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Public Debt and state-dependent Effects of Fiscal Policy in the Euro Area

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Public Debt and state-dependent Effects of Fiscal Policy in the Euro Area*

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Abstract

We investigate public debt related state dependencies in the impact of fiscal policy shocks on the macroeconomy for a panel of fifteen euro area economies during the period from 2000:Q1 to 2019:Q4. Our estimated impulse response functions suggest that the impact of fiscal policy shocks varies depending on the level of public debt characterizing an economy. We observe that differences in the time-serial as well as in the cross-sectional dimension play an important role driving the impact of fiscal policy. In the high-debt cross-sectional state, output, consumption and inflation, as well as consumption intentions and inflation expectations, go up in response to a positive government spending shock, and these responses are distinctly different from those in the low-debt state. Using an extended model that considers simultaneously time-serial and cross-sectional high- and low-debt states, our results suggest that cross-sectional debt variation is more important in driving cross-country differences in the responses to expenditure shocks across the euro area.

Keywords: government spending, shock, debt-to-gdp, output, consumption, inflation, credit constraints, expectations.

JEL Classification: E62, E3, H63, H3

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1 Introduction

Public debt has been a rising concern for policy makers as of the recent financial and European sovereign debt crises, and is set to remain a primary concern for many years to come in the aftermath of the global pandemic crisis that has seen public debt levels reach historical heights for economies across the world.

While the potential effects of rising public debt levels have received a lot of attention, we focus on an aspect that has not been studied as much, namely the idea that the impact of fiscal policy shocks on economic activity and economic expectations varies across space and time depending on the level of public debt. The potential state-dependence of fiscal policy is a key issue for individual euro area economies in the face of rising public debt levels, given that monetary policy cannot be tailored to their specific needs and that this common monetary policy is itself constrained by the zero-lower bound, leaving fiscal policy as the main policy tool that can be used to alleviate the impact of business cycle recessions and major crises such as the one at hand.

To explore the above issue, we estimate the effects of fiscal policy shocks on economic activity and economic expectations allowing for state-dependent effects associated with the debt-to-GDP ratio. Given the substantial variation in public debt levels across the euro area economies, we identify high- and low-debt states utilizing this cross-sectional variation at each point in time rather than focusing solely on time-serial variation in debt-to-GDP as in previous work.[1] Considering cross-sectional variation in debt-to-GDP to identify low- and high-debt states makes good sense in the case of the euro area where the latter source of variation accounts, based on our calculations, for nearly 80 percent of the total variation in debt-to-GDP across these economies over time. Using the Jordà (2005) local projection approach, we then estimate impulse response functions for a low- and a high-debt state for a panel of fifteen euro area economies during the period from 2000:Q1 to 2019:Q4.

[1] For example, Geiger and Zachariadis (2021) exploit time-series variation to identify high- and low-debt states for the US, while Huidrom et al. (2020) exploit public debt states identified over time, having removed fixed country effects, to explore how fiscal multipliers vary in a panel of thirty-four countries. These papers find that the effects of positive government spending shocks on consumption are negative when public debt is at the high state.

Our results provide strong evidence in favor of state-dependent effects. When we consider cross-sectional variation in debt-to-GDP, we find that real GDP, real consumption and the inflation rate increase strongly in response to an expansionary government spending shock in the high-debt state, differently than in previous work using time-series variation to identify debt states. Furthermore, these responses are significantly different to those in the low-debt state. We also find that measures of survey expectations such as inflation expectations and consumption intentions respond to the shock in the same manner as these macroeconomic developments, and in line with the standard propagation mechanism.[2]

Using an extended model that considers simultaneously time-serial and cross-sectional high- and low-debt states, our results suggest that cross-sectional debt variation is more important in driving cross-country differences in the reaction of output, inflation, consumption intentions and inflation expectations to expenditure shocks across the euro area,[3] and the same is true for the reaction of consumption expenditures once we purge our government spending shocks from anticipation effects.

Our results have important implications for the effectiveness of fiscal policy across euro area economies and beyond. Previous work suggests that government spending is less effective in the face of high debt, and might even cause adverse effects, due to looming fiscal consolidation and investors' concerns about sovereign credit risk (see e.g. Blanchard, 1990; Sutherland, 1997; Corsetti et al., 2012; Huidrom et al., 2020). Our results suggest that these channels are primarily linked to the evolution of public debt over time. By contrast, cross-sectional variation in public debt affects the effectiveness of public debt in quite the opposite way. As state-dependencies associated with public debt are mainly driven by cross-sectional variation in public debt, this should be taken into account to a larger degree in the assessment and conduct of fiscal policy.

High public debt can induce banks to limit the credit they extent, leading to a higher prevalence of liquidity-constrained agents in high-debt economies. This can happen simply due

[2]Related but distinct from our findings here, Coibion et al. (2021) infer that providing households with information about how high public debt is expected to be in a decade has pronounced effects. More specifically, news about higher future debt levels lead households to anticipate higher inflation.

[3]This also holds for firms' production expectations and their selling price expectations.

to crowding-out as banks in high-debt economies may hold large amounts of domestic government debt, or because forward-looking banks view the future tax liabilities of households and firms as a factor reducing the present value of borrower's net worth. In this sense, public debt plays a similar role as private debt, which has been shown to amplify the effects of fiscal policy (Klein, 2017; Klein et al., 2020). While our results are consistent with private sector credit constraints being tighter in high public debt states, we discuss several potential mechanisms underlying this state-dependent effects on economic activity in Section 5.

The remainder of the paper is structured as follows: In Section 2, we describe the data, in Section 3 we present the econometric approach and in Section 4 we present our empirical findings. In Section 5, we provide a discussion and interpretation of the main results. The last section briefly concludes.

2 Data

2.1 Macroeconomic data

We measure economic activity using real GDP derived by dividing nominal GDP with the GDP deflator with 2015 as the base year. To measure inflation we use the annual rate of change in the harmonised consumer price index (HICP) for all items.[4] Government spending is measured as the final consumption expenditure of general government plus gross capital formation.[5] Those values are in real terms and are seasonally and calendar adjusted. The macroeconomic data that we use in our study for real GDP, inflation, and real government total spending are from the Eurostat database. Household consumption expenditure is also measured in real terms and is provided by the OECD database.[6] Taking into account the zero lower bound period, we use the Krippner's shadow short rate as an indicator of

[4]The Harmonised Indices of Consumer Prices (HICP) measure the changes over time in the prices of consumer goods and services acquired by households. They give a comparable measure of inflation as they are calculated according to harmonised definitions. Data is available on a monthly basis on the following link https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=prc_hicp_manr&lang=en

[5]Data is available here https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=namq_10_gdp&lang=en

[6]Data for household consumption expenditure is from the link below https://stats.oecd.org/#, where the data for private final consumption expenditure by durability can be found in the quarterly national accounts section.

monetary policy.[7] Particularly, we use the monthly average of shadow short rates estimates for the Euro Area. Finally, our analysis takes into account the price of crude oil[8] and the financial market risk aversion measured by the implied volatility index for the major stock market index, VSTOXX.[9]

2.2 Survey data

We use survey-based measures of consumers' and firms' expectations in fifteen euro area economies. We mainly focus on consumers' inflation expectations and consumption intentions over the next 12 months. We also consider firms' selling price and production expectations. Particularly, data that we use for agents' expectations are from the Joint Harmonized EU Programme of Business and Consumer Surveys database, which is published monthly by the European Commission.[10] The sample size of the survey varies across countries and is generally positively related to their respective population size. The consumer survey is mainly qualitative although, as of 2003, two quantitative questions are asked concerning perceived and expected price changes. However, the results of the questions on consumers' quantitative inflation perceptions and expectations have so far not been part of the European Commission's comprehensive monthly survey data releases. Neither has the micro data set on consumers' quantitative inflation perceptions and expectations been publicly released.[11] Arioli et al. (2017) mention that the quantitative inflation estimates are found to be consistent with the results from the corresponding qualitative survey questions.[12] Mestre

[7]The data that we use are produced from the research of Leo Krippner available at https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures

[8]We smooth the log of commodity price by removing the trend using a Hodrick-Prescott time series filter and then take the smoothed change of the price of crude oil

[9]VSTOXX provides a benchmark of market volatility in European markets. In our study we use the historical data of closing prices.

[10]The link for consumers' inflation and consumption expectations as well as firms' selling price expectations is https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/business-and-consumer-surveys/download-business-and-consumer-survey-data/time-series_en.

[11]Arioli et al. (2017) mention that following the agreement between the European Commission (DG ECFIN) and its EU partner institutes that perform the data collection at national level, the ECB was given access to the (anonymised) micro data set for the purpose of conducting their evaluation and related future research jointly with DG ECFIN.

[12]Based on the evaluation of consumers' survey data Arioli et al. (2017), respondents who indicate rising inflation for the qualitative questions generally report higher inflation rates also for the quantitative

(2007) studying the European Commission Consumer survey, directed to consumers, finds that models used by survey respondents were of sufficient quality to enable them to actually build good forecasts. In our analysis, we concentrate on qualitative data since quantitative European data are not currently publicly available.

We use seasonally adjusted monthly data for total consumers and firms across fifteen euro-area economies[13] for the period 2000:Q1-2019:Q4. As mentioned above, the data that the European Commission uses for inflation expectations are qualitative and are obtained from the question *"By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will..."*. Consumers have six options to answer this question as follows: prices will increase more rapidly (PP), increase at the same rate (P), increase at a slower rate (E), stay about the same (M), fall (MM), and don't know (N). Data for consumption intentions over the next twelve months derive from the question *"Compared to the past 12 months, do you expect to spend more or less money on major purchases (furniture, electrical/electronic devices, etc.) over the next 12 months? I will spend..."* Consumers have six options to answer this question as follows: much more(PP), a little more (P), about the same (E), a little less (M), much less (MM), and don't know (N). Similarly, data for firms' selling price expectations derive from the question *"How do you expect your selling prices to change over the next 3 months? They will... increase, remain unchanged, decrease."* We also use data for firms' production expectations derived from the following question: *"How do you expect your production to develop over the next 3 months? It will... increase, remain unchanged, decrease."*

Since the data obtained from the questionnaire is qualitative, they have to be quantified. To quantify these qualitative data, we obtain the simple balance statistic defined as the difference between the proportions of respondents considered, e.g., in Nielsen (2003) and Lyziak (2009). The simple balance statistic is given as the difference between positive and negative answering options measured as percentage points of total answers, and is calculated as $B = (PP+1/2P)-(1/2M+MM)$ on the basis of weighted averages that add up to 100,

questions.

[13]The nineteen euro-area economies minus Cyprus, Malta, Latvia and Lithuania due to data unavailability.

$PP + P + E + M + MM + N = 100$. Thus, values range from -100, when all respondents choose the negative option to +100, when all respondents choose the positive option. The Commission calculates and seasonally adjusts the balance series that we use in our analysis.

Finally, since the real GDP and government spending data that we use in our analysis, are only available with quarterly frequency, we aggregate the monthly series of consumers' and firms' expectations using quarterly averages.

2.3 The state of public finances

To study potential state-dependency associated with public debt differentials in the euro area, we will exploit a number of methods that can help us identify different debt states. The transition variable we use is the debt-to-GDP ratio, which is the quarterly consolidated gross government debt in percent of GDP provided by the Eurostat database.[14] Figure 1 presents the debt to GDP ratio across fifteen euro area economies along with an indication for 80 percent, which is often referred to as a critical threshold in the literature (see e.g. Reinhart and Rogoff, 2010).

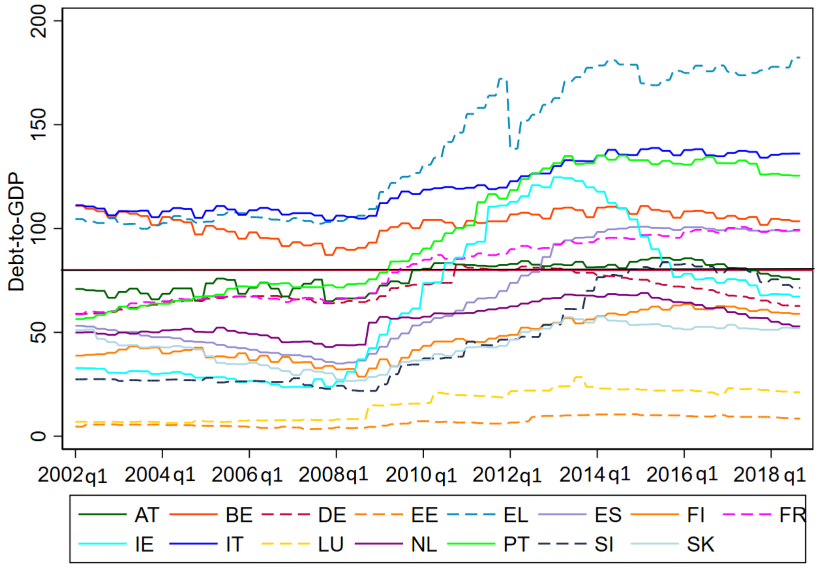
Overall, variation in debt-to-GDP levels over time and across countries in the euro area is large. As we can see in Figure 1, the financial crisis of 2008 played a crucial role increasing government debt for all of the countries of our sample. At the same time, the dispersion of debt-to-GDP levels across countries in the euro area increased markedly.

As an indication for the role of cross-sectional and time-serial variation in our sample we consider the variance decomposition of debt-to-gdp. We find that 79.43 percentage of total variance is explained by between variation, and 20.57 percentage is explained by within variation.[15] This already highlights the important role of cross-sectional variation in debt-to-GDP ratios across euro area economies.

[14] Quarterly data for general government gross debt is given at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gov_10q_ggdebt&lang=en. Public debt is defined in the Maastricht Treaty as consolidated general government gross debt at nominal value, outstanding at the end of the year. Data for the general government sector are consolidated between subsectors at the national level. Data are non-seasonally adjusted.

[15] In decomposing the total variance of debt-to-gdp into within and between variation, we are using the biased-corrected variance estimates (i.e., multiplied by $n/(n-1)$ where n is equal to the number of panels).

