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ARTICLE

Government debt and fiscal multipliers in the era of population aging*

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Abstract

Over the past decade, the most salient changes in macroeconomic conditions in developed economies have included rising government debt and population aging, which are strongly correlated with each other. This paper investigates fiscal multipliers by disentangling the effects of population aging from those of government debt. Our analysis, which uses heterogeneous panel data from 24 OECD economies, shows that while fiscal policy is ineffective for economies with high-debt levels, it is effective for economies with low-debt levels. Furthermore, the estimation results reveal that fiscal policy is ineffective for aged economies, regardless of the level of government debt. However, for nonaged economies, while fiscal policy leads to negative effects on output in times of high debt, its positive effects are more pronounced in times of low debt. Our results suggest that, for the effective implementation of fiscal stimulus policies, policy-based stimulation of employment in the labor market is essential.

Keywords: Fiscal policy; Government debt; Population aging; Local projections

JEL classifications: E62; H30; H63; J10

1. Introduction

Fiscal multipliers are state contingent. Numerous empirical studies have found that fiscal multipliers depend on the phase of the business cycle [Auerbach and Gorodnichenko (2012, 2013), Blanchard and Leigh (2013), and Pyun and Rhee (2015)], income levels [Ilzetzki et al. (2013) and Kraay (2012)], trade openness [Ilzetzki et al. (2013) and Koh (2017)], exchange rate regimes [Corsetti et al. (2012), Born et al. (2013), Ilzetzki et al. (2013), and Koh (2017)], government debt levels [Auerbach and Gorodnichenko (2013), Huidrom et al. (2020), Ilzetzki et al. (2013), and Nickel and Tudyka (2014)], and population aging [Basso and Rachedi (2021), Honda and Miyamoto (2021), and Miyamoto and Yoshino (2022)].[1] Since fiscal policy, along with monetary policy, forms a major tool for macroeconomic stabilization, discussions on policy effectiveness have been extensively conducted over the past decade in response to economic disruptions such as the global financial crisis, the Eurozone public debt crisis, and the recent COVID-19 pandemic.[2]

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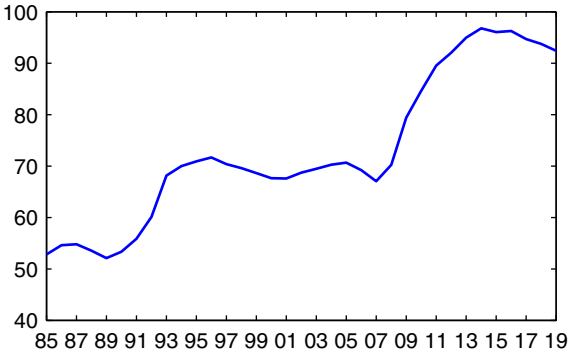

Figure 1. Average value of the debt-to-GDP ratios (%) across 24 countries in the sample over the period 1985–2019.

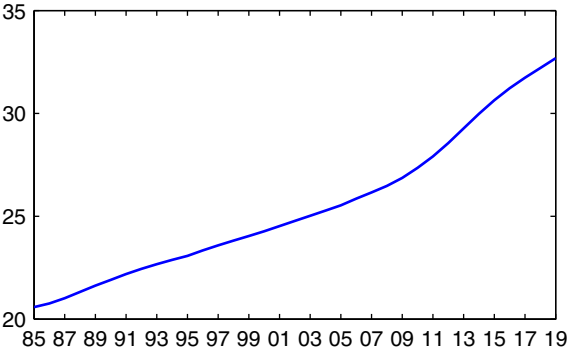

Figure 2. Average value of the old age dependency ratios (%) across 24 countries in the sample over the period 1985–2019.

To appropriately understand and evaluate the performance of developed economies' fiscal policies, it is essential to consider a changing macroeconomic environment. Over the past decade, the most salient changes in macroeconomic conditions have included rising government debt and population aging.

Figure 1 illustrates the average trend of the general government debt-to-GDP ratio for 24 developed economies in our sample; it shows that the public debt level increased over the sample period 1985–2019. There have been many lengthy discussions on how a higher level of government debt affects fiscal multipliers [Blanchard (1990), Perotti (1999), and Giavazzi and Pagano (1990, 1996)]. As government debt rises, households tend to cut their consumption since they expect higher taxes in the near future. Then, fiscal expansion crowds out private consumption and investment, which undermines the output effects of fiscal expansion. Population aging is a more persistent and long-term trend, which cannot be reversed over future decades, as it is caused by both a low birth rate and an increase in life expectancy. Figure 2 plots the average value of old-age dependency ratios across 24 developed economies in our sample, which shows that it has been monotonically increasing, and has recently risen rapidly. Population aging may cause blocks in the flow from formulation of the fiscal policy to output in the employment channel. Since, in aged economies, the working-age population forms a smaller portion of the aged population, it is possible that fiscal stimulus may not be able to boost the labor market in the economies, which, in turn, could lower fiscal multipliers [Honda and Miyamoto (2021)].[3] Furthermore, it should be noted that population aging tends to increase the government's social welfare expenditure, leading to an increase in national debt. Thus, the issues of population aging and government debt should be considered simultaneously, but this point has not been addressed in the previous literature.

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This paper investigates how government debt affects the output effect of a government spending shock in the era of population aging. Furthermore, considering that government debt and population aging are highly correlated, we attempt to disentangle these two distinct effects on fiscal multipliers. The government spending shock is identified as a forecast error of government spending, and state-dependent local projections are employed to estimate its effect on output; toward this end, heterogeneous panel data of 24 OECD countries over the sample period from 1985 to 2019 are used. The estimation results reveal that both government debt and population aging significantly affect fiscal multipliers. First, we confirm the results of the previous empirical studies which show that the government debt level can affect the output effect of government spending shocks: the output effect of discretionary fiscal policies is significant and positive in countries with relatively low debt, while it is negative in countries with relatively high debt. Second, to disentangle the effects of government debt from those of a demographic change, we divide the sample countries based on the mean of the old-age dependency ratio. The results show that, for aged economies, fiscal policy is ineffective regardless of the level of government debt, while, for nonaged economies, the output effects are prominent depending on the level of government debt. That is, while an expansionary fiscal policy leads to negative effects on output in times of high debt, its positive effects on output are more pronounced in times of low debt. Third, subsequent analysis suggests that population aging could nullify the channel from fiscal policy to output, making fiscal policy ineffective. In contrast, for nonaged economies, the employment channel appears to amplify the output effect of fiscal policy. For economies with high-debt levels, the Ricardian channel crowds out consumption and investment, leading to shrinking employment and negative output effects. However, for economies with low-debt levels, the Ricardian channel is weakened, boosting consumption and investment, which tends to increase employment and output.

The results in this study shed new light on fiscal multipliers. Previous literature has focused mainly on the Ricardian channel when understanding fiscal multipliers; however, our results suggest that the employment channel should be considered together with the Ricardian channel and that population aging hampers the employment channel. Furthermore, our study fills this gap in the literature by considering the demographic structure of the economy when estimating the effects of government debt on fiscal multipliers.

