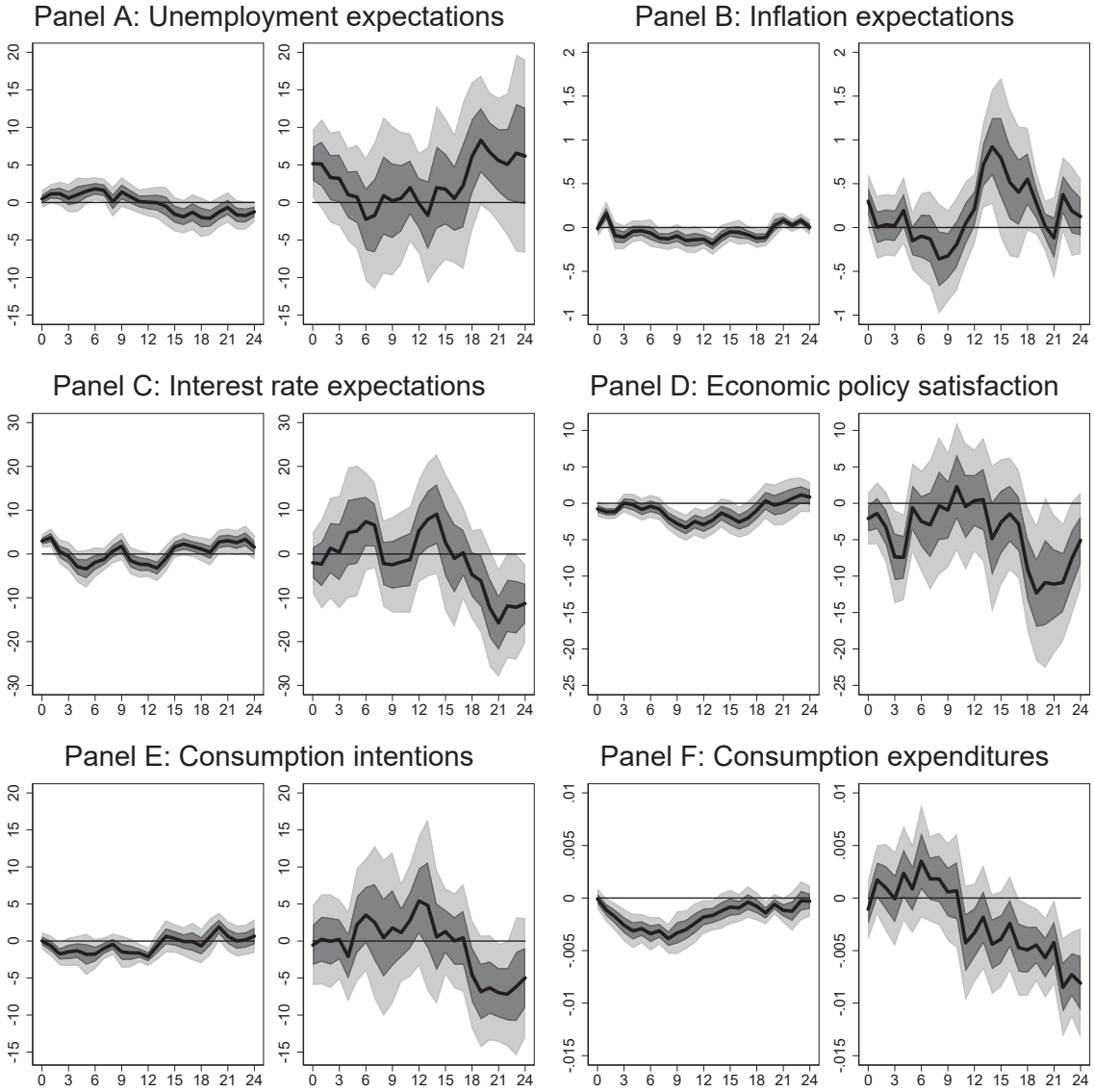
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending calculated for various thresholds 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)