Figure 1: Debt to GDP ratio



Notes: This figure presents debt-to-GDP levels over time and across countries in the euro area. Countries included are: Austria (AT), Belgium (BE), Germany (DE), Estonia (EE), Greece (EL), Spain (ES), Finland (FI), France (FR), Ireland (IE), Italy (IT), Luxembourg (LU), the Netherlands (NL), Portugal (PT), Slovenia (SI) and the Slovak Republic (SK).

To scrutinize cross-sectional and time-serial variation, we construct states using smooth transition functions in which we evaluate government debt as a percentage of GDP in line with previous studies (see, for example, Teräsvirta (1994), Jansen and Teräsvirta (1996), Geiger and Zachariadis (2021)). In particular, following Granger et al. (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_{it}. Since we want to study transition processes over time and across countries, we analyze each case separately by constructing two different state variables.

First, we capture time-serial variation for each country i as

$$S^T(z_{it}) = exp(\theta((z_{it} - c_i)/\sigma_z)/1 + exp(\theta((z_{it} - c_i)/\sigma_z)$$

where c_i is country-specific and 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. Here, as in Geiger and Zachariadis (2021), c is selected so that approximately two-thirds of the distribution of z_{it}

is in a state of low debt.[16] 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. In line with Tenreyro and Thwaites (2016), Geiger and Zachariadis (2021), and others, we set θ to 3 which gives an intermediate degree of intensity to the regime switching.[17]

Second, we capture cross-sectional variation of debt-to-GDP as

$$S^C(z_{it}) = exp(\theta((z_{it} - c_t)/\sigma_z)/1 + exp(\theta((z_{it})/\sigma_z)$$

where c_t is time-specific.

Figure 2 shows the debt-to-GDP ratio for each country i along with the smooth transition function $S^T(z_{it})$ which captures the time-serial variation, and $S^C(z_{it})$ which captures the cross-sectional variation. Comparing the two transition functions, we see that the two transition processes pick up different variation in the data. While the time-serial smooth transition process mainly reflects the patterns of the raw time series, the cross-sectional smooth transition process reflects the relative debt position within the population of Eurozone countries. Notably, $S^C(z_{it})$ is relatively low for countries such as Estonia, Finland, Luxembourg, Slovenia and Slovak Republic, while for Greece, Italy and Portugal it is high.

2.4 Government spending

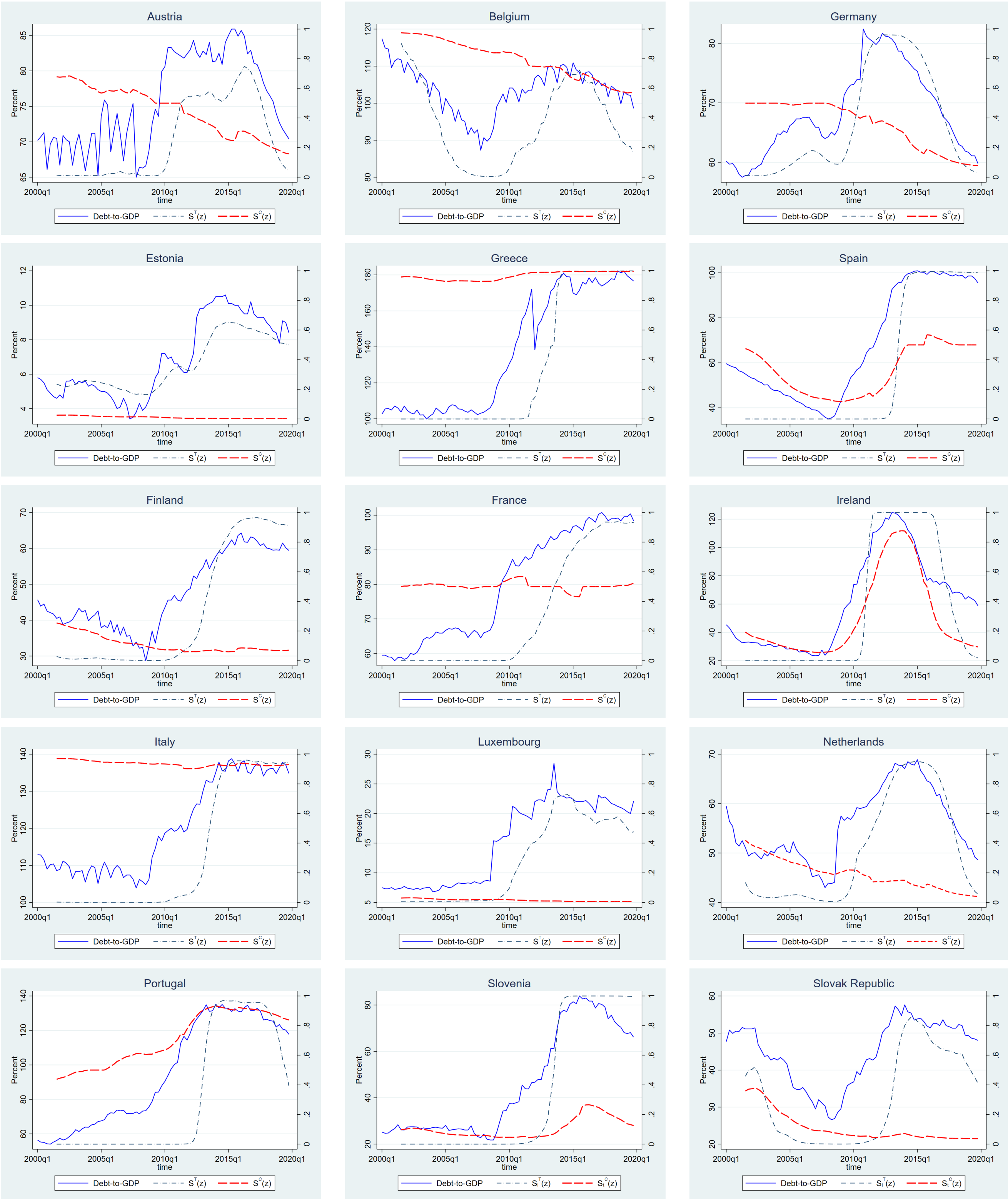
Following previous literature, we consider the sum of real final consumption expenditure of general government and real gross government investment in log-levels as a measure of government spending.[18] To evaluate changes in government spending we employ the Blanchard and Perotti (2002) identification scheme. This identification scheme is based on the assumption that within-quarter government spending does not *contemporaneously*

[16]Particularly, c is the 66th percentile of the distribution of the backward-looking seven quarter moving average of the debt-to-GDP ratio.

[17]The smooth transition process is parameterized along the lines of Auerbach and Gorodnichenko (2013), Tenreyro and Thwaites (2016) and Ramey and Zubairy (2018).

[18]As e.g. in Auerbach and Gorodnichenko (2012, 2013), we focus on the effects of government spending rather than those of taxes and transfer payments, which are more difficult to identify and estimate.

Figure 2: State variables of public finances



Notes: The figure shows the two transition function (right axis) along with the debt-to-GDP ratio (left axis).

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 (1) 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 Blanchard and Perotti (2002).

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 from the OECD Economic Outlook. 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.

3 The econometric approach

The econometric framework that we use to estimate the dynamic responses of agents' expectations to fiscal policy shock is the local projection method developed by Jordà (2005). This method allows us to estimate the response of a dependent variable (e.g. real GDP) to shocks at different horizons conditional on the state of the economy. Given the flexibility of the local projection method, we introduce state-dependence in the evaluation of the effects of government spending. Specifically, following Auerbach and Gorodnichenko (2013), Jordà et al. (2013), Tenreyro and Thwaites (2016), Ramey and Zubairy (2018), we allow that coefficients of the model vary according to the state of the economy by incorporating interactions terms and estimate the equation below for each forecasting horizon h.

$$
\begin{aligned}
y_{i,t+h} &= \alpha_{i,h} + \beta_{i,h}G_t + \sum_{j=1}^{p}\gamma_{h,j}y_{i,t-j} + \sum_{j=1}^{p}\delta_{h,j}G_{t-j} + \sum_{j=1}^{p}\zeta_{h,j}\mathbf{X}_{i,t-j} \\
&+ S^s(z_{i,t-1})(\alpha^s_{i,h} + \beta^s_{i,h}G_t + \sum_{j=1}^{p}\gamma^s_{h,j}y_{i,t-j} + \sum_{j=1}^{p}\delta^s_{h,j}G_{t-j} + \sum_{j=1}^{p}\zeta^s_{h,j}\mathbf{X}_{i,t-j}) \\
&+ \theta_{it}D^{rec}_t + \kappa_h t + \lambda_h t^2 + \epsilon_{i,t+h}
\end{aligned}
\tag{1}
$$

where the dependent variable, $y_{i,t+h}$, denotes in each case real GDP, the actual inflation rate, actual consumption expenditure, consumers' inflation expectations, and consumption intentions over the next year in country i at time t. We also consider additional dependent variables such as production expectations and selling price expectations of firms in the total manufacturing sector. The state variable indicates the state of public finances and is captured by the smooth transition function $S^s(z_{i,t-1})$, which we evaluate at 0 (low debt) and 1 (high debt).[19] The transition function $S^s(z_{i,t-1})$ depending on the dimension that we want to explore could be either time-serial ($s = T$) or cross-sectional ($s = C$). G_t captures an unexpected increase in government spending as described in section 2.2. We regress the dependent variable on its lagged values, $y_{i,t-j}$, current and lagged values of government spending, G.

Also, we consider a set of control variables which are used to capture the state of the business cycle. Those control variables are contained in vector $\mathbf{X}_t$, which are the log level of real GDP, the annual rate of change of harmonised consumer price index, the euro area shadow short rate, smoothed log of price of crude oil and the closing value of VSTOXX. Moreover, we control for recession periods by including a country-specific recession indicator, D^{rec}_t, which is specified based on a business cycle dating algorithm of Harding and Pagan (2002). In particular, we identify potential turning points as the local minima and maxima in the quarterly GDP series. Finally, taking into account the upward trend in government spending, we control for a linear and a quadratic time trend. Based on the Akaike information criterion (AIC), the number of lags p is equal to one.

We calculate the confidence bands using the Driscoll and Kraay (1998) standard errors that

[19] In line with previous literature we use lagged values of the state variables to avoid contemporaneous feedback from policy actions (see e.g. Auerbach and Gorodnichenko, 2012).

allow arbitrary correlations of the error term across countries and time (see, for example, Iacoviello and Navarro (2019)). The impulse response functions (IRFs) in a state of low-debt are just the sequences of the estimated $\beta_{i,h}$ coefficients, while in a high-debt state are the sequences of $\beta_{i,h} + \beta^s_{i,h}$.

In our second specification, we estimate our model by simultaneously considering the two states, $S^T(z_{i,t-1})$ and $S^C(z_{i,t-1})$, as per the equation below:

$$\begin{aligned}
y_{i,t+h} = {} & \alpha_{i,h} + \beta_{i,h} G_t + \sum_{j=1}^{p} \gamma_{h,j} y_{i,t-j} + \sum_{j=1}^{p} \delta_{h,j} G_{t-j} + \sum_{j=1}^{p} \zeta_{h,j} \mathbf{X}_{i,t-j} \\
& + S^T(z_{i,t-1})(\alpha^T_{i,h} + \beta^T_{i,h} G_t + \sum_{j=1}^{p} \gamma^T_{h,j} y_{i,t-j} + \sum_{j=1}^{p} \delta^T_{h,j} G_{t-j} + \sum_{j=1}^{p} \zeta^T_{h,j} \mathbf{X}_{i,t-j}) \\
& + S^C(z_{i,t-1})(\alpha^C_{i,h} + \beta^C_{i,h} G_t + \sum_{j=1}^{p} \gamma^C_{h,j} y_{i,t-j} + \sum_{j=1}^{p} \delta^C_{h,j} G_{t-j} + \sum_{j=1}^{p} \zeta^C_{h,j} \mathbf{X}_{i,t-j}) \\
& + S^T(z_{i,t-1}) S^C(z_{i,t-1})(\alpha^{TC}_{i,h} + \beta^{TC}_{i,h} G_t + \sum_{j=1}^{p} \gamma^{TC}_{h,j} y_{i,t-j} + \sum_{j=1}^{p} \delta^{TC}_{h,j} G_{t-j} + \\
& \sum_{j=1}^{p} \zeta^{TC}_{h,j} \mathbf{X}_{i,t-j}) + \theta_{it} D^{rec}_t + \kappa_h t + \lambda_h t^2 + \epsilon_{i,t+h}.
\end{aligned} \tag{2}$$

With this specification we further isolate the partial effects of state dependencies arising from the cross-sectional and time-serial dimension of variation in public debt. Moreover, by considering the two phenomena simultaneously we can evaluate the relative importance of each.