To our best knowledge, this study is the first to simultaneously consider the effects of the two-dimensional issues of government debt and population aging on fiscal multipliers. In the literature, these two conditions are separately addressed. Numerous studies, such as Auerbach and Gorodnichenko (2013), Huidrom et al. (2020), Ilzetzki et al. (2013), and Nickel and Tudyka (2014), using a panel vector autoregressive (VAR) methodology, consistently report that the fiscal multiplier is smaller in highly indebted countries. Using panel data of 44 countries over the period Q1 1960–Q4 2007, Ilzetzki et al. (2013) find a significantly negative long-run multiplier effect when the government debt-to-GDP ratio exceeds 60%. Using extended data of 120 countries from 1960 to 2014, Koh (2017) confirms the results of Ilzetzki et al. (2013) in that fiscal multipliers are found to be larger when public debt is low. For OECD countries, Auerbach and Gorodnichenko (2013) find that, over the period 1985–2008, positive and significant fiscal multipliers are observed only in low-debt countries during a recession, while such multipliers become insignificant in high-debt countries regardless of the debt level. Huidrom et al. (2020) consider 34 developed and developing countries over the period Q1 1980–Q1 2014 and show that government debt weakens the multiplier effect through both the Ricardian channel and the interest rate channel. Our study differs from the aforementioned studies in that they did not address labor market changes due to population aging.

Furthermore, Basso and Rachedi (2021), Honda and Miyamoto (2021), and Miyamoto and Yoshino (2022) explore the effects of population aging on fiscal multipliers. Basso and Rachedi (2021) investigate changes in the military spending multiplier depending on the demographic structure using U.S. state-level data and find that the multipliers are larger in a relatively young

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economy. Moreover, they match their empirical results with a version of the New Keynesian model and conclude that U.S. population aging has decreased multipliers by 38% between 1980 and 2015. Miyamoto and Yoshino (2022) employ the local projection method to estimate state-dependent fiscal multipliers depending on the degree of population aging for 17 OECD countries over the period 1985–2017. They find that a positive government spending shock increases output significantly in relatively young economies, which is not so in relatively old economies. Honda and Miyamoto (2021) consider the two-tiered structure of fiscal multipliers depending on the demographic structure and business cycle for OECD countries and confirm the results of Auerbach and Gorodnichenko (2012) and Honda and Miyamoto (2021). They find that there is no positive output effect in expansionary times, while there is a significantly positive output effect of positive government spending shocks, which is weakened as the population ages. In addition, Cho and Lee (2022) provide evidence that an aging population can weaken the effectiveness of fiscal policy for improving fiscal sustainability in the countries that experienced the crisis.

The remainder of this paper is organized as follows. Section 2 presents a literature review where we discuss and distinguish our study from previous studies. Section 3 describes the data used and presents state-dependent local projections. Section 4 presents the estimation results for the output effects and their transmission channels. Section 5 provides concluding remarks.

2. Related literature

The first hurdle encountered in estimating the fiscal multiplier is to address the endogeneity problem between fiscal changes and output. In empirical literature, there are three main strategies for identifying fiscal shocks. First, Barro (1981) and Ramey and Shapiro (1998) regard government defense spending as a "natural experiment" of an exogenous increase in government spending, and estimate the military spending multiplier. Barro (1981) uses U.S. defense spending data and concludes that the multiplier is consistently smaller than unity, and that the effects of temporary movements in defense purchases on output are greater than those of permanent cases. Ramey and Shapiro (1998) also estimate the output effects of U.S. defense spending, and conclude that spending shocks lower product and consumption wages, consistent with the expectations of the two-sector neoclassical model.

The second strand employs various versions of the structural VAR methodology to identify government spending shocks, which was first proposed by Blanchard and Perotti (2002). The basic presumption in this SVAR approach is that it takes more than a quarter for government spending to react to changes in output, while changes in fiscal policy are directly reflected in output. Blanchard and Perotti (2002) propose short-run restrictions, partly along with institutional information on tax, transfer, and government spending, for identifying fiscal shocks.[4] They find that the estimated fiscal multipliers are smaller than expected, often close to one.

The identification scheme of Blanchard and Perotti (2002) is extended to cross-country panel data to explore various macroeconomic conditions behind fiscal policies [Huidrom et al. (2020), Ilzetzki et al. (2013), and Nickel and Tudyka (2014)]. The pioneering work of Ilzetzki et al. (2013) implements various subsample analyses for 44 developed and developing countries and finds evidence that the output effects of fiscal policy are greater in developed countries, in countries with predetermined exchange rate regimes, countries with a lower level of trade openness, and countries with a lower government debt-to-GDP ratio. Nickel and Tudyka (2014) focus on the government debt and trade balance of 17 European countries and show that a positive fiscal shock could cause twin deficits or twin divergence, depending on public indebtedness levels. Huidrom et al. (2020) examine 34 developed and developing countries to determine the mechanism by which the government debt level could affect fiscal multipliers. They find that, as the government debt level increases, consumers become more Ricardian and the borrowing cost rises due to an increase in the risk premium.

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Furthermore, Koh (2017) and Pappa (2009) add sign restrictions in the VAR estimation to identify fiscal shocks in annual data since the previous recursive restrictions are based on the quarterly frequency. The sign restriction assumes that the impact of a fiscal spending shock increases output and fiscal deficit. Pappa (2009) employs U.S. aggregate and state-level data and shows that government consumption, investment, and employment shocks could raise real wages and total employment in aggregate-level data, while government employment could decrease total employment in one-third of the states. Koh (2017) extends the experiments of Ilzetzki et al. (2013) to 120 countries with an annual frequency and concludes that there is no evidence that fiscal multipliers are smaller in countries with higher trade openness, capital openness, and flexible exchange rate regimes; this appears to be inconsistent with the findings of Ilzetzki et al. (2013).

The third empirical strategy to estimate the fiscal multiplier involves using observable forecast errors of fiscal innovations, which can be interpreted as unexpected fiscal shocks. Auerbach and Gorodnichenko (2012) investigate the differences in the output effects of U.S. fiscal shocks depending on the business cycle using the regime-switching SVAR model with information from surveys of professional forecasters. Auerbach and Gorodnichenko (2013) extend their previous study to cross-country panel data from OECD economies. Auerbach and Gorodnichenko (2012, 2013) find that fiscal multipliers are greater during recessions than during expansions. Honda and Miyamoto (2021) and Miyamoto and Yoshino (2022) identify unanticipated fiscal shocks by the gap between forecasted and realized fiscal stances for OECD economies. Both studies employ the local projection methodology and find that fiscal multipliers are insignificant in aged economies.

Our study is in line with the third strategy in that we identify fiscal shocks by the forecast errors of the OECD economic outlook. Furthermore, our estimation strategy is more consistent with those of Auerbach and Gorodnichenko (2012, 2013), Honda and Miyamoto (2021), and Miyamoto and Yoshino (2022) than with those of Ilzetzki et al. (2013), Huidrom et al. (2020), and Nickel and Tudyka (2014) in that we use a state-dependent or regime-switching approach, instead of relying on a subsample analysis based on exogenously predetermined criteria for the debt-to-GDP ratio.[5]

3. Econometric framework

3.1. Data

The data used in our analysis are sourced from the OECD's Statistics and Projections Database, OECD Economic Outlook, and the International Monetary Fund's World Economic Outlook. Macroeconomic series, such as real GDP, real consumption, real investment, and employment, are obtained from the OECD Economic Outlook. The debt-to-GDP ratio is sourced from the International Monetary Fund's World Economic Outlook. In addition, the data on the consumer confidence index and business confidence index are collected from the OECD database. For the forecast of government spending, we use the forecast reported in the fall issue of the OECD Economic Outlook for the same year to construct government spending shocks.[6] The old-age dependency ratio is obtained from the World Bank's World Development Indicator. It is defined as the ratio of the population aged over 65 years to the population aged 15–64 years.[7] Our sample includes an unbalanced panel of 24 OECD countries for the period 1985–2019. Our analysis uses the old-age dependency ratio as a measure of the aging state of an economy. We define an economy as aged when the old-age dependency ratio exceeds a certain threshold. In our analysis, an economy is regarded as aged (nonaged) if its old-age dependency ratio is above (below) the sample mean of 22.8%.[8] After dividing 24 OECD countries into aged and nonaged economies, we estimate state-dependent local projections using the debt-to-GDP ratio as a transition variable that drives the dynamics of the fiscal multipliers in each group of countries.