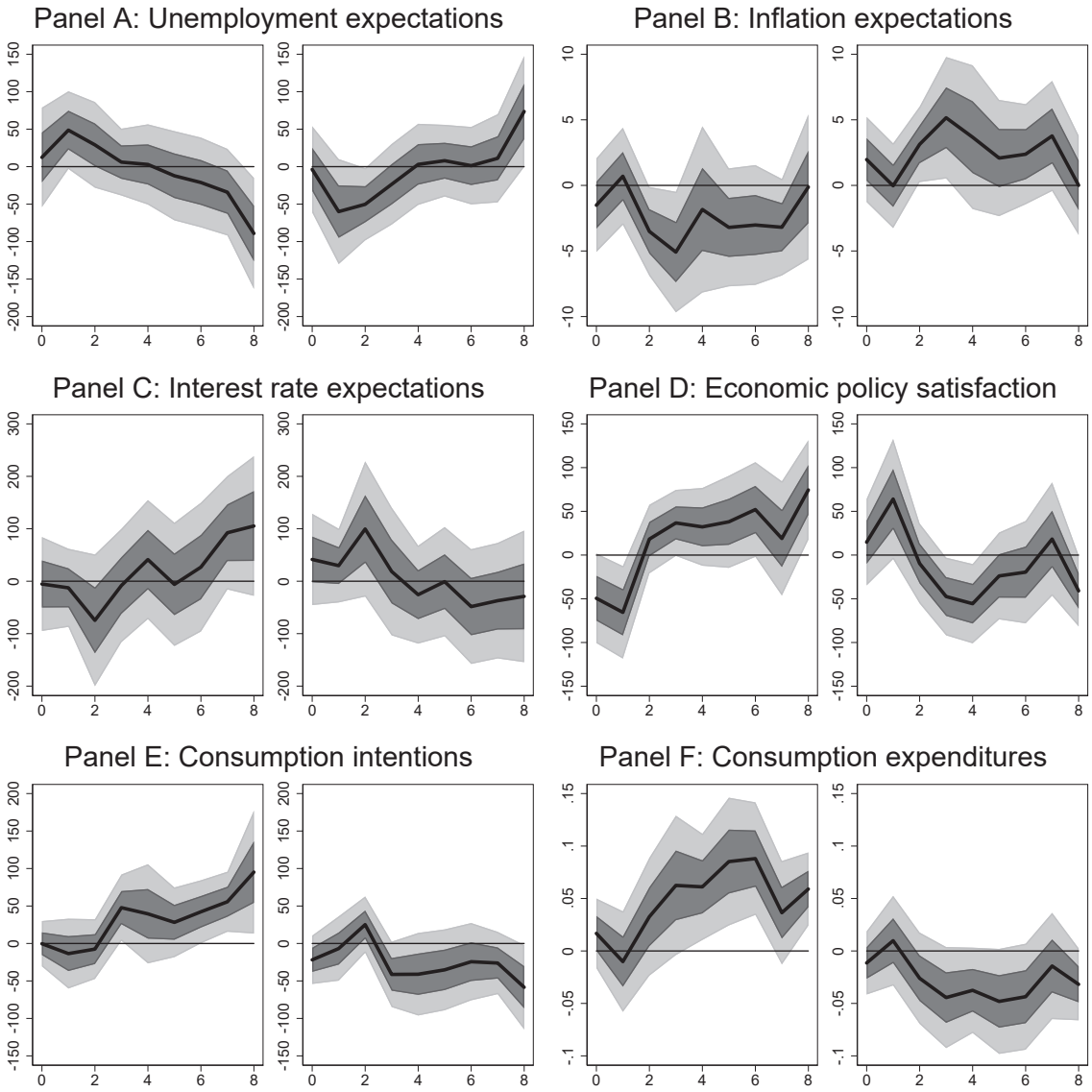
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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)



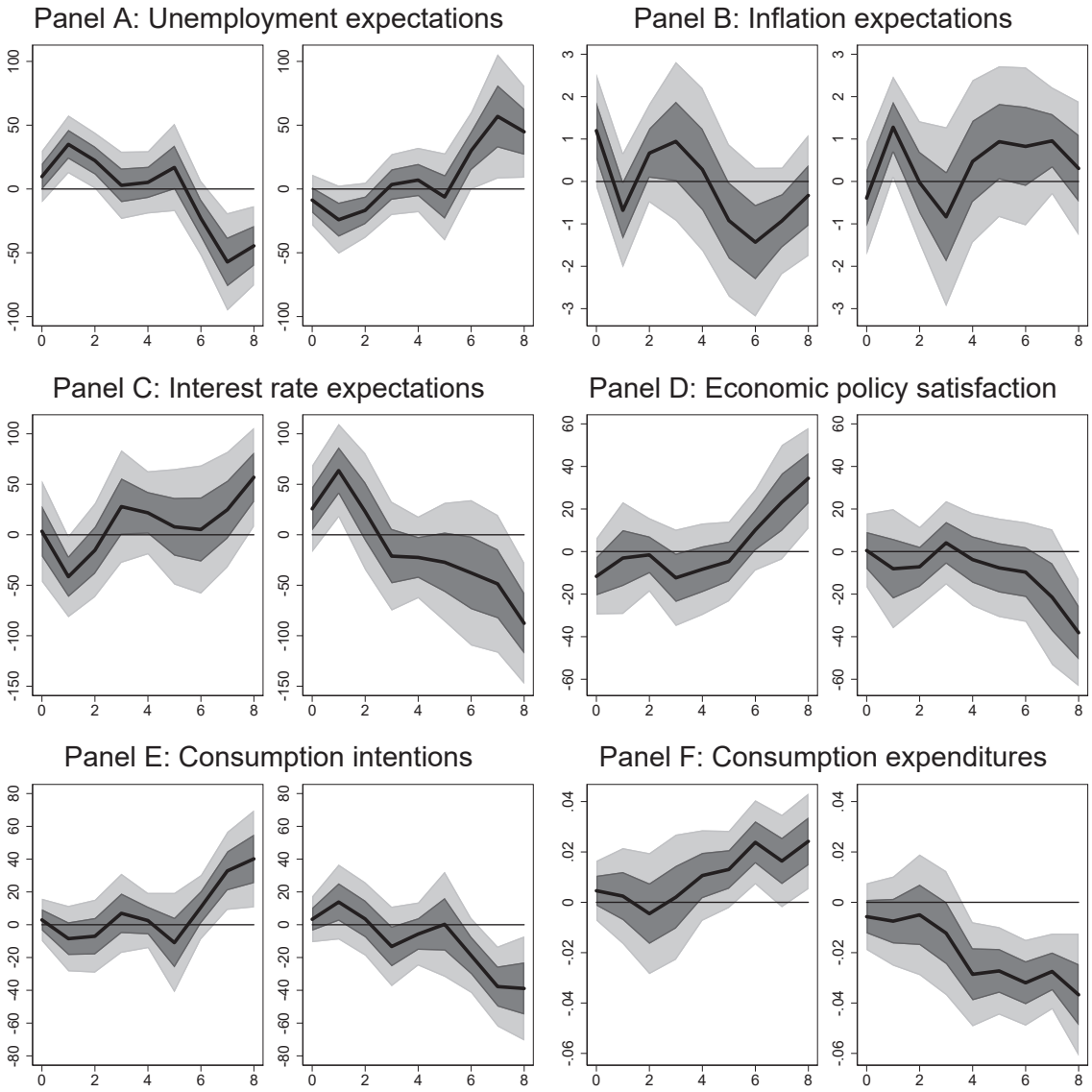