4 Results

4.1 Baseline

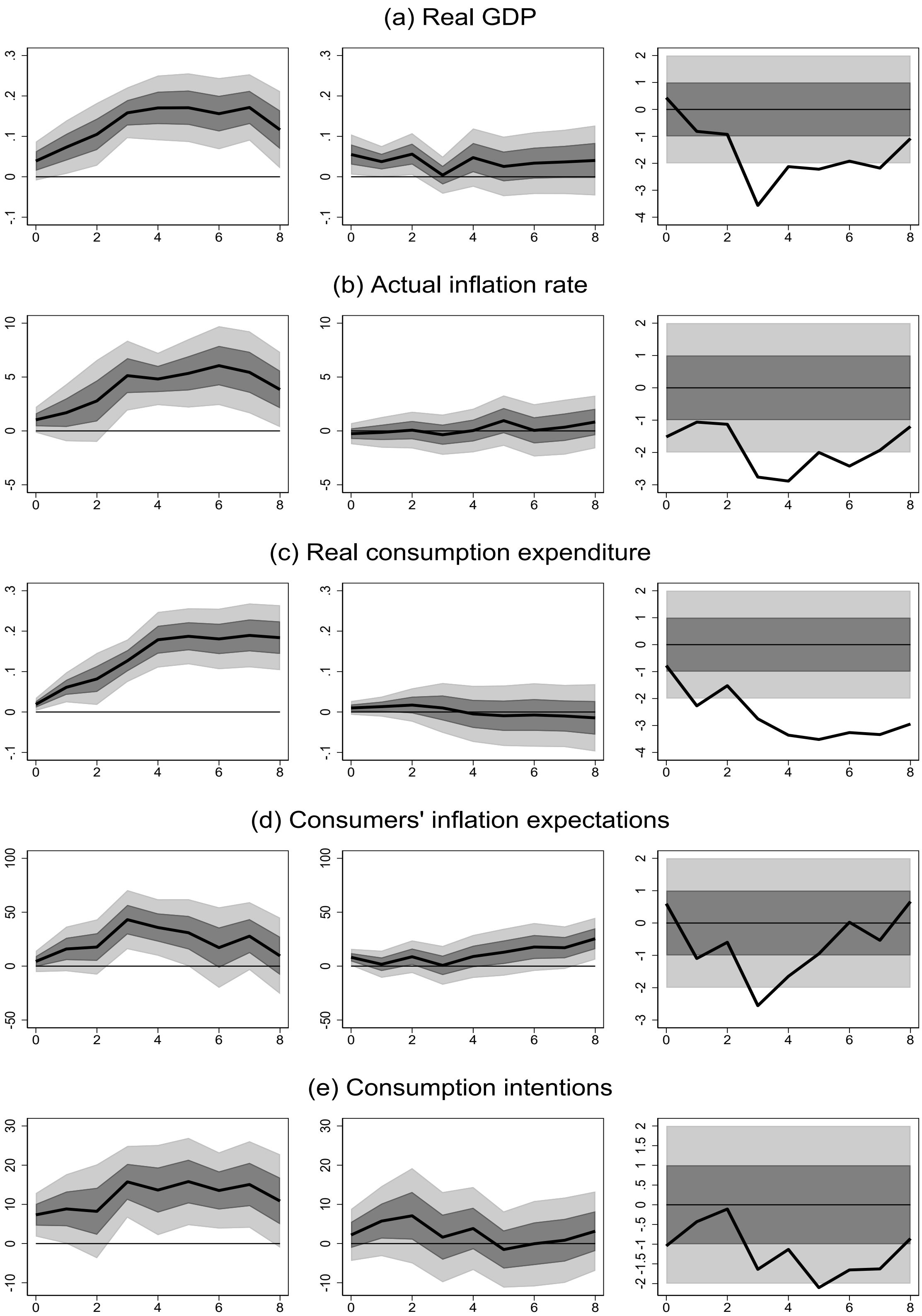
In this section, we present the impulse responses to a positive government spending shock for real GDP, the actual level of inflation and real consumption spending, along with their inflation expectations and consumers' buying intentions. More specifically, Figure 3 shows the impulse response functions obtained from estimating equation (1) with $s = T$ so that the state function captures time-serial variation, while Figure 4 shows the corresponding impulse response functions from estimating equation (1) with $s = C$ so that the state function captures cross-sectional variation. The first two columns show the responses to a one-standard-deviation shock in government spending in the low and high-debt states respectively. The third column presents the t-statistic test that shows the significance of the difference between the low- and high-debt states, together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals.

In Figure 3 we see that a positive government spending shock has positive and significant impact in the low-debt state as compared to typically insignificant impact in the high-debt state for all measures we consider: real GDP, the actual level of inflation, real consumption spending, consumers' buying intentions and consumers' inflation expectations. As shown in the third column of Figure 3, these responses are often significantly different in the low- versus the high-debt state for real GDP, the inflation rate and real consumption. These results are well in line with the existing literature. Lower effectiveness, or even negative effects of government expenditures, are documented in several studies entertaining comparable empirical analyses (see e.g. Corsetti et al., 2012; Huidrom et al., 2020; Geiger and Zachariadis, 2021).

Shifting our focus to cross-sectional variation, in Figure 4 we see that a government spending shock has positive and significant impact in the high-debt state as compared to typically insignificant impact in the low-debt state for all measures we consider. This effectively reverses the findings regarding the state-dependent impact of government spending shocks based on time-serial variation which were shown in Figure 3.

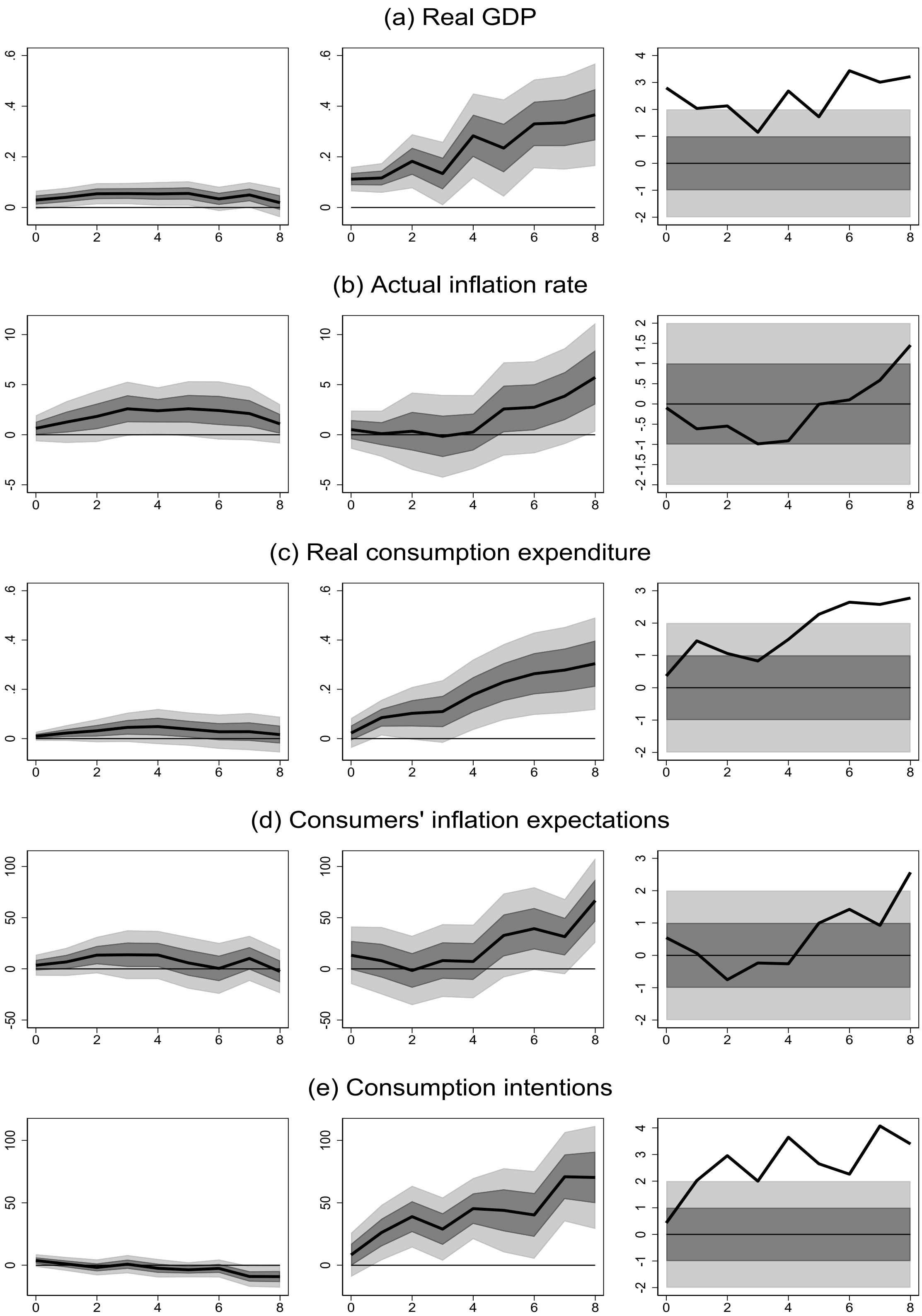
As we can see in Figure 4(a), real GDP increases on impact after a positive government spending shock and the response remains positive and significant all the way to the end of the eight-quarter horizon we consider. This positive response in the high-debt state is much stronger as compared to the low-debt state where the responses are smaller but become significantly positive between quarters two and four after impact. As a result, as shown in the third column of Figure 4(a), the responses in the high-debt state are typically significantly different that those in the low-debt state.

Figure 3: Responses to positive government spending shock - State variable $S^T(z_{i,t-1})$



Notes: In each Panel, the first column shows responses together with one- and two-standard-error bands in the low-debt state, the second column responses in the high-debt state, and the third column the t-statistic showing the significance in difference between low- and high-debt state.

Figure 4: Responses to positive government spending shock - State variable $S^C(z_{i,t-1})$



Notes: In each Panel, the first column shows responses together with one- and two-standard-error bands in the low-debt state, the second column responses in the high-debt state, and the third column the t-statistic showing the significance in difference between low- and high-debt state.

Turning to actual inflation and inflation expectations in Figures 4(b) and 4(d) respectively, we see that there is a delayed positive response to a government spending shock in the high-debt state, which turns significant by quarter eight after impact in both cases. Interestingly, the increase in real GDP in Figure 4(a) precedes the response of the actual inflation rate and of consumers' inflation expectations in Figures 4(b) and 4(d) respectively, going up on impact while consumers come to anticipate higher inflation starting in the seventh quarter after impact. This suggests that inflation expectations and inflation go up following higher economic activity rather than the other way round.

In Figure 4(c) we see that households' real consumption expenditure increases in response to a positive government spending shock in the high-debt state, and that this increase is typically statistically significant and quite persistent.[20] At the same time, the response in the low-debt state revolves insignificantly around zero. The third column of Figure 4(c) shows that the difference between the response in the low- and high-debt states becomes statistically significant after the fourth quarter.

Comparing Figure 4(c) with Figure 4(e), we see that the response of consumption spending is entirely consistent with the response of consumption intentions which move positively, significantly and persistently following a government spending shock in the high-debt state, and precede the upwards movement in actual consumption. As shown in Figure 4(e), consumers in the high-debt state increase their consumption intentions following a positive government spending shock, while the response of consumers in the low-debt state is statistically insignificant. The distinct response of consumption in the high-debt state as compared to the low-debt state could be due to the anticipation of higher taxes in the high debt economies reducing the present value of consumers' income flows thus rendering forward-looking banks less willing to lend to them. These borrowing-constrained or liquidity constrained consumers in high-debt economies would tend to raise consumption more than those in low-debt ones.

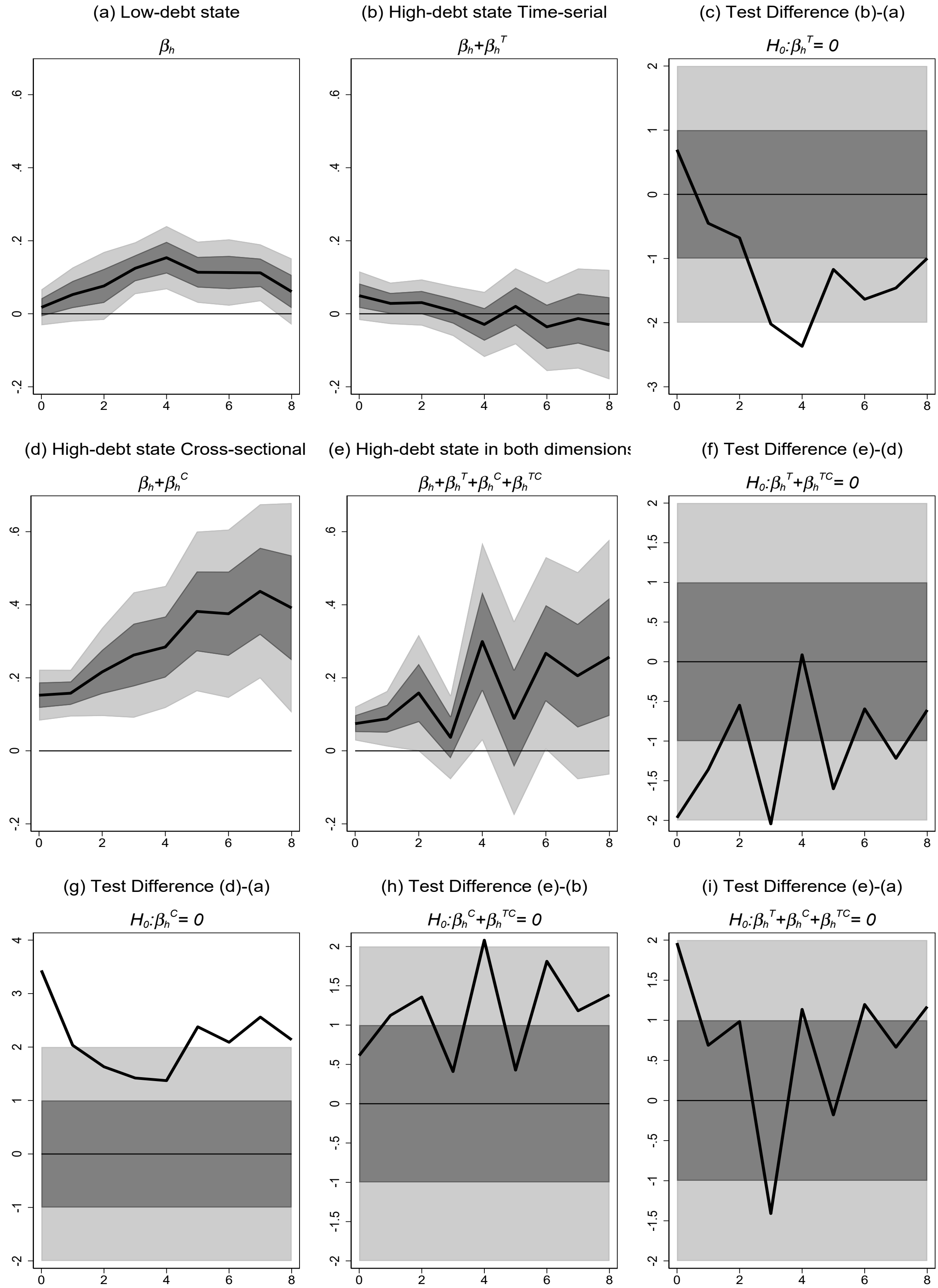
[20]In particular, consumers raise their consumption up beginning in the third quarter after impact until the eighth quarter. This relatively long duration of the government spending shock impact on actual consumption along with the delayed response of inflation expectations in the seventh and eighth quarters, suggests the possibility that feed-back effects of the latter consistent with a standard Euler equation may play a role in sustaining the initial rise in consumption.