It is worth noting that there are two issues for the selection of countries in each group. The first issue is associated with consistency in assigning countries in each group. Among aged economies,

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Japan exhibited remarkable changes in the demographic structure over our sample period 1985–2019. While Japan was included in the nonaged group in the early stage of our sample period, it became the most aged economy in the aged group in a short period of time.[9] Similarly, the Netherlands was undoubtedly included in the nonaged group until 2010. However, after 2010, it was included in the aged group with the old-age dependency ratio sharply increasing from 23.03 in 2010 to 30.39 in 2019. To address the issue of consistency in assigning countries in each group, we estimate the model using aged economies without Japan and nonaged economies without the Netherlands and discuss the results accordingly in Section 4.2.

Another issue would be discrepancy of the government debt level between the two groups since there is a positive correlation between government debt and population aging. While the median for the government debt-to-GDP ratio is 60.52 for the aged group, it is 55.06 for the nonaged group. If the government debt-to-GDP ratio substantially differs across the two groups, it appears to be difficult to distinguish between the effects of population aging and those of government debt.[10] To investigate how robust our main findings are to the issue of discrepancy, we estimate the model with some adjustments for this discrepancy, i.e., by excluding one country with an extreme outlier for the debt level in each group: Japan exhibiting the highest debt level in the aged group and Luxemburg showing the lowest debt level in the nonaged group. Making adjustments for this discrepancy provides quite similar median values of the government debt-to-GDP ratio for aged and nonaged groups. Specifically, the median for the aged group becomes 59.06 and for the nonaged group, 60.46.[11]

3.2. Identification of government spending shocks

Following the Auerbach and Gorodnichenko (2012, 2013)'s approach, we identify government spending shocks as forecast errors of government spending. Specifically, government spending shocks are identified as follows:

$$\varepsilon_{it} = \frac{G_{it} - G_{it}^{e}}{Y_{i,t-1}},$$

where G_{it} is the actual government consumption of country i in year t, G_{it}^{e} is the forecast of government consumption spending, and $Y_{i,t-1}$ is real GDP of country i in year $t-1$. We use forecasts from the fall issue of the OECD Economic Outlook and data sourced from the OECD's Statistics and Projections Database. Specifically, to obtain government spending shocks, we use the forecast of government spending in the fall issue of the OECD Economic Outlook for the same year. We also use the forecast of government spending in the fall issue of the previous year as a robustness check. This identification strategy could resolve the well-known issues of (i) fiscal foresight [Leeper et al. (2012, 2013)] and (ii) potential feedback from the state of the economy to fiscal policy. We scale fiscal variables (i.e., G_{it} and G_{it}^{e}) by real GDP in the previous year, so that the estimated coefficients are fiscal multipliers.[12]

Based on the available data regarding forecast errors of government spending, our sample covers the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the USA.

3.3. Model estimation using local projections

As in Auerbach and Gorodnichenko (2012, 2013), we estimate nonlinear (or state-dependent) local projections to quantify the effects of government spending shocks on macroeconomic variables such as output, private consumption, investment, and employment by using heterogeneous panel data for 24 OECD countries in the sample. Local projections are found to have some distinct advantages compared to VAR models: (i) local projections are more robust to misspecification

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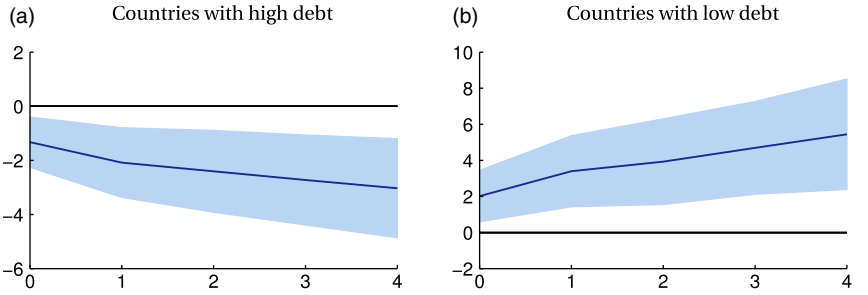

Figure 3. State-dependent impulse responses of output to an unanticipated government spending shock for 24 countries in the sample, with 90% confidence bands.

since they impose weaker assumptions on the dynamics of the data; (ii) a joint or point-wise analytic inference is readily implemented; and (iii) compared to VAR models, local projections are easier to estimate. However, there is one drawback in using local projections—chiefly, the importance of identifying structural shocks beforehand. Thus, we use the government spending shock identified as explained above in the estimation of nonlinear local projections.

We estimate the following state-dependent local projection model.

$$y_{i,t+h} - y_{i,t-1} = \alpha_i^h + \theta_t^h + \beta_1^h G(z_{it})\,\varepsilon_{it} + \beta_2^h [1 - G(z_{it})]\,\varepsilon_{it} + \omega^h X_{it} + u_{i,t+h}^h, \tag{1}$$

with

$$G(z_{it}) = \frac{\exp(-\gamma z_{it})}{1 + \exp(-\gamma z_{it})},\ \gamma > 0$$

where $y_{i,t}$ is the log of real GDP, α_i^h is the country fixed effect, θ_t^h is the time fixed effect, ε_{it} is the identified government spending shock, and X_{it} is a set of control variables. The control variables include two lags of government spending shocks and two lags of real GDP growth. All the coefficients vary with horizon h. Thus, equation (1) is estimated separately for each horizon. We estimate equation (1) for each $h = 0, 1, \ldots, 4$, where $h = 0$ indicates the year in which the government spending shock occurs. We compute the impulse response function of output using the estimated β^h. We set $\gamma = 1$ as in Abiad et al. (2016) and Miyamoto and Yoshino (2022).[13] The transition variable z is the government debt-to-GDP ratio. As in Auerbach and Gorodnichenko (2012), we date the transition variable z by $t - 1$ to avoid contemporaneous feedbacks from policy actions as to whether the economy is in a high- or a low-debt regime.[14] Standard errors are obtained using the robust covariance matrix estimator of Driscoll and Kraay (1998). The estimation results remain consistent in the presence of cross-sectional dependence and serial correlation and thus provides heteroskedasticity-robust standard errors.

4. Empirical analysis

4.1. Results from state-dependent local projections

Figure 3 illustrates the cumulative impulse responses to an unanticipated increase in government spending by 1% of GDP at time 0 for all of our sample economies (i.e., unconditional on population aging). The shaded area represents 90% confidence bands. At first glance, impulse responses qualitatively confirm the findings of previous studies. That is, fiscal stimulus based on government spending increases is effective when the government debt level is low and ineffective when it is high. In the high-debt regime, the impact multiplier is estimated to be –1.3, and the cumulative magnitude falls to –3 in Year 4. In contrast, in the low-debt regime, the impact multiplier is estimated to be 2, and the cumulative multiplier rises to 5.4 in Year 4.