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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)



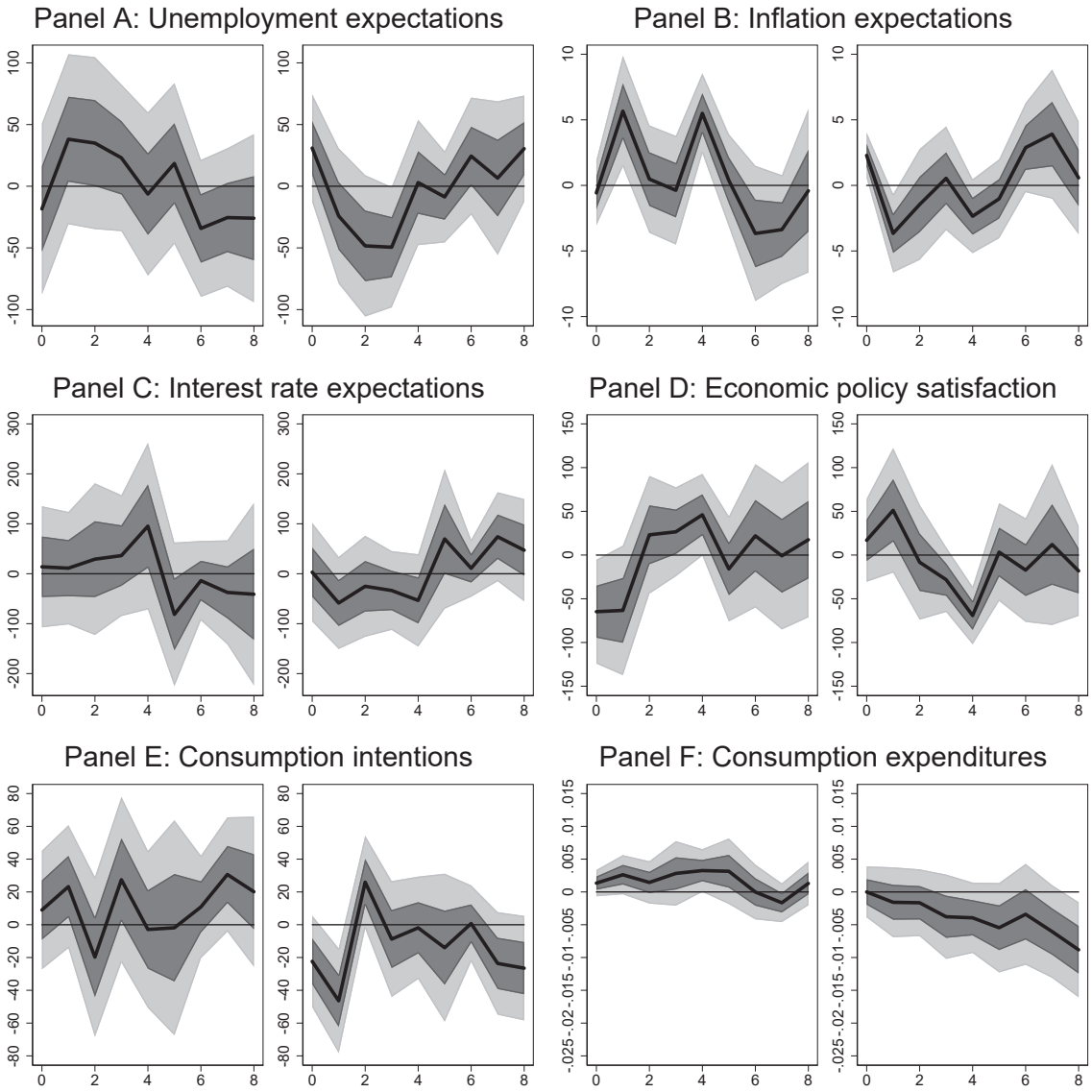
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