4.2 Multi-state model

Next, we estimate our model shown in equation (2) which considers the two states, $S^T(z_{i,t-1})$ and $S^C(z_{i,t-1})$, simultaneously. Our results are presented in Figures 5 to 9 for real GDP, the actual inflation rate, real consumption spending, consumers' inflation expectations and consumers' buying intentions respectively. Equation (2) allows for four different cases depending on the realization of each of the two states. Thus, we have a low-debt state (given by parameter β_h) shown in sub-figure (a) of each of the Figures 5 to 9, a high-debt time-serial state (given by $\beta_h+\beta_h^T$) shown in sub-figure (b), a high-debt cross-sectional state (given by $\beta_h+\beta_h^C$) shown in sub-figure (d), and a high-debt state in both dimensions (given by $\beta_h+\beta_h^T+\beta_h^C+\beta_h^{TC}$) shown in sub-figure (e) of each Figure.

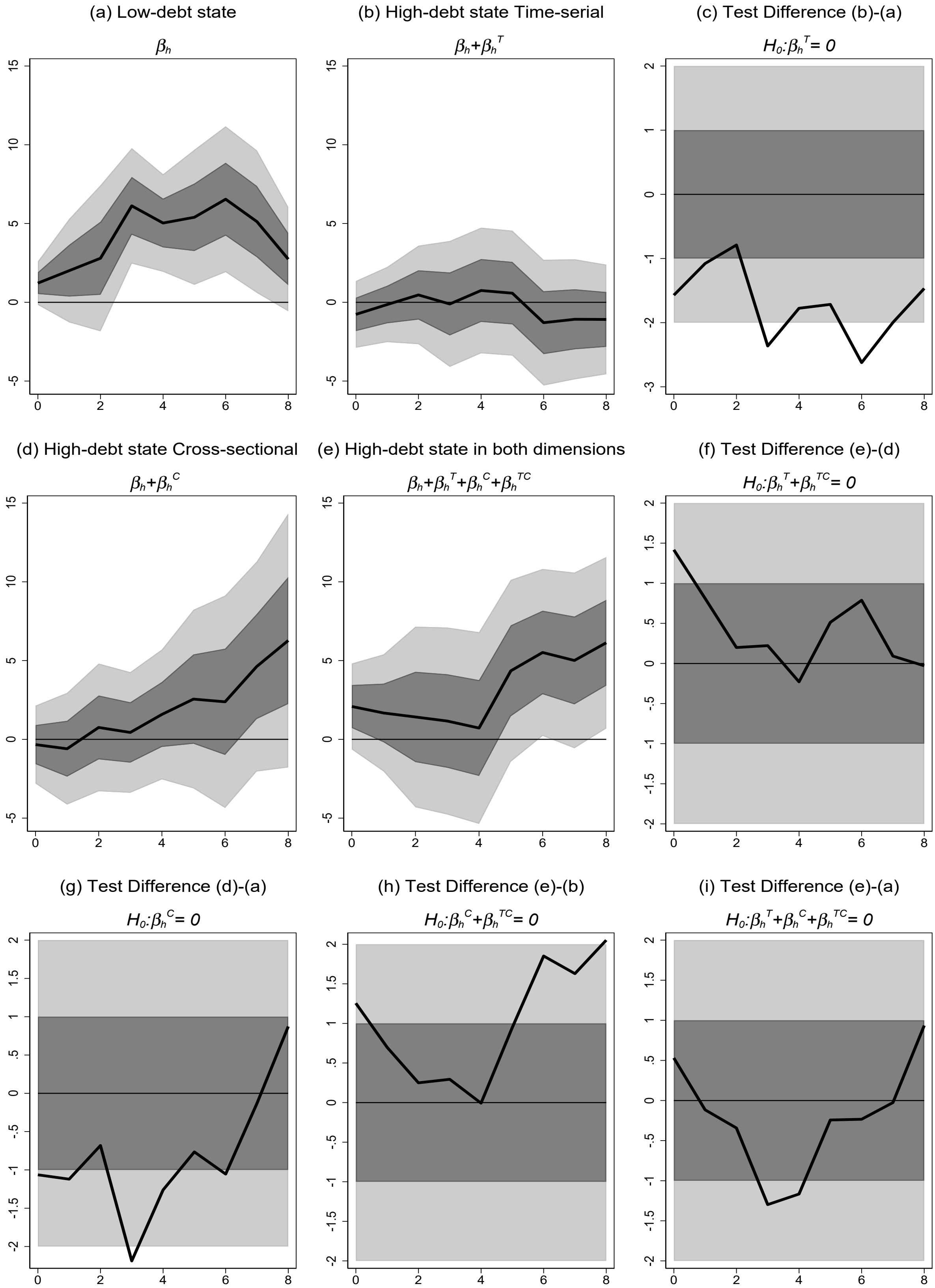
Moreover, in sub-figures (c), (f), (g), (h) and (i) of Figures 5 to 9 we show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal. More specifically, in sub-figure (c) we compare the responses in sub-figures (a) and (b) shown in the same row (i.e. test the null hypothesis that β_h^T=0), in sub-figure (f) we compare the responses in sub-figures (d) and (e) shown in the same row (i.e. test the null that $\beta_h^T+\beta_h^{TC}$=0), in sub-figure (g) we compare the responses in sub-figures (a) and (d) shown in the same column (i.e. test the null that β_h^C=0), in sub-figure (h) we compare the responses in sub-figures (b) and (e) shown in the same column (i.e. test the null that $\beta_h^C+\beta_h^{TC}$=0), and in sub-figure (i) we compare the responses in sub-figures (a) and (e) shown across that diagonal (i.e. test the null that $\beta_h^T+\beta_h^C+\beta_h^{TC}$=0).

Figure 5: Responses of Real GDP to positive government spending shock



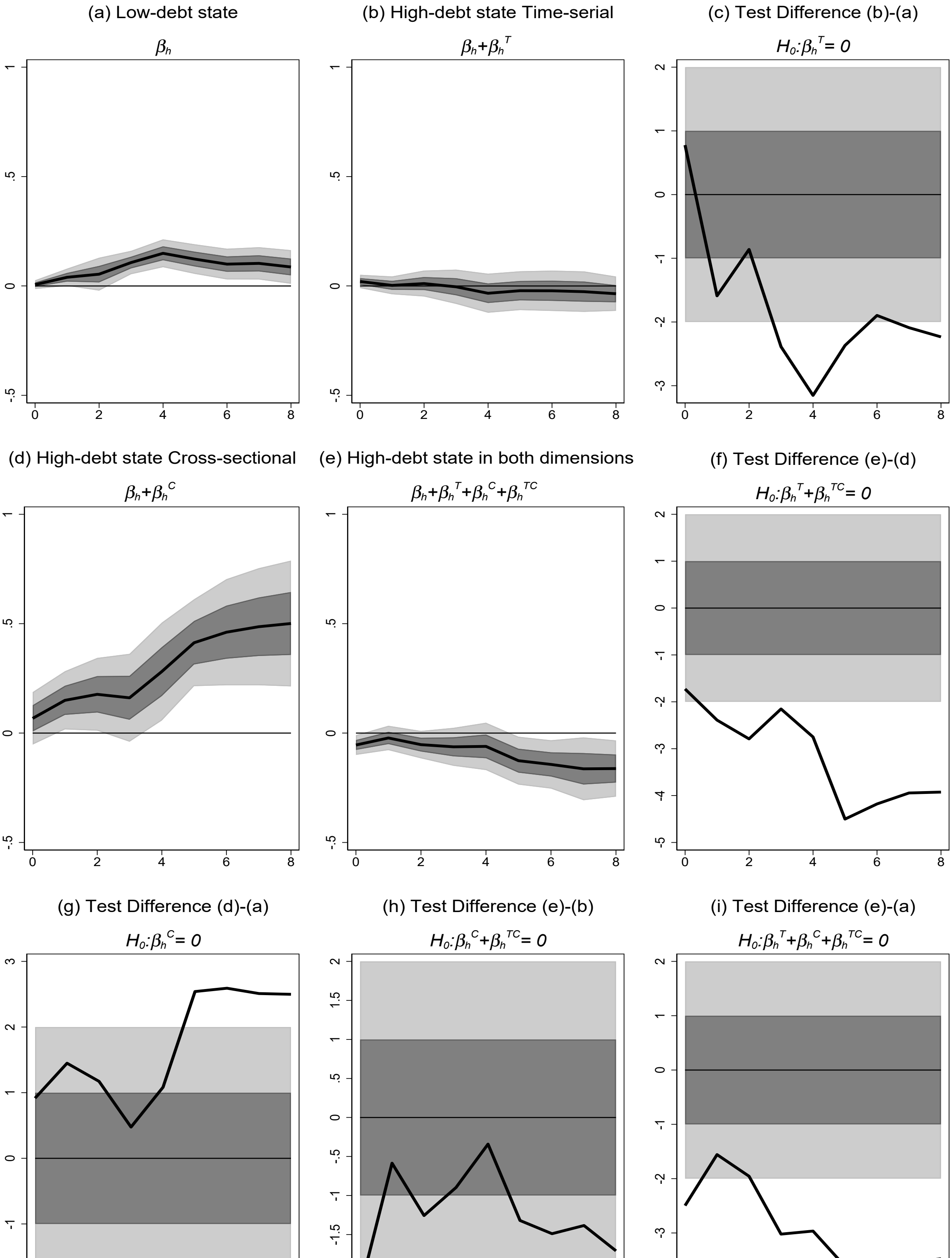
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure 6: Responses of Actual Inflation to positive government spending shock



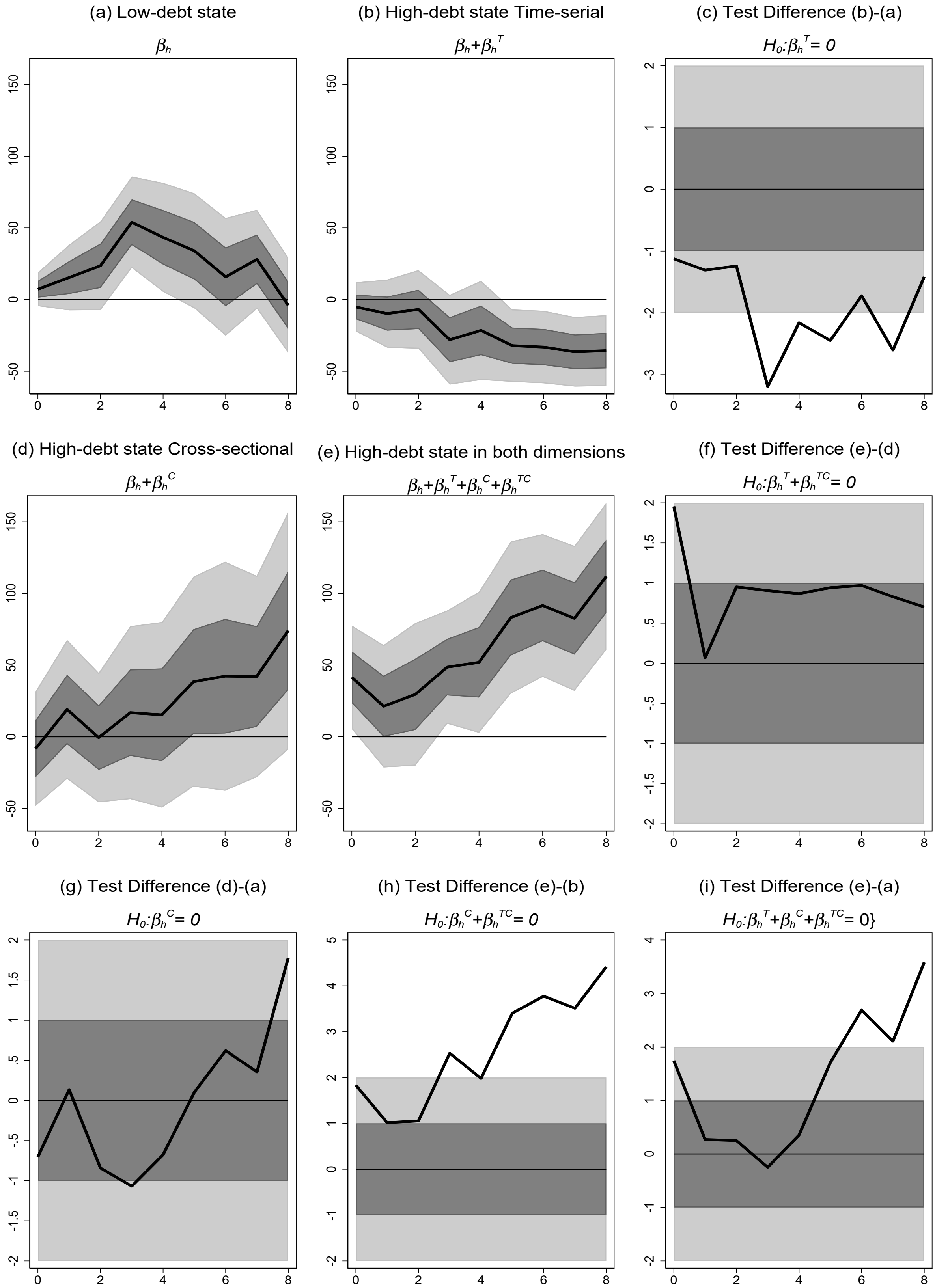
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure 7: Responses of Real consumption expenditure to positive government spending shock