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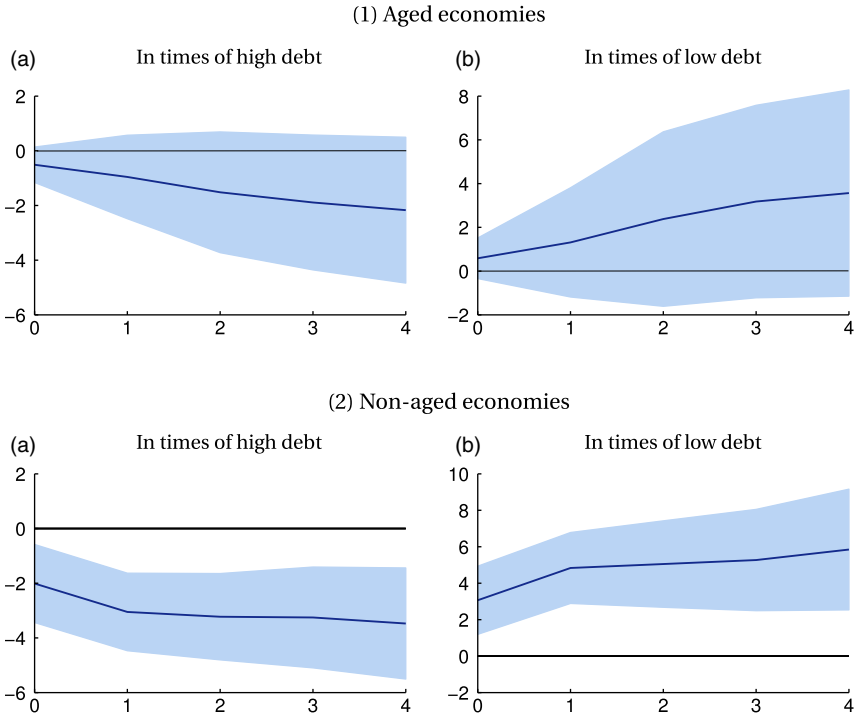

Figure 4. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

In previous studies, the fiscal multiplier, depending on the government debt level, is estimated to varying degrees, which stems from different sample countries, sample periods, and estimation methodologies. In the high-debt regime, Ilzetzki et al. (2013) and Nickel and Tudyka (2014) find significantly negative fiscal multipliers, whereas Koh (2017) and Huidrom et al. (2020) find insignificant output effects. Ilzetzki et al. (2013) provide a similar long-run multiplier to our case, which is –3, when the government debt-to-GDP ratio exceeds 60%, but the multiplier is nil when it remains lower. Nickel and Tudyka (2014) report that the estimated impact multiplier is 1.2; however, the persistence of the positive effect is eroded as the debt-to-GDP ratio increases, and there are significantly negative output effects in the long run when the ratio exceeds 109%. Koh (2017) shows that the long-run multiplier is still significant and positive at approximately 0.4 when the government debt-to-GDP ratio exceeds 60%, but they also find that it becomes close to zero when it exceeds 90%. Lastly, Huidrom et al. (2020) estimate that the 2-year multiplier is 0.6 when the government debt is below 17% of GDP, while it is insignificant when it is above 92% of GDP. The impulse responses depicted in Figure 3 appear to be consistent with those of Ilzetzki et al. (2013) and Nickel and Tudyka (2014) in that the significantly negative multiplier is pronounced in the high-debt regime, while a significant and positive multiplier is evident in the low-debt regime.

As explained above, the impulse responses in Figure 3 have already been reported in existing literature. However, in our study, we consider the fact that population aging is correlated with the government debt level. To separate these two effects, we divide our sample economies into the two groups, "aged and nonaged," based on the mean of the old-age dependency ratio. Figure 4 plots state-dependent impulse responses depending on the government debt-to-GDP ratio for both the

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Table 1. State-dependent impulse responses of various variables to an unanticipated government spending shock

	Aged economies		Nonaged economies		Aged economies		Nonaged economies	
h	High debt	Low debt	High debt	Low debt	High debt	Low debt	High debt	Low debt
	(a) Output				(b) Consumption			
0	−0.511	0.585	−2.011**	3.065***	−0.233	−0.017	−1.140*	2.064*
	[0.196]	[0.304]	[0.020]	[0.007]	[0.560]	[0.980]	[0.059]	[0.076]
1	−0.957	1.312	−3.051***	4.836***	−0.558	0.503	−2.217**	4.045**
	[0.307]	[0.394]	[0.000]	[0.000]	[0.508]	[0.734]	[0.040]	[0.041]
2	−1.518	2.380	−3.225***	5.051***	−0.899	1.122	−2.955**	5.303**
	[0.261]	[0.332]	[0.001]	[0.000]	[0.457]	[0.629]	[0.031]	[0.039]
3	−1.890	3.180	−3.253***	5.271***	−1.514	2.182	−2.747**	4.819**
	[0.209]	[0.237]	[0.004]	[0.002]	[0.264]	[0.413]	[0.040]	[0.041]
4	−2.170	3.568	−3.473***	5.847***	−1.792	2.698	−3.364**	6.097***
	[0.182]	[0.215]	[0.005]	[0.004]	[0.168]	[0.309]	[0.012]	[0.007]
	(c) Investment				(d) Employment			
0	−0.523	−1.715	−4.265**	5.894**	−0.022	−0.814*	−0.704**	1.123*
	[0.553]	[0.365]	[0.028]	[0.020]	[0.938]	[0.082]	[0.022]	[0.062]
1	−1.729	−0.436	−10.215**	15.570***	−0.044	−1.066	−1.109*	1.682
	[0.428]	[0.917]	[0.012]	[0.005]	[0.957]	[0.372]	[0.076]	[0.162]
2	−4.292	4.726	−9.638**	14.016**	−0.721	0.134	−1.379	2.058
	[0.164]	[0.413]	[0.021]	[0.024]	[0.561]	[0.953]	[0.142]	[0.225]
3	−5.883*	9.182	−8.981**	13.198**	−1.322	1.521	−0.590	0.400
	[0.078]	[0.127]	[0.016]	[0.015]	[0.302]	[0.531]	[0.469]	[0.778]
4	−6.299**	10.094*	−13.640*	20.550**	−2.016	3.156	−0.082	−0.234
	[0.046]	[0.091]	[0.061]	[0.050]	[0.144]	[0.224]	[0.925]	[0.859]
	(e) CCI				(f) BCI			
0	0.182	−0.649	0.040	−0.288	−0.103	0.478	0.343	−0.986
	[0.453]	[0.268]	[0.939]	[0.779]	[0.763]	[0.620]	[0.626]	[0.476]
1	0.138	−0.522	−0.037	0.111	−0.041	0.604	0.287	−0.510
	[0.707]	[0.569]	[0.953]	[0.933]	[0.922]	[0.549]	[0.663]	[0.690]
2	0.126	−0.364	−0.658	1.474	−0.231	0.751	−1.348**	3.201**
	[0.757]	[0.690]	[0.168]	[0.154]	[0.431]	[0.344]	[0.049]	[0.017]
3	−0.031	0.425	−0.840	1.896	0.181	0.183	−1.989**	4.388**
	[0.949]	[0.708]	[0.203]	[0.167]	[0.573]	[0.832]	[0.023]	[0.013]
4	−0.104	1.098	−1.021	2.242	0.245	0.313	0.153	−0.198
	[0.866]	[0.421]	[0.185]	[0.146]	[0.535]	[0.759]	[0.891]	[0.929]

Notes. In panels (a)–(d), the state-dependent impulse responses of macroeconomic variables to an unanticipated government spending shock are reported. In panels (e) and (f), state-dependent impulse responses of CCI and BCI to an unanticipated government spending shock are reported, respectively, as further analysis. The *p*-value is in brackets below the corresponding estimate. *, **, and *** indicate 10%, 5%, and 1% statistical significance, respectively.

aged and nonaged groups. We also report the *p*-values for state-dependent impulse responses in Table 1. First, in the upper panels of Figure 4, for aged economies, fiscal stimulus is found to be ineffective, regardless of the government debt level. That is, the output responses to a government spending shock are not significant. Honda and Miyamoto (2021) and Miyamoto and Yoshino (2022) also find that the output effects of fiscal policy are insignificant in aged economies.