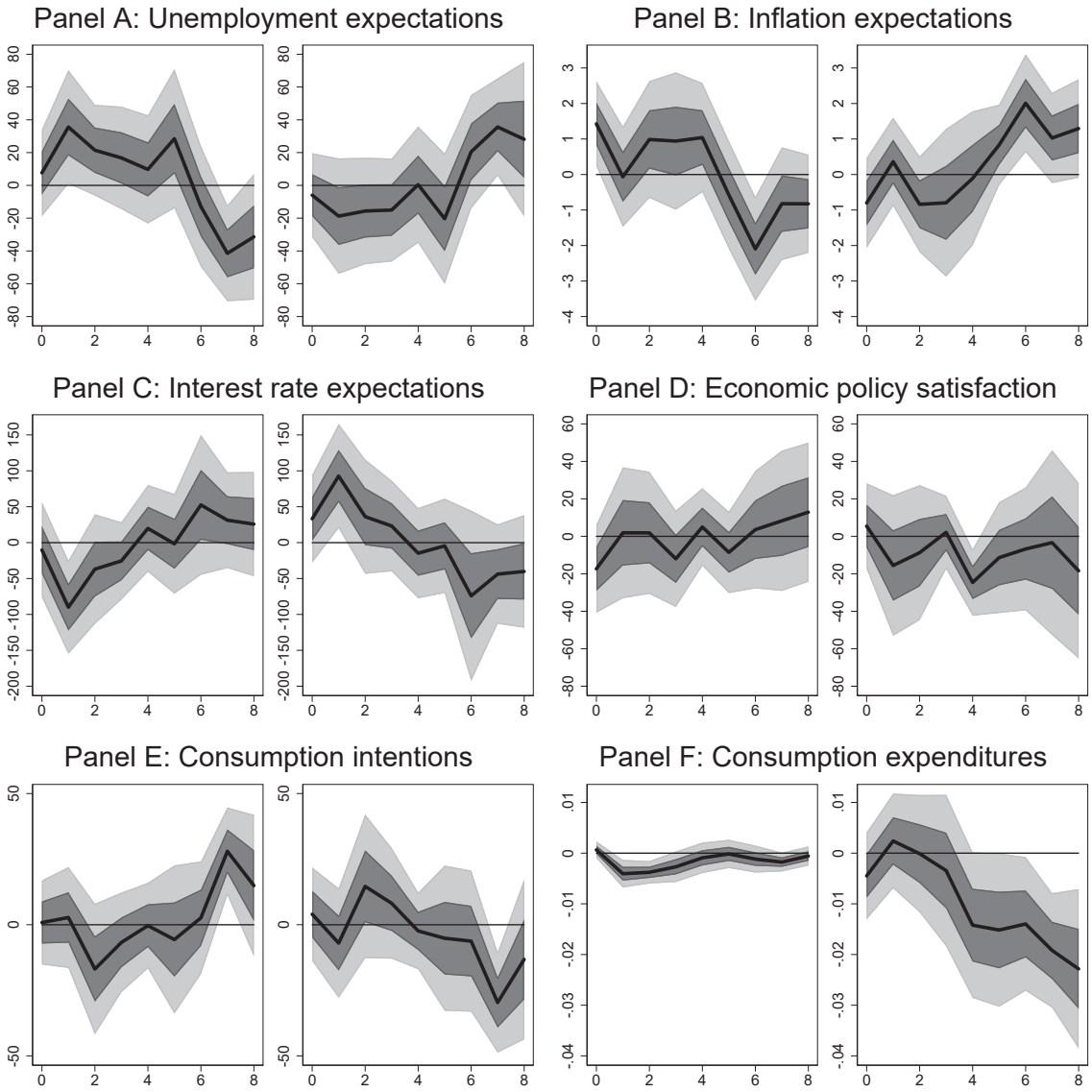
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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)