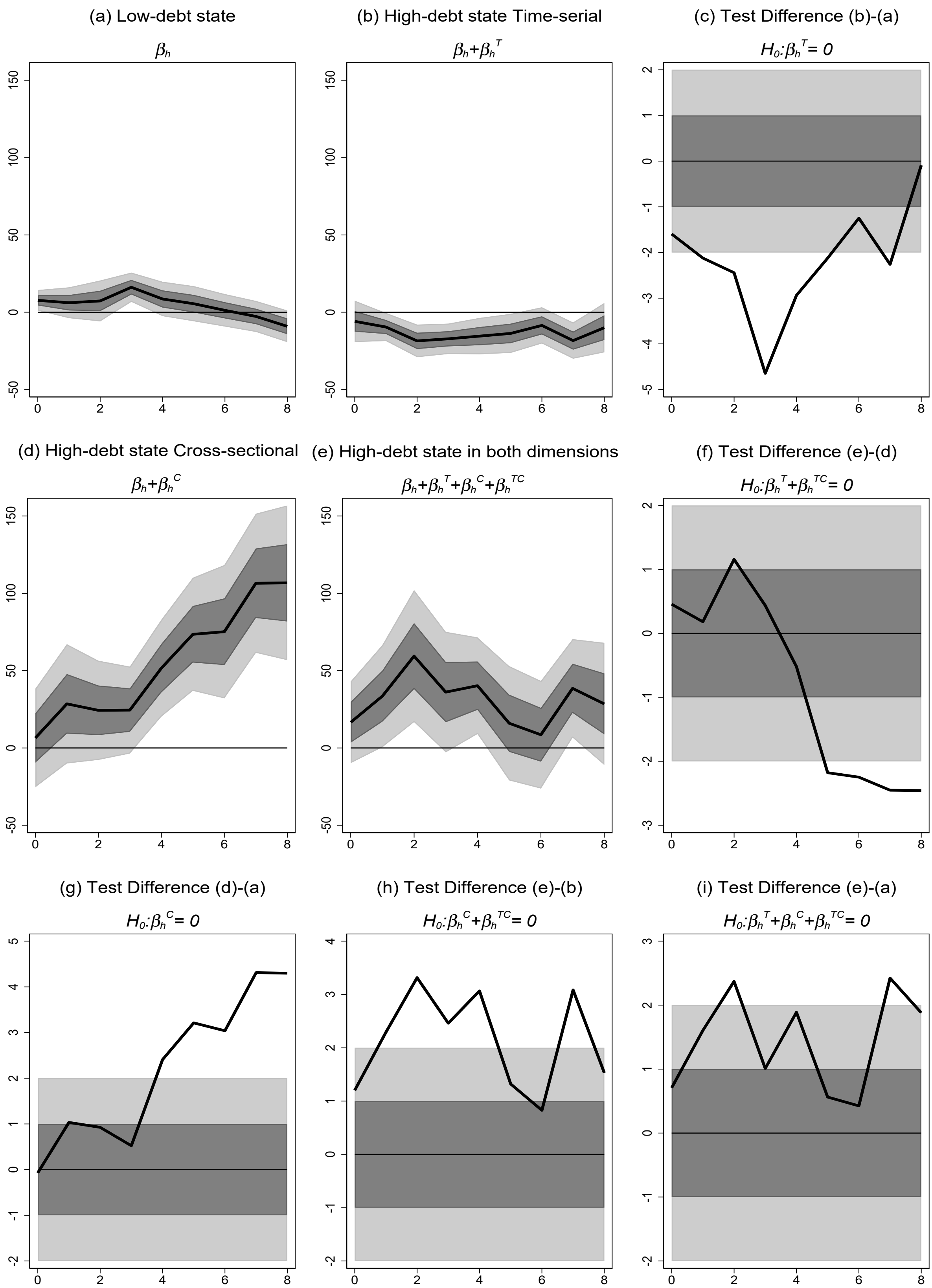
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure 8: Responses of Consumers' inflation expectations to positive government spending shock



Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure 9: Responses of Consumption intentions to positive government spending shock



Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Overall, the results from estimating the multi-state equation (2) concur with those from estimating our baseline equation (1). That is, in the low-debt state, responses are significantly greater than in the high-debt time serial state as shown in sub-figure (c) of Figures 5 to 9, and significantly smaller than those in the high-debt cross-sectional state as shown in sub-figure (g) of Figures 5, 7, and 9 for real GDP, consumption and consumption intentions respectively, but in this case not in Figures 6 and 8 for inflation and inflation expectations.

Moreover, our extended multi-state specification where we model the effects of the different state variables simultaneously, helps us disentangle time-serial and cross-sectional variation in public debt-to-GDP and to assess the relative importance of mechanisms active in, e.g., a state of high cross-sectional debt versus those active in a state of high time-serial debt, for the determination of macroeconomic variables and economic expectations. As we can see in sub-figure (e) of Figures 5, 6, 8 and 9, real output, the actual inflation rate, inflation expectations and consumption intentions go up following a positive government spending shock in a state where both cross-sectional and time-serial debt-to-GDP levels are high, suggesting that mechanisms active in the high cross-sectional debt state dominate. This also holds for firms' production expectations and selling price expectations in sub-figure (e) of Figures A2 and A3. The reverse is the case in sub-figure (e) of Figure 7 for actual consumption expenditure. However, once we purge our government spending shocks from anticipation effects, the response of actual consumption spending shown in sub-figure (e) of Figure A6, concurs with the results for the other variables, corroborating that mechanisms active in the high cross-sectional debt state dominate those in the time-serial debt state for the macroeconomic and expectations variables we consider.

4.3 Robustness Analysis

In this section, we evaluate the robustness of our main results. We now take into account anticipation effects by purifying the changes of government spending of the anticipated component. To this purpose, we use expectations of real total government consumption and real government gross fixed capital formation from the OECD Economic Outlook.[21] The government spending expectations are compiled twice a year by the OECD in Economic Outlook Statistics and Projections. Before 2004:S1, the forecasting horizon was semiannual with projections made in one semester for the next semester). Since 2003:S2 the forecast target period of expectations refers to quarterly values (expectation made in semester 1 for the next two quarters). Thus even thought forecasts are made twice a year, the forecasting horizon is on a quarterly basis and we have expected values for each quarter.[22]

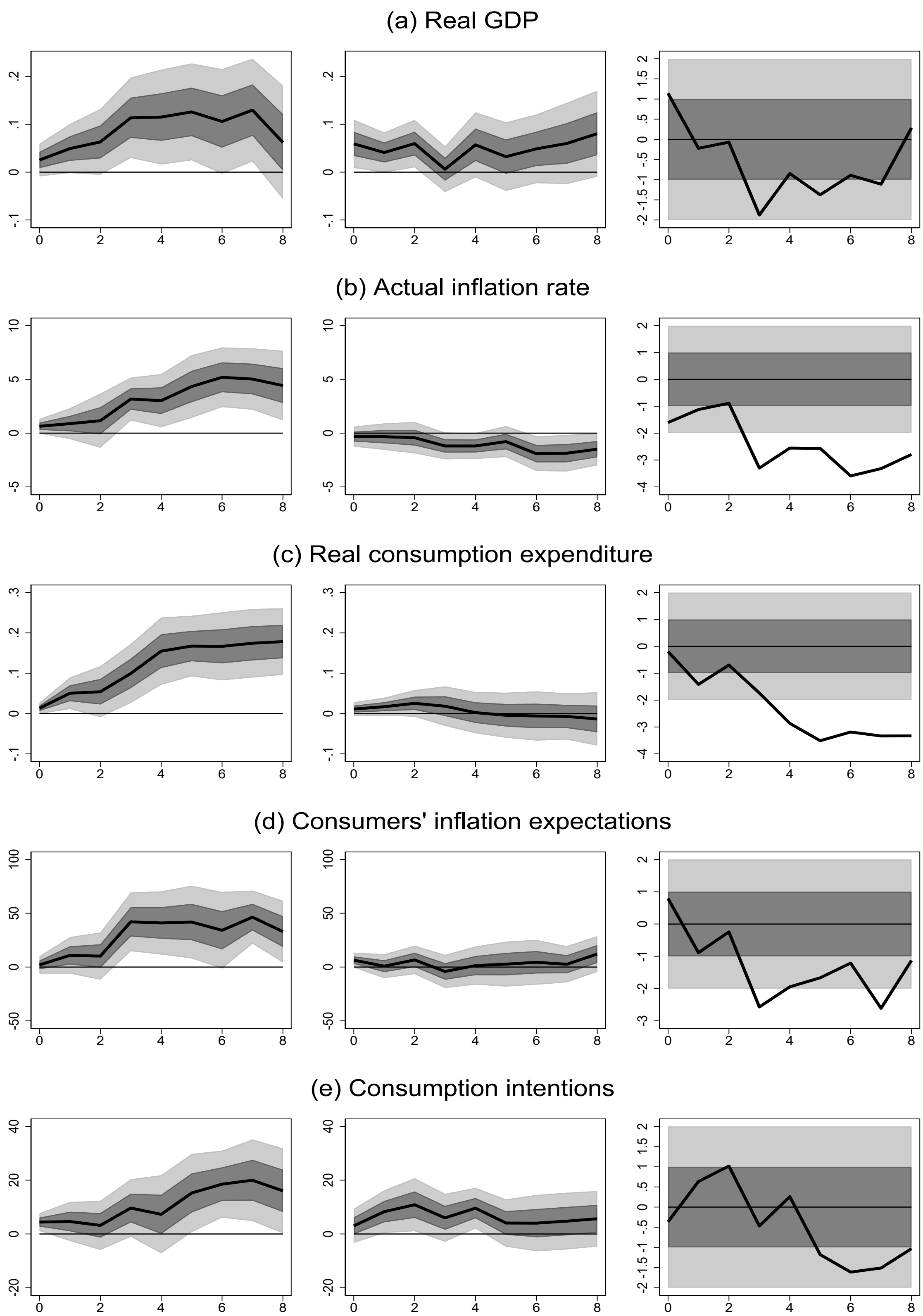
In a first step, we regress the log level of real government spending on log levels of real government consumption and real government investment expectations elicited from the survey of professional forecasters to obtain the residuals to be later used instead of actual government spending. In the second step, we use local projections based on Jordà (2005) and estimate the response of the dependent variables to the forecast error of government spending. The IRFs for each of the variables we consider (real GDP, the actual level of inflation, real consumption spending, consumers' buying intentions and consumers' inflation expectations) are presented in Figures 10 and 11 for the time-serial and cross-sectional dimensions respectively. These figures show the response of these variables to a fiscal policy shock which captures unanticipated/non-systematic innovations in government spending.

We find that accounting for anticipation effects in Figures 10 and 11 does not change our baseline results from Figures 3 and 4 for the time-serial and cross-sectional dimension respectively. A positive government spending shock has positive and significant impact in the low-debt state as compared to typically insignificant impact in the high-debt state for time-serial variation, and positive and significant impact in the high-debt state as compared to typically insignificant impact in the low-debt state in the case of cross-sectional variation.

[21]Estonia, Slovenia and the Slovak Republic are now excluded as we have data gaps for Government consumption expectations and no data for government gross fixed capital formation expectations.

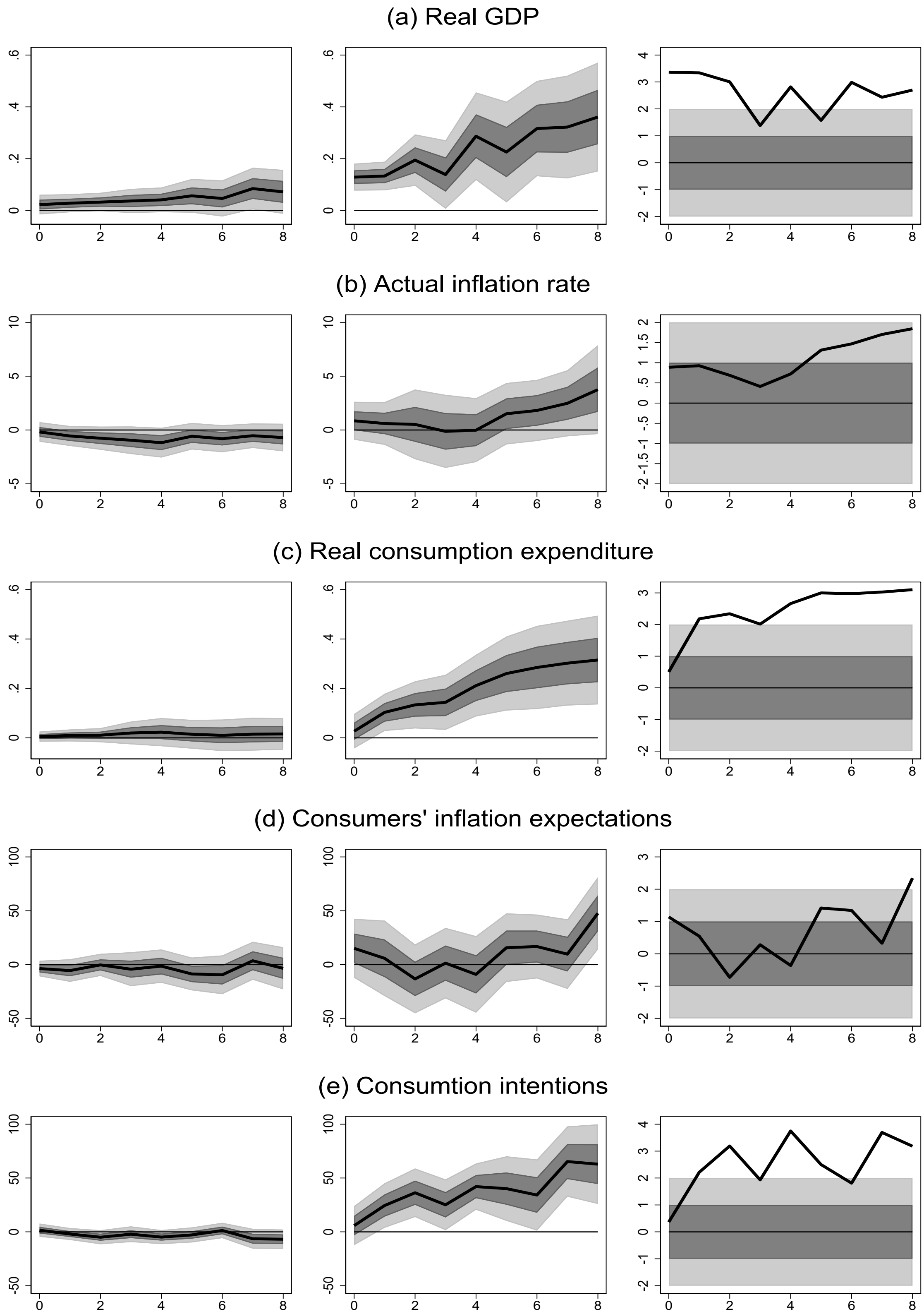
[22]Prior to 2004:S1, we assign the expected values made in the current semester to the next two quarters so that the expected values for the next two quarters are identical.