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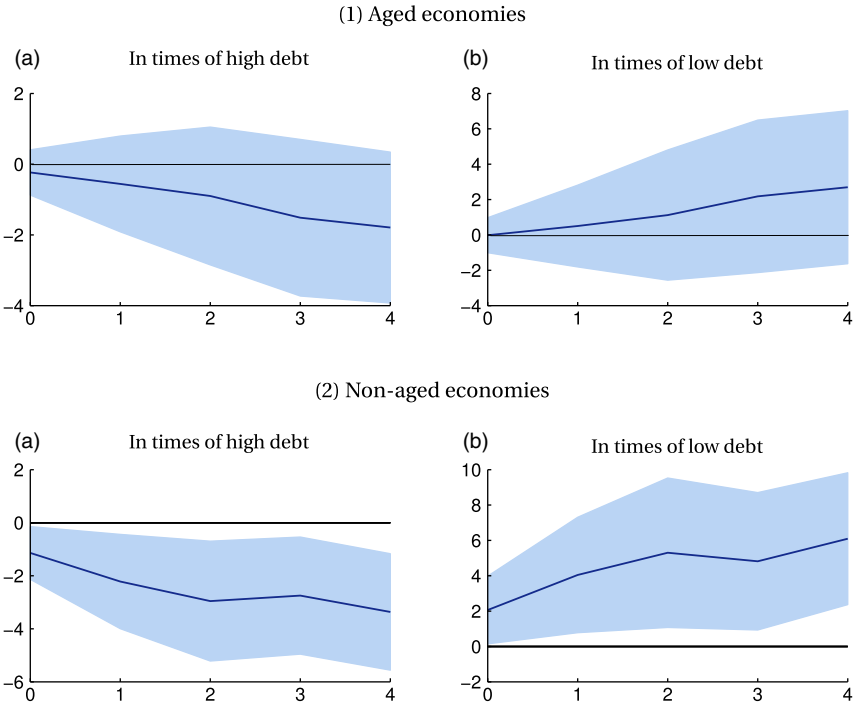

Figure 5. State-dependent impulse responses of private consumption to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

However, distinct from the previous studies, Figure 4 indicates that the effect of population aging on the fiscal multiplier prevails irrespective of the level of government debt.

In contrast, for nonaged economies, the level of government debt may govern the output effect of fiscal policy. The lower panels of Figure 4 show that a positive government spending shock lowers output for nonaged economies with high-debt levels, whereas it increases output for nonaged economies with low-debt levels. The impulse responses are consistent with those of Ilzetzki et al. (2013) and Nickel and Tudyka (2014), in that expansionary fiscal policy is contractionary in countries with high government debt. However, Figure 4 indicates that the contractionary output effect is at work only in nonaged economies. Furthermore, expansionary fiscal policies can stimulate the economy only for nonaged economies with a low government debt level. It is also worth noting that the magnitude of the impulse responses for nonaged economies in Figure 4 is greater than that of our baseline case (i.e., unconditional on population aging) in Figure 3. Specifically, for nonaged economies, the impact multiplier is –2 in the high-debt regime and 3.1 in the low-debt regime (compared to –1.3 in the high-debt regime and 2 in the low-debt regime when population aging is not considered).

The main findings from Figures 3 and 4 suggest that a demographic structure plays a key role in determining the fiscal multiplier, irrespective of the level of government debt.[15] Thus, further investigation of each route, through which population aging and government debt affect the fiscal multiplier, is necessary. Figures 5, 6, and 7 along with Table 1 show the impact of a government spending shock on private consumption, private investment, and employment, respectively. The impulse responses for aged economies in Figures 5 and 6 indicate that consumption and investment do not increase at the initial stage, even in the low-debt regime, which prevents the output effect of fiscal expansion. Similarly, there is also no crowding-out effect in the high-debt regime for nonaged economies in Figures 5 and 6. For aged economies, fiscal surprises cannot influence

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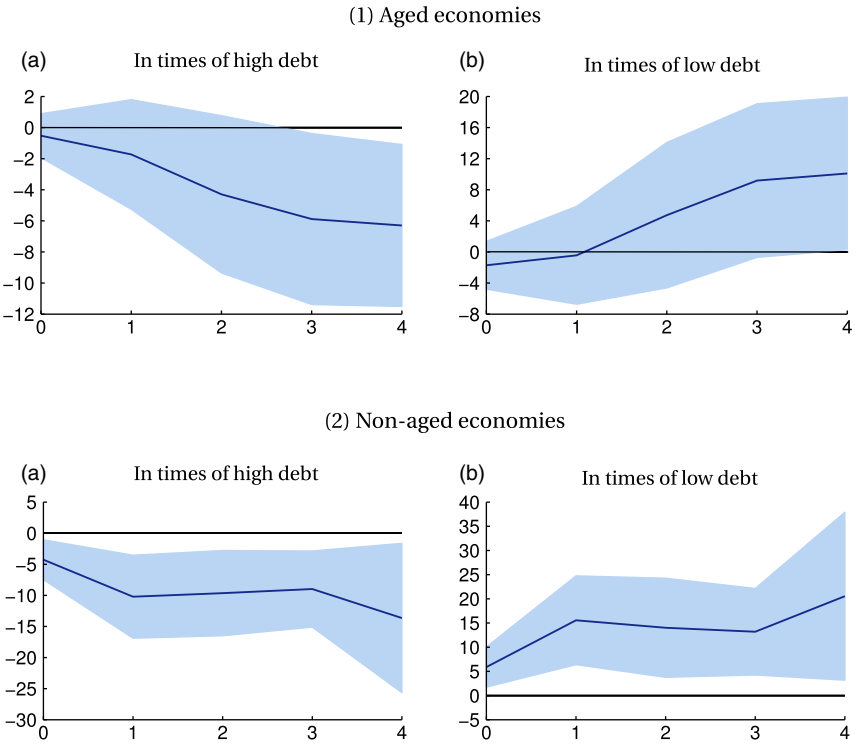

Figure 6. State-dependent impulse responses of investment to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