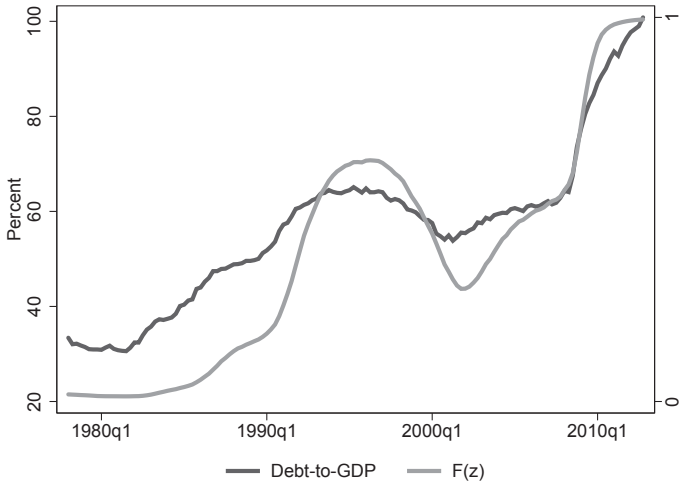
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



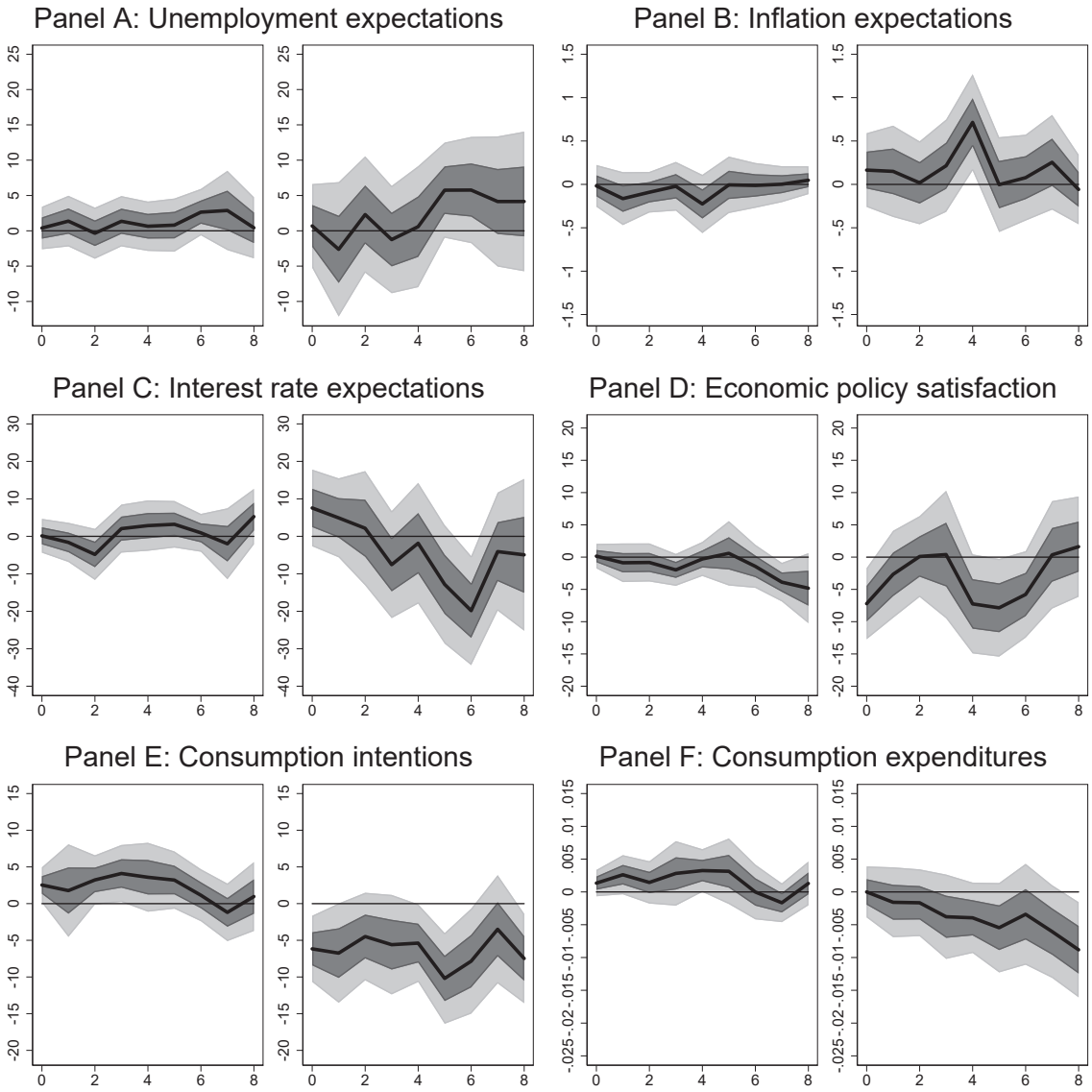
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the intended 