Figure 10: Responses to positive government spending shock purged from anticipation effects - State variable $S^T(z_{i,t-1})$



Notes: In each Panel, the first column shows responses together with one- and two-standard-error bands in the low-debt state, the second column responses in the high-debt state, and the third column the t-statistic showing the significance in difference between low- and high-debt state. *Note that due to the data availability of professional forecasts, we have excluded Estonia, Slovenia and Slovak Republic from our sample.*

Figure 11: Responses to positive government spending shock purged from anticipation effects - State variable $S^C(z_{i,t-1})$



Notes: In each Panel, the first column shows responses together with one- and two-standard-error bands in the low-debt state, the second column responses in the high-debt state, and the third column the t-statistic showing the significance in difference between low- and high-debt state. *Note that due to the data availability of professional forecasts, we have excluded Estonia, Slovenia and Slovak Republic from our sample.*

In the Appendix, we present the corresponding impulse response functions allowing for the four different states simultaneously. More specifically, figures A4 to A8 present the responses of each dependent variable (real output, the actual inflation rate, actual consumption spending, inflation expectations and consumption intentions) to a positive government spending shock purged from anticipation effects, while allowing simultaneously for the low-debt, high-debt, time-serial and cross-sectional states. Our results here are comparable with our baseline ones. As in the baseline specifications presented in Figures 5 to 9, the responses are significantly larger in the high-debt cross-sectional state relative to the low-debt state as shown in sub-figure (g) of Figures A4, A6 and A8 for real GDP, consumption and consumption intentions respectively, and not in Figures A5 and A7 for inflation and inflation expectations. One notable change relative to the baseline results is that, once we purge our government spending shocks from anticipation effects, the response of actual consumption spending shown in sub-figure (e) of Figure A6 differs from that in Figure 7 so that it now concurs with our earlier results for the other four variables, corroborating that mechanisms active in the high cross-sectional debt state dominate those in the time-serial debt state.

5 Discussion

The channels through which public debt erodes the effectiveness of fiscal policy in stimulating the economy are intensively discussed in the literature (see e.g. Blanchard, 1990; Sutherland, 1997; Corsetti et al., 2012). Huidrom et al. (2020) identify the so-called Ricardian and interest rate channels as the main driving forces behind weaker, or even adverse responses to higher expenditures. Our results suggest that these channels are mainly related to the evolution of public debt over time, i.e. the time-serial variation in public debt.

As we have shown in the last section, fiscal policy shocks exert distinct and significantly more pronounced macroeconomic effects in countries with relatively high levels of public debt as compared to the effects in countries with low public debt. In this section, we provide an interpretation of this result with respect to the potential mechanisms that may be the source of this state-dependent effect associated with cross-sectional variation in debt-to-GDP ratios.

To begin with, the stronger responses in the high debt state could be related to relatively strong expectation effects. For example, if households expect that a fiscal expansion leads to debt monetization via the central bank, then households adjust their inflation expectations upwards. Holding nominal interest rates constant, the Fisher equation together with the standard Euler equation then suggest that households increase consumption.[23] Thus, according to this argument, the fiscal policy shock primarily propagates to macroeconomic aggregates via household's expectations and consumption decisions. And since debt monetization becomes more likely if the existing amount of government debt is higher, this mechanism could in principle be consistent with the state-dependent effects described in the previous section. However, given that monetary policy in the euro area is common, expectations of debt monetization would be shared across the euro area members giving rise to higher inflation in the euro area as a whole. It is thus not clear why inflation expectations would rise only in the high-debt economies in response to a positive fiscal shock as a result of this mechanism. Hence, although we find that inflation expectations respond to fiscal shocks, it is less likely that this response, which is roughly in line with the response of actual inflation, is a consequence of expected debt monetization. Moreover, as we have shown in the previous section, the increases in real GDP and consumption in Figure 4 evidently precede the response of consumers' inflation expectations. Based on the preceding, it appears more likely that inflation expectations adjust upwards in response to economic activity and the associated upward pressure on inflation.

The stronger responses in the high-debt cross-sectional state may also be the result of positive wealth effects if higher nominal government debt is perceived as higher real wealth along the lines of the fiscal theory of the price level. However, although it may play some role, the positive wealth effect for domestic debt holders implied by such a setting would be less strong to the extent that government debt issued by high-debt eurozone economies

[23] Although the empirical relationship between expected inflation and consumption is not without controversy, several papers (see e.g. Dräger and Nghiem, 2020; Duca-Radu et al., 2021) document that consumers' willingness to spend increases with higher expected inflation (see also Bachmann et al., 2015). Coibion et al. (2019) directly show that exogenous changes in inflation expectations induced by treatments about monetary policy news, result in changes in individuals' future consumption spending in line with the consumer Euler equation.

is also held by foreign entities. The positive and distinctly stronger responses in the high-debt state as compared to the low-debt state, could be the result of positive wealth effects associated with higher nominal government debt being perceived as higher real wealth as in the "non-Ricardian" imperfect knowledge setting of Eusepi and Preston (2018) where "holdings of the public debt generate (positive) wealth effects on aggregate demand" that "get larger as the average scale of issued debt increases ". In this setting, non-Ricardian effects from fiscal policy are larger when the average debt-to-GDP ratio is high since, in this case, the aforementioned wealth effects dominate. Our results do not rule out this particular theoretical explanation.[24]

Having examined expectation effects and wealth effects as possible drivers of the state-dependent effects we observe, we now turn to private sector credit constraints as a potential alternative explanation. Klein (2017) shows that fiscal consolidations exert larger effects when the private sector is more highly indebted, which suggests that fiscal shocks have stronger effects if private agents face stronger credit constraints (see also Klein et al., 2020). It appears conceivable that public debt plays a similar role as private debt. That is, high levels of government debt may give rise to tighter private sector constraints for at least two reasons (see also Pozzi et al., 2004): First, banks may hold a large amount of domestic government debt in high-debt economies which crowds out private credit as banks might be less willing to extend credit to private borrowers in this case.[25] Moreover, banks may consider the tax liabilities associated with high public debt as a factor limiting borrowers' capacity to repay loans, and thus limit the amount of credit to the private sector. In other words, the anticipation of higher taxes gives rise to lower borrowers' net worth as the present value of households' income and firms' cash flows is lower, which may result in tighter credit

[24]The inflationary consequences of wealth effects from fiscal policy increase with higher levels of debt in this framework, while as these authors explain "this is not true in the fiscal theory of the price level", further suggesting that the latter theory cannot explain our finding of a greater response of inflation and inflation expectations in high-debt economies.

[25]Moreover, debt dilution becomes more likely in a high-debt economy reducing the present value of debt-holding banks' balance sheets and their implied ability to lend. A related, albeit distinct, issue is the so-called sovereign-bank nexus, which emphasizes financial stability risks associated with holdings of government debt by the national banking sector (see e.g. Battistini et al., 2014; Brunnermeier et al., 2016; Farhi and Tirole, 2018). Hristov et al. (2021) show that the ECB's unconventional monetary policy gave rise to higher sovereign bond holdings of domestic banks, particularly in euro area crisis countries.

constraints as banks become less willing to lend to them. In such a setting, high public debt will then be associated with a relatively higher prevalence of liquidity-constrained agents in high-debt economies, resulting in stronger and possibly distinct effects of fiscal shocks on economic activity in these economies. Using firm-level data, Huang et al. (2018) find that government debt makes investment more sensitive to cash-flows, which is consistent with this view. Thus, our empirical findings can be rationalized within a setting where high public debt is associated with tighter private sector credit constraints, resulting in stronger and distinct effects of fiscal shocks in high-debt economies as compared to low-debt economies.

6 Conclusion

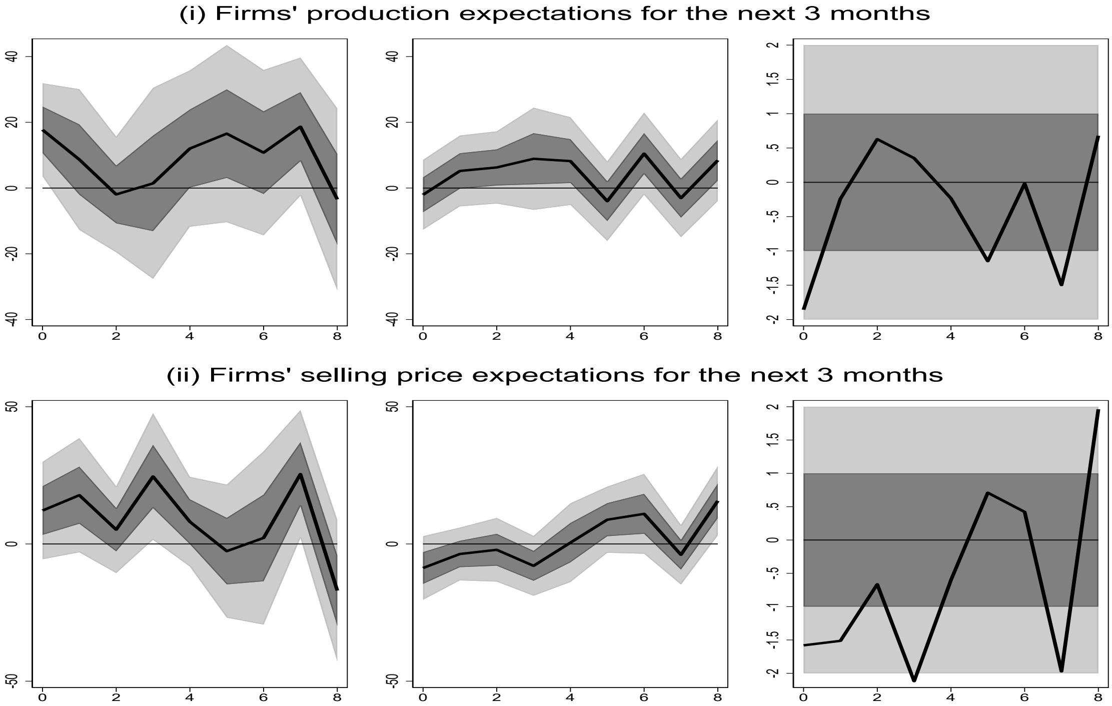
The state-dependence of fiscal policy we find in this paper is of particular importance for euro area economies facing high and rising public debt levels. Given that their common monetary policy is constrained by the zero-lower bound and that, in any case, it could not be perfectly tailored to their individual needs, fiscal policy then remains as the main policy tool for alleviating the impact of the crisis at hand. Our findings suggest that higher government spending would boost economic activity and economic expectations more in the high-debt economies as compared to the low-debt economies in the cross-section.

At the same time, the strong impact of government spending on economic activity and economic expectations in the high-debt state suggests that, given high debt levels in some euro area economies, the implementation of austerity measures to bring public debt levels under control would be particularly painful. This is important to take into account in planning co-ordinated action in regards to debt sustainability in the euro area in the aftermath of the current pandemic. Moreover, given that the current pandemic like the financial crisis before it have seen public debt levels reach unprecedented highs in the eurozone and elsewhere, our findings based on time-serial variation suggest that expansionary fiscal policy has tended to become less effective.

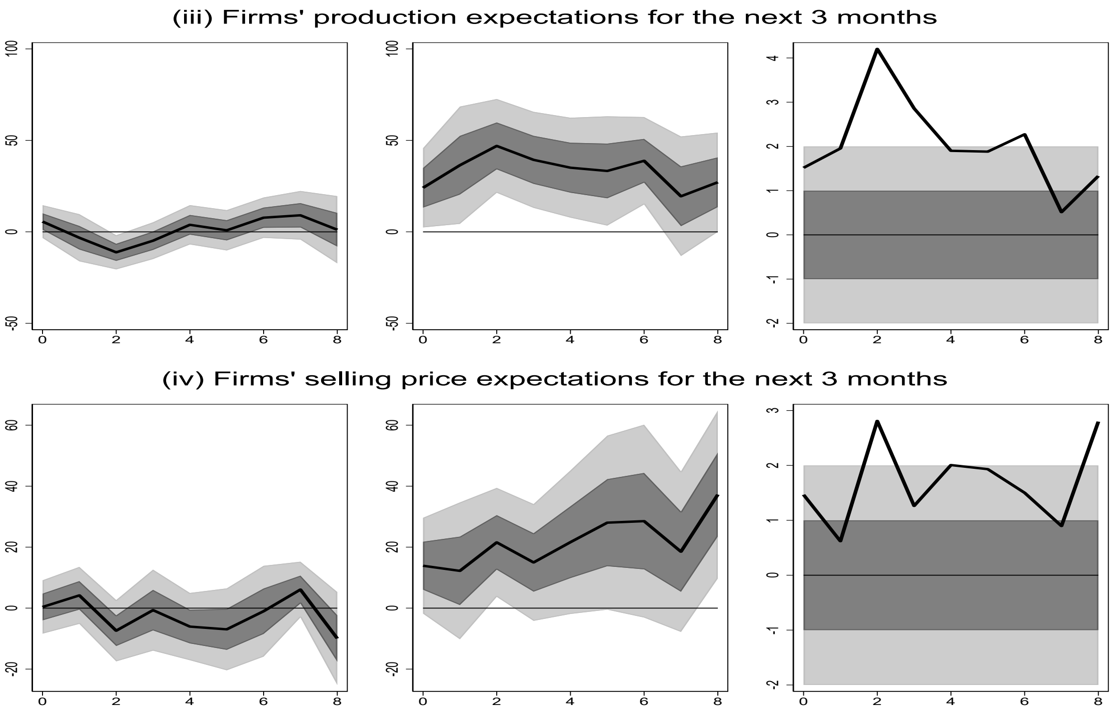
Appendix

Figure A1: Responses of firms' expectations to positive government spending shock