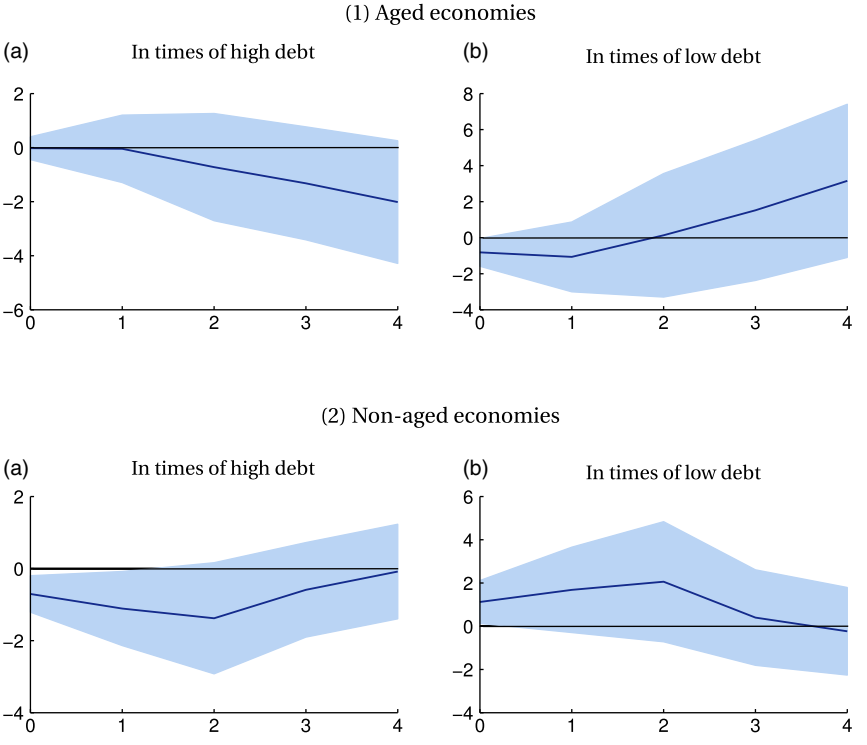

Figure 7. State-dependent impulse responses of employment to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

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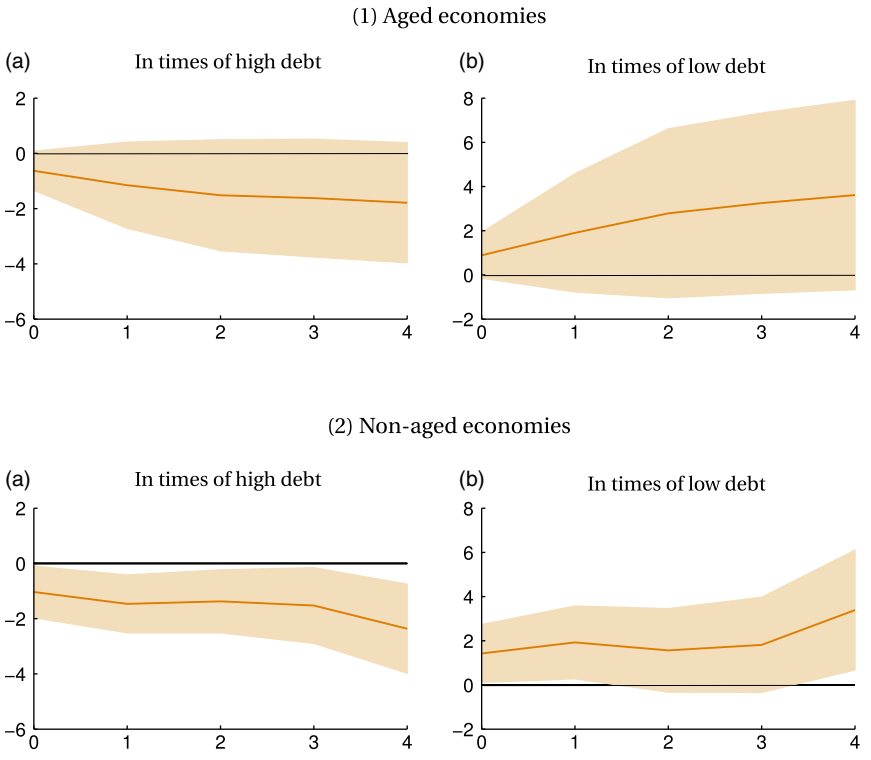

Figure 8. Robustness check. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands. Lagged short-term interest rates and tax revenues are included as additional control variables.

consumption and investment and, therefore, have no effect on output. However, for nonaged economies, as shown in Figures 5 and 6, consumption and investment fall in response to government spending expansion in the high-debt regime, while they significantly rise in the low-debt regime.

As pointed out by Yoshino and Miyamoto (2017), this sharp contrast can be accounted for by the sluggish response of the labor market in an aged economy. They show that fiscal multipliers are smaller in an aged economy since the employment effects of the policy are limited because the larger proportion of retired people in an aged economy. Furthermore, Bachmann and Sims (2012) show that markets' confidence regarding the future economy is the main route for determining fiscal multipliers; furthermore, the results of Rendahl (2016) indicate that an increase in employment would help market participants increase their confidence in the future economy. Therefore, employment may be a key channel for understanding the responses of consumption, investment, and output.[16]

In Figure 7, for aged economies, employment does not fall in response to a fiscal expansion in the high-debt regime and does not rise in the low-debt regime. On the contrary, for nonaged economies, employment shrinks in response to fiscal expansion in the high-debt regime, which leads to a crowding-out of consumption and investment, and in turn, output falls due to this crowding-out effect. However, in the low-debt regime, employment increases significantly in response to expansionary fiscal shocks, which boosts consumption and investment and, in turn, output increases. The responses of employment are consistent with those of consumption, investment, and output.

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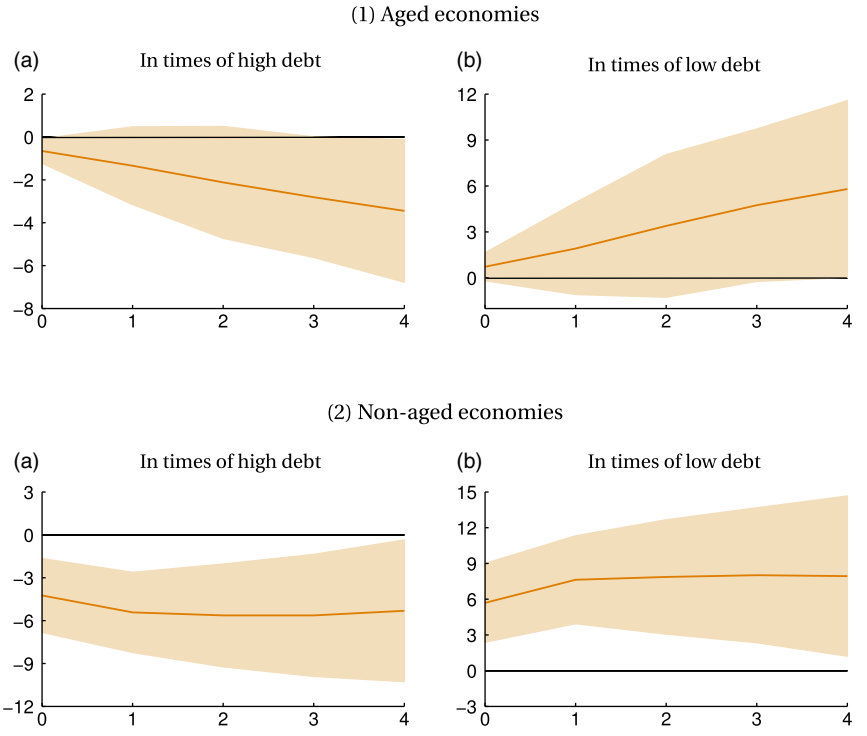

Figure 9. Robustness check. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands. To address the issue associated with consistency in assigning countries in each group, we exclude Japan in aged economies and the Netherlands in nonaged economies since two countries moved from one group to another during our sample period.