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



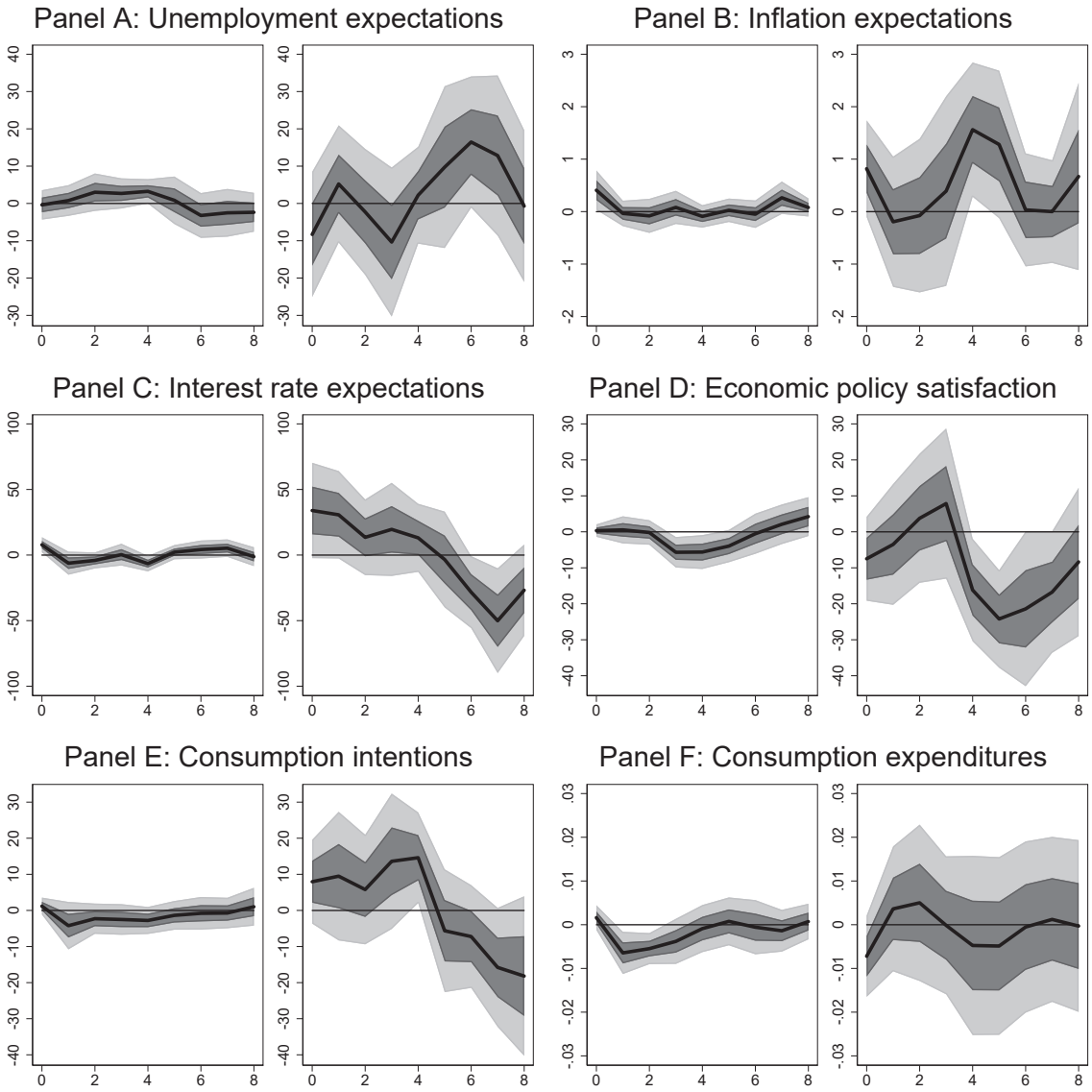
Notes: The figure shows the transition function $F(z)$ together with the debt-to-GDP ratio.