(a) State variable Time serial $S^T(z_{i,t-1})$

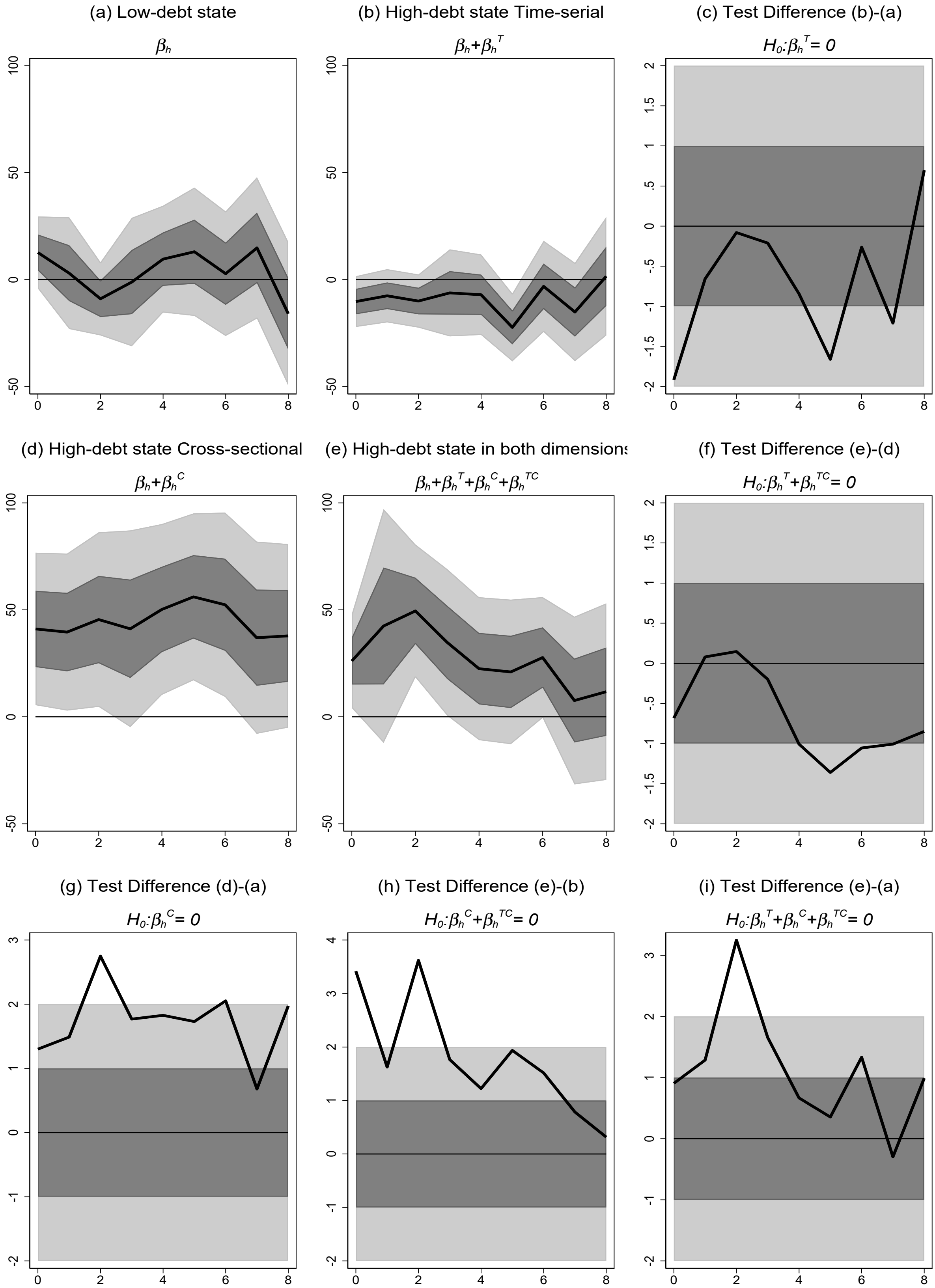


(b) State variable Cross sectional $S^C(z_{i,t-1})$



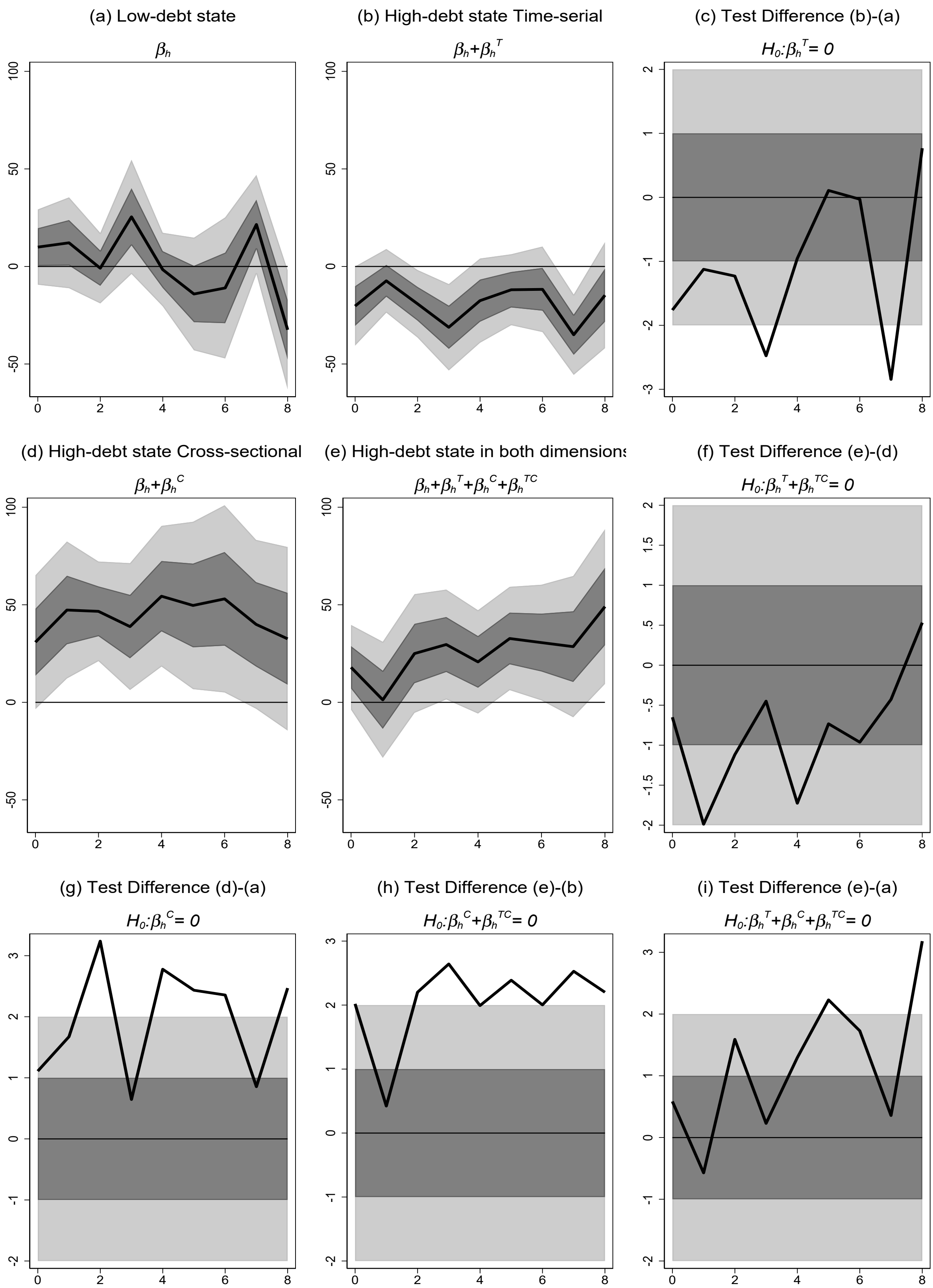
Notes: In each Panel, the first column shows responses together with one- and two-standard-error bands in the low-debt state, the second column responses in the high-debt state, and the third column the t-statistic showing the significance in difference between low- and high-debt state.

Figure A2: Responses of firms' production expectations to positive government spending shock



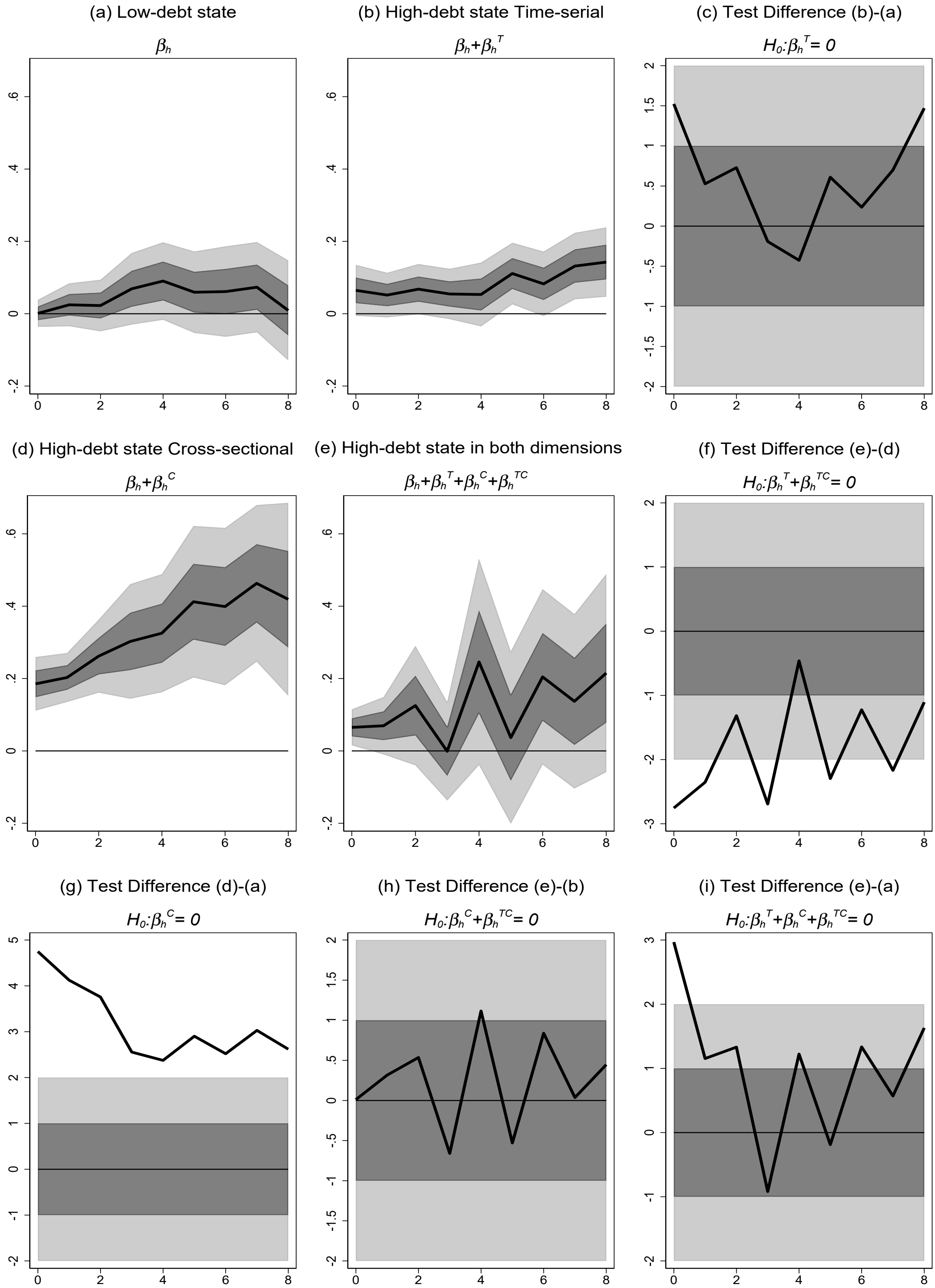
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A3: Responses of firms' selling price expectations to positive government spending shock



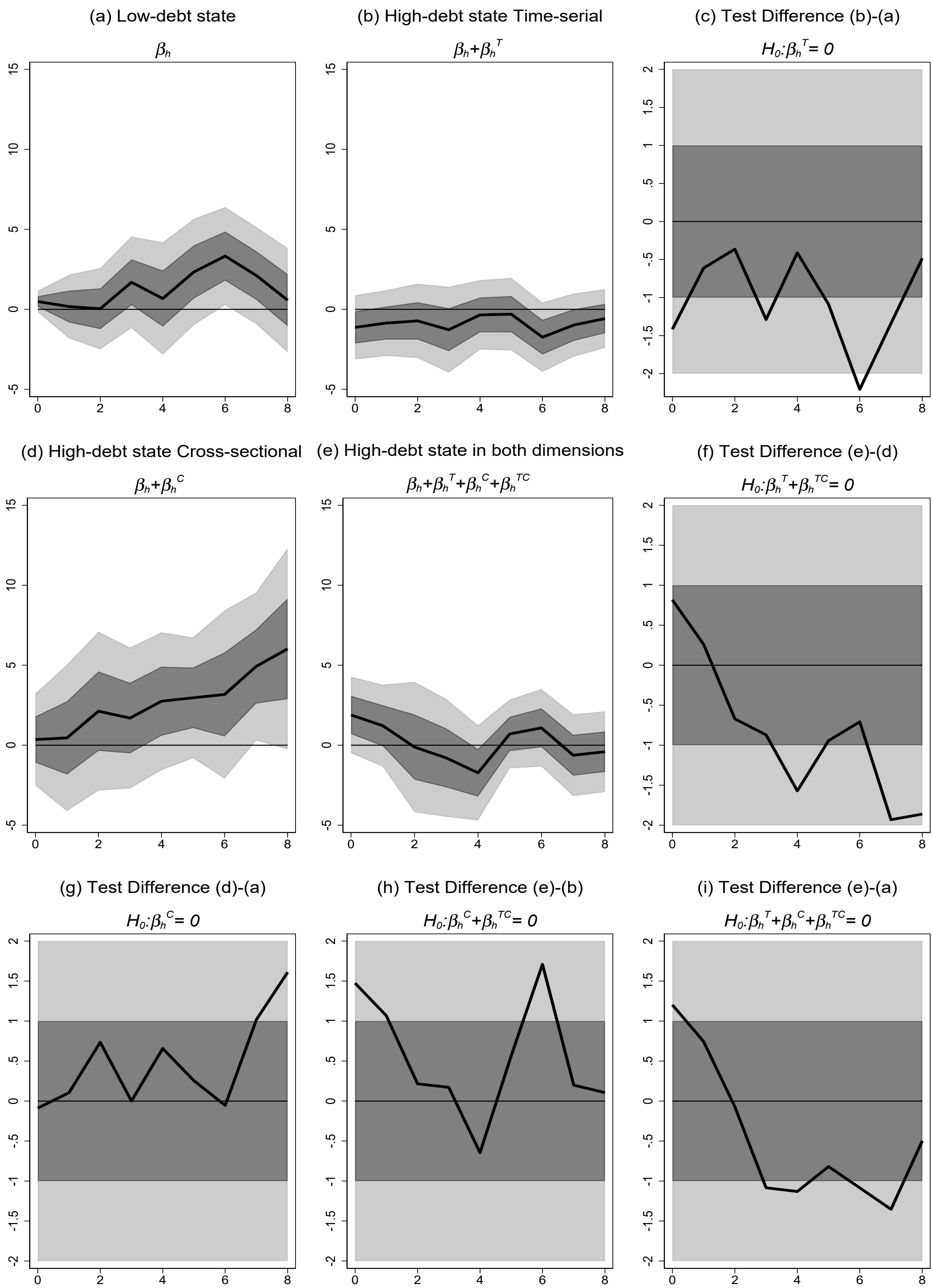
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A4: Responses of Real GDP to positive government spending shock purged from anticipation effects (-EE,SI,SK)