4.2. Robustness checks

In this section, we check the robustness of our empirical results for state-dependent local projections.[17] First, we obtain impulse responses with additional control variables such as lagged short-term interest rates and tax revenues. Figure 8 displays impulse responses of output to a government spending shock with additional lagged control variables. For both aged and nonaged economies, the results are quite similar to those from the baseline case, as reported in Figure 4.[18] Figure 9 shows impulse responses for aged and nonaged groups, using data excluding Japan and the Netherlands, respectively. As discussed in Section 3.1, Japan and the Netherlands are considered to be exceptional cases, featuring rapidly growing population aging: while both economies exhibited a relatively young demographic structure in the early stage of the sample period, they were classified as aged economies in the later sample period. Figure 9 confirms that our key findings in Figure 4 remain qualitatively unaltered. That is, the responses of output are broadly insignificant in aged economies; while there are negative effects on output in nonaged and high-debt economies, there are positive effects on output in nonaged and low-debt economies. In addition, it is worth mentioning that the responses of output to a government spending shock in the nonaged group are greater than those in the baseline case of Figure 4.

We also use an alternative government spending shock. That is, a government spending shock is generated using the forecast of government spending in the fall issue of the previous year rather than the same year as in the baseline case. Figure 10 depicts the state-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies with 90% confidence bands. For aged economies, fiscal policy is ineffective regardless of the level of government debt. For nonaged economies, while fiscal policy leads to negative effects on output

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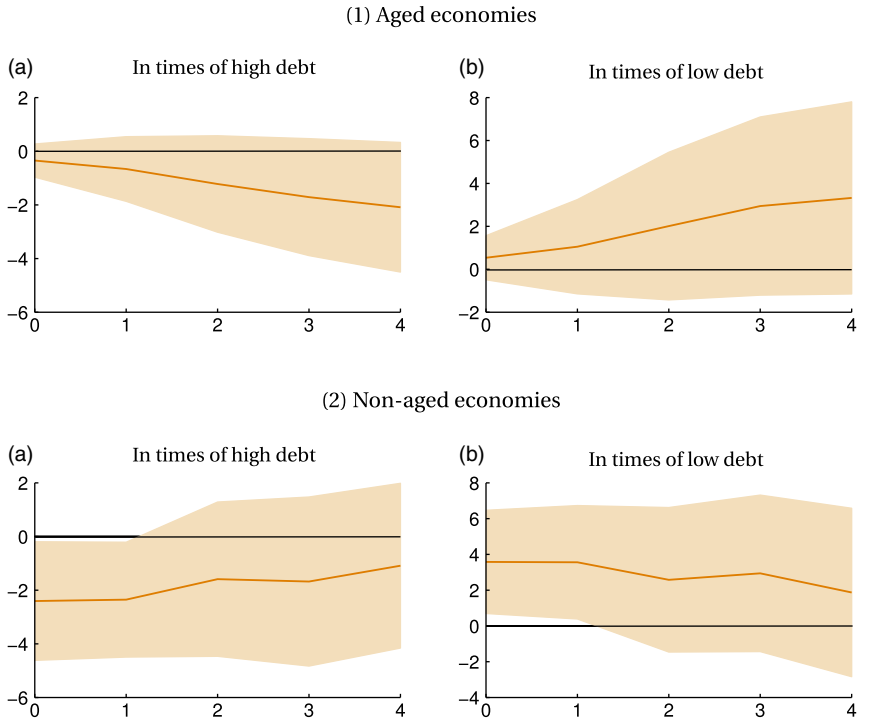

Figure 10. Robustness check. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands. The government spending shock is generated using the forecast of government spending in the fall issue of the previous year.

up to 1 year in times of high debt, its positive effects on output are more pronounced in times of low debt and last for about a year. Thus, the estimated impulse responses exhibit a qualitatively similar pattern for aged and nonaged economies compared with the baseline case, thus confirming our main hypothesis that fiscal multipliers are state contingent.

Furthermore, to mitigate the endogeneity problem caused by unanticipated business cycle conditions, local projections are estimated with additional control variables, such as current and lagged output growth shocks, which are defined as the forecast error of GDP growth. Figure 11 depicts the state-dependent impulse responses of output to an unanticipated government spending shock, including current and lagged output growth shocks as additional control variables, in both aged and nonaged economies with 90% confidence bands. This clearly shows that considering an unanticipated business cycle condition generates qualitatively similar results to the baseline case. That is, in aged economies, fiscal policy is ineffective regardless of the level of government debt. However, in nonaged economies, while fiscal policy leads to negative effects on output in times of high debt, its positive effects are more pronounced in times of low debt.

Since a high old-age dependency ratio implies labor scarcity which could be a driving force behind our results, we have also included the measure for labor market tightness in the estimation. As in Duval et al. (2022), we employ the ratio of open vacancies to the number of unemployed (i.e., the vacancy-to-unemployment ratio) as a measure for labor market tightness. That is, local projections are estimated with additional control variables, including the current and lagged vacancy-to-unemployment ratio, which is obtained from the IFS and OECD database. Figure 12 depicts the state-dependent impulse responses of output to an unanticipated government spending shock, including the current and lagged measure for labor market tightness as additional control variables, in both aged and nonaged economies with 90% confidence bands.

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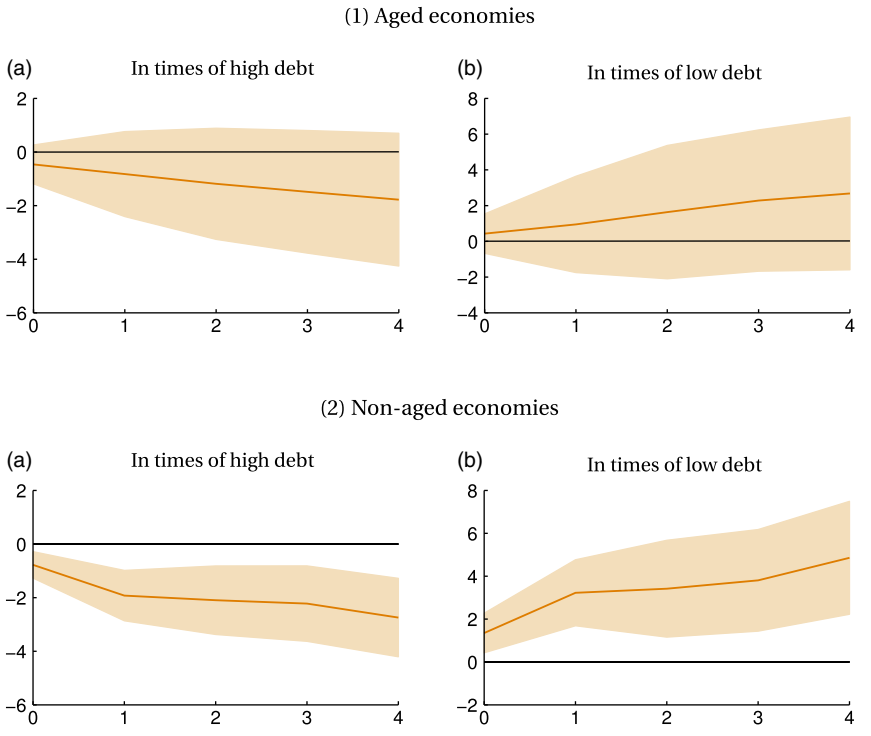

Figure 11. Robustness check. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands. Local projections are estimated with additional control variables such as current and lagged output growth shocks, which are defined as the forecast error of the GDP growth rate, to mitigate the endogeneity problem caused by an unanticipated business cycle condition.