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



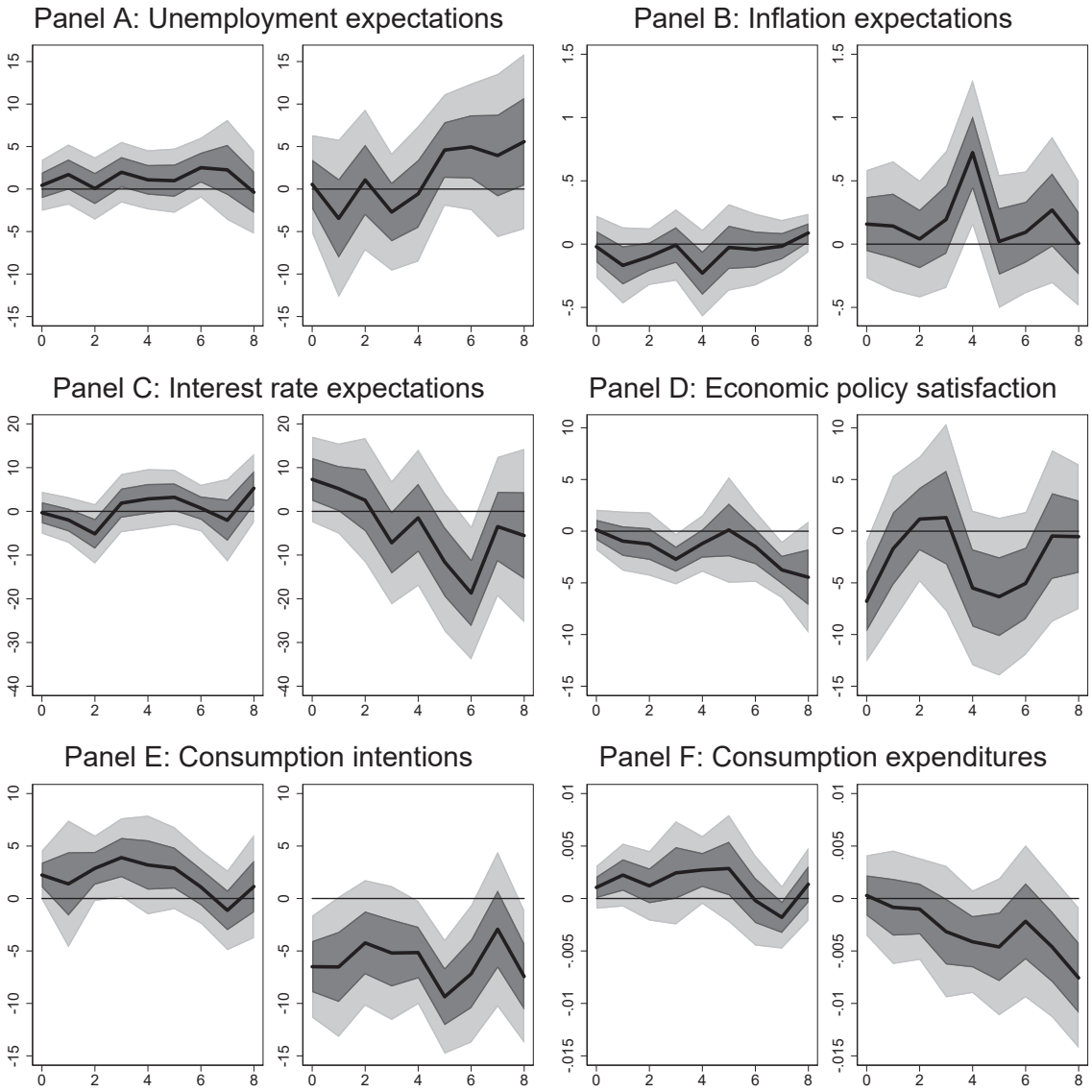
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard-deviation shock in (detrended) government spending together with one and two standard 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)



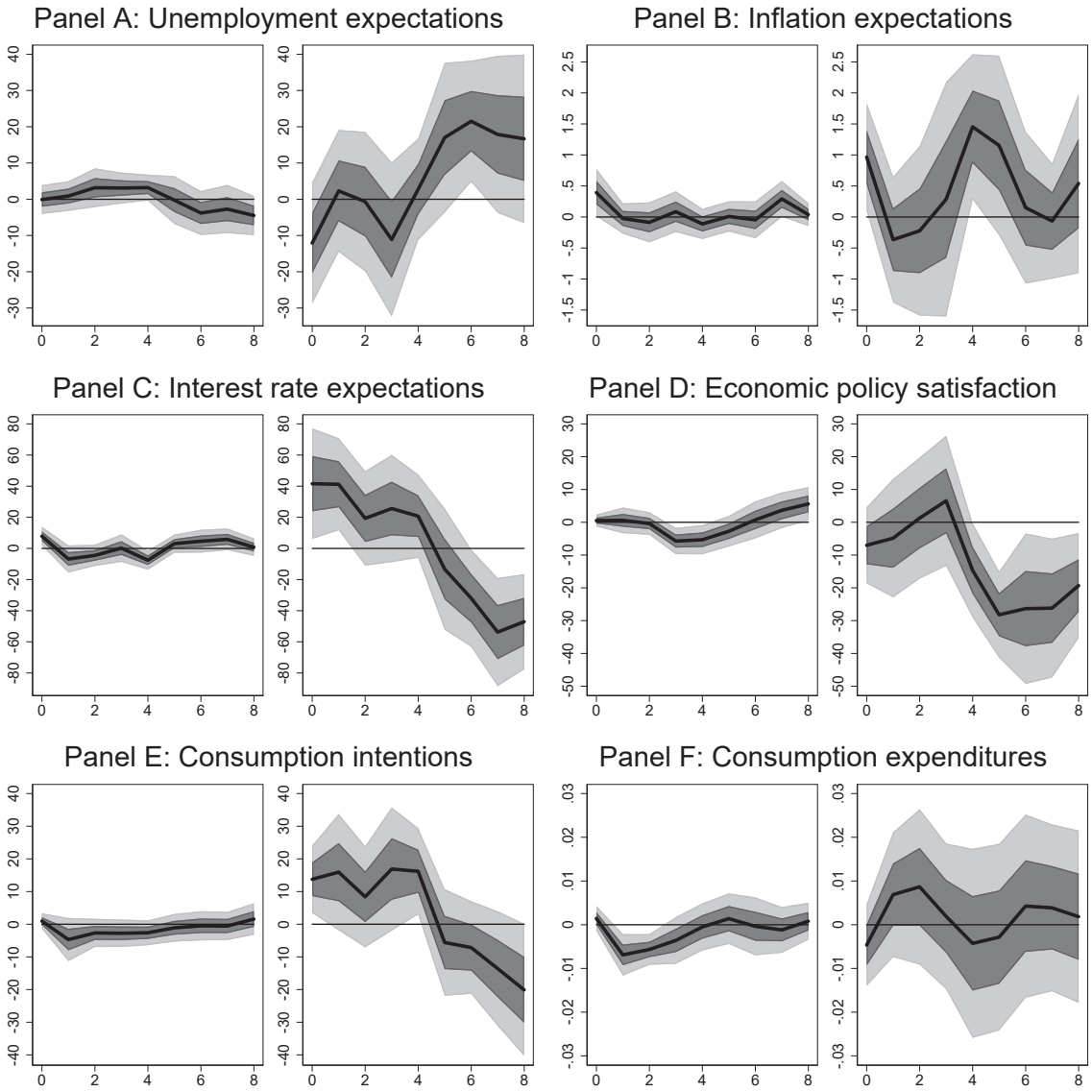
Notes: Inflation expectations are average point estimates in percent, all other survey measures are balance scores. Real personal consumption expenditures enters in log-levels. We show mean responses to a one-standard deviation shock in the Romer and Romer (2004) measure of exogenous changes in the Federal 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.