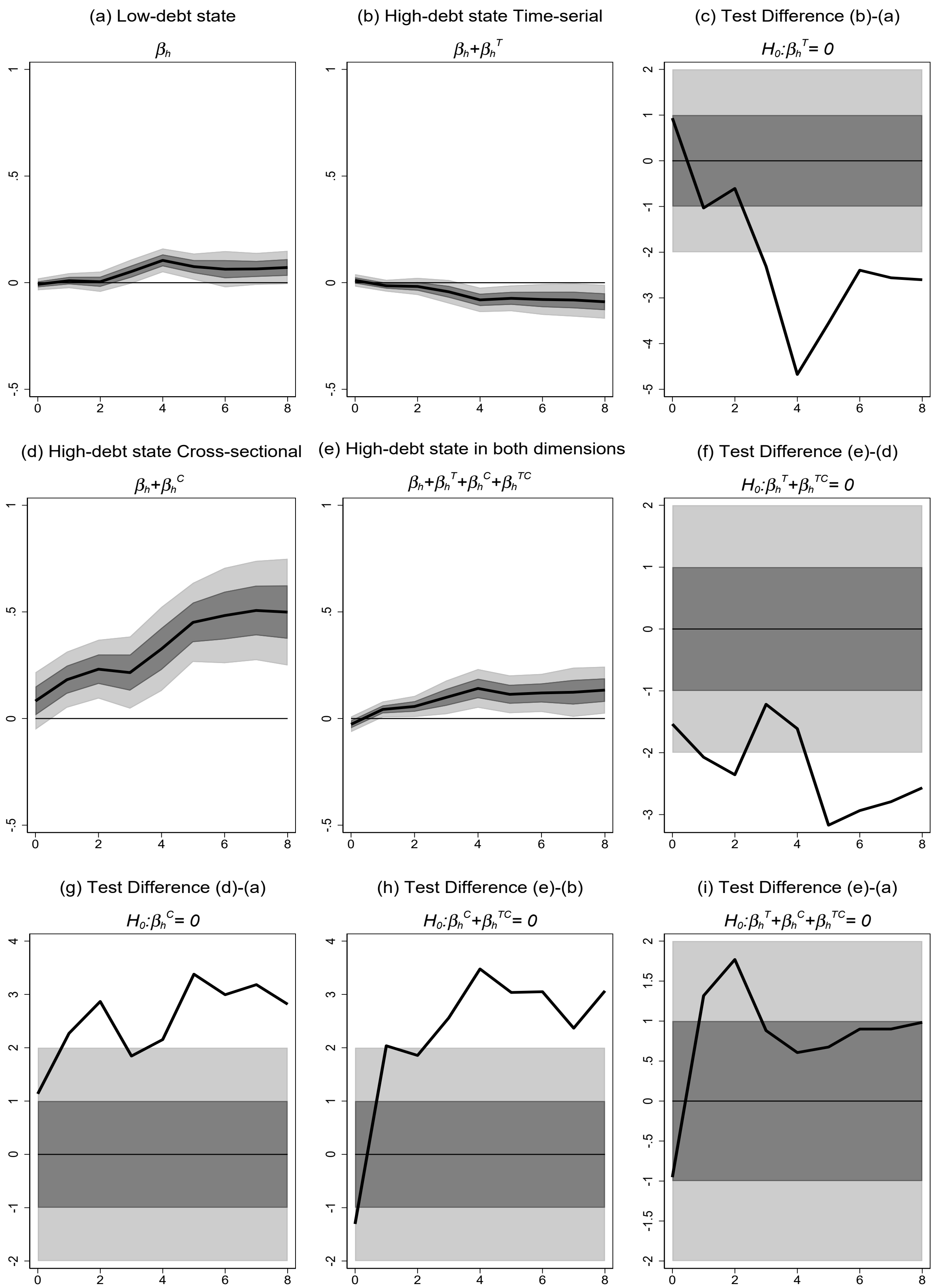
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A5: Responses of Actual Inflation to positive government spending shock purged from anticipation effects (-EE,SI,SK)



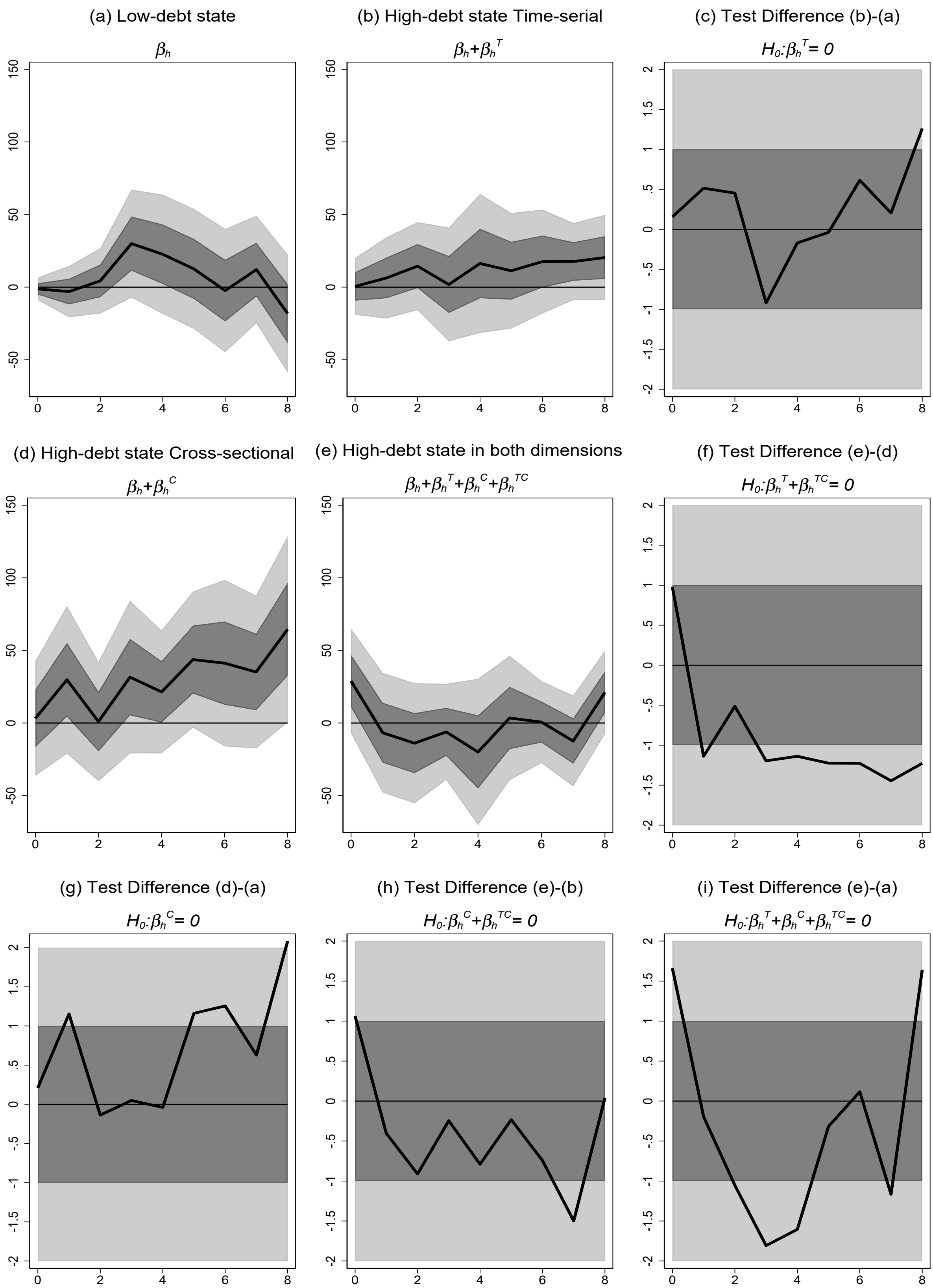
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A6: Responses of Real consumption expenditure to positive government spending shock purged from anticipation effects (-EE,SI,SK)



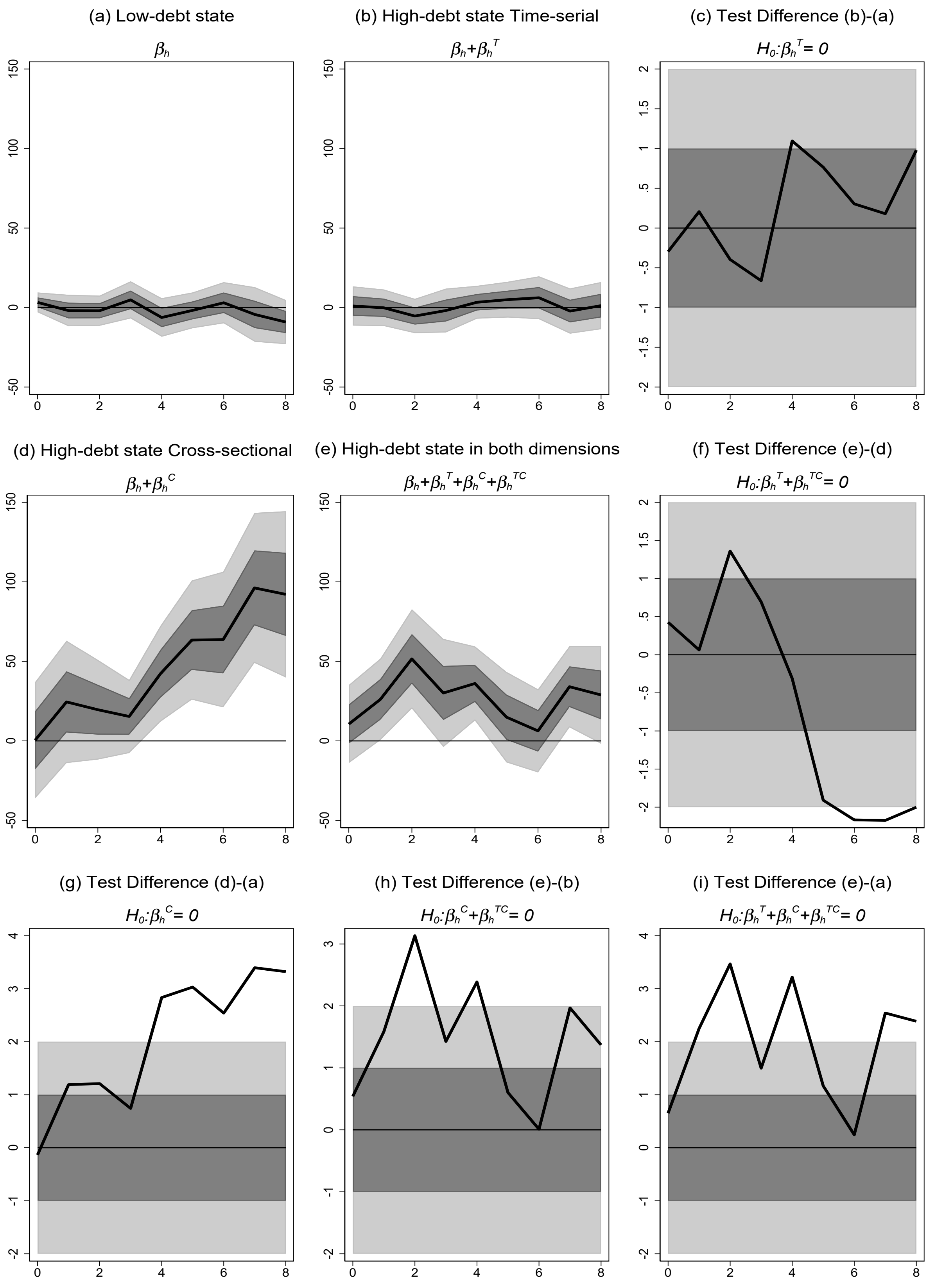
Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A7: Responses of Consumers' inflation expectations to positive government spending shock purged from anticipation effects (-EE,SI,SK)



Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

Figure A8: Responses of Consumption intentions to positive government spending shock purged from anticipation effects (-EE,SI,SK)



Notes: Subfigures (a), (b), (d), and (e) show state-dependent impulse responses together with one and two standard error bands corresponding approximately to the 68 and 96 percent confidence intervals. The solid lines in the remaining sub figures show the t-statistics for the null hypothesis that the responses for each pair of the four cases shown in sub-figures (a), (b), (d) and (e) are equal.

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