This indicates that considering tightness in the labor market provides qualitatively similar results to the baseline case.

Furthermore, we implement various robustness checks.[19] We use different lags of control variables (1, 3, and 4), such as government spending shocks and real GDP growth, in estimating state-dependent local projections. The results obtained using different lags are similar to our baseline results. We also obtained the results by excluding outliers that could influence our main results. The estimation results confirm that our main results remain qualitatively unaltered. We divide the 24 OECD countries into aged and nonaged economies using the sample median for the old-age dependency ratio. The estimation results obtained using the new grouping of countries remain qualitatively similar. All the results from the robustness checks are similar to the baseline results, as shown in Figure 4.

4.3. Discussion

We discuss the fiscal transmission mechanism of government spending shocks. Figures 13 and 14, combined with Figures 5, 6, and 7, provide supporting evidence for the transmission mechanism as discussed above. Figures 13 and 14 along with Table 1 illustrate the impulse responses of consumer and business confidence, respectively, to the impact of a positive fiscal shock.[20] Generally, consumer confidence is not significantly affected by fiscal shocks. However, Figure 14 indicates that the responses of business confidence are consistent with those of consumption, investment, and output. While the responses of business confidence are insignificant in aged economies, they are positive in nonaged economies with lower government debt and negative

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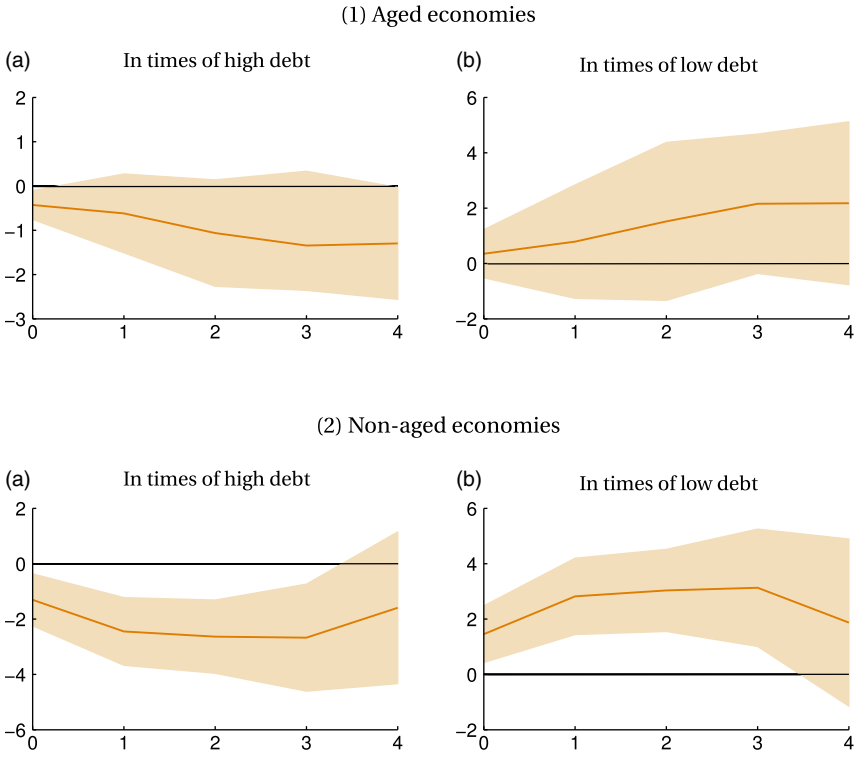

Figure 12. Robustness check. State-dependent impulse responses of output to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands. Local projections are estimated with additional control variables including the current and lagged measure for labor market tightness.

in nonaged economies with higher government debt. Thus, Figure 13 appears to complete the linkage between fiscal policy, employment, and output effects in aged economies: a positive fiscal shock cannot increase employment, which does not enhance business confidence. Stagnated business confidence cannot increase consumption and investment, which results in a lower fiscal multiplier.

The apparent distinction in employment responses between the aged and nonaged groups can be attributed to the fact that the working-age population is relatively small for aged economies, and therefore, the number of people who can be newly employed by the government's additional fiscal expansion is also small. In this respect, it is worth focusing on the discussions of Bachmann and Sims (2012) and Rendahl (2016). Bachmann and Sims (2012) investigate the role of private agents' confidence in the economy in determining the output effects of fiscal policy and reveal that, during an economic downturn, the government's fiscal expansion could have a greater output effect, as it strengthens households' confidence. Rendahl (2016) develops the idea of Bachmann and Sims (2012) by showing that employment is the route through which fiscal expansion increases private confidence and, in turn, output. He argues that the creation of jobs implies a persistent rise in income for private agents, which increases confidence in the future economy and leads to a rise in consumption and investment, resulting in a high fiscal multiplier.

In the context of Bachmann and Sims (2012) and Rendahl (2016), for an aged economy, an increase in government spending does not sufficiently raise employment, which does not enhance the economic agents' confidence in the future economy, thus preventing increases in consumption and investment. Finally, the output effect becomes insignificant. In contrast, for nonaged

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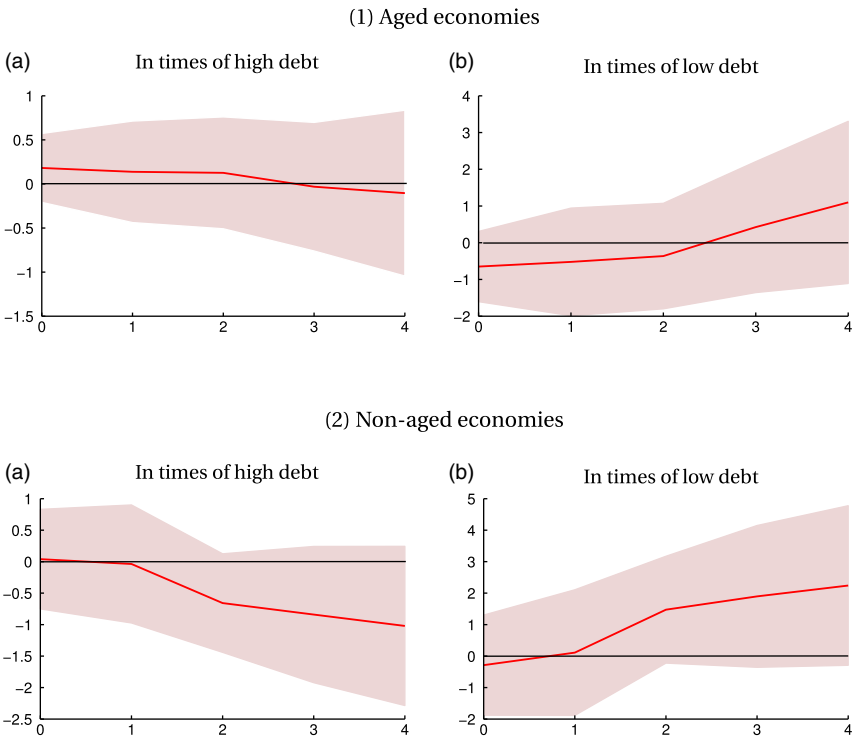

Figure 13. State-dependent impulse responses of consumer confidence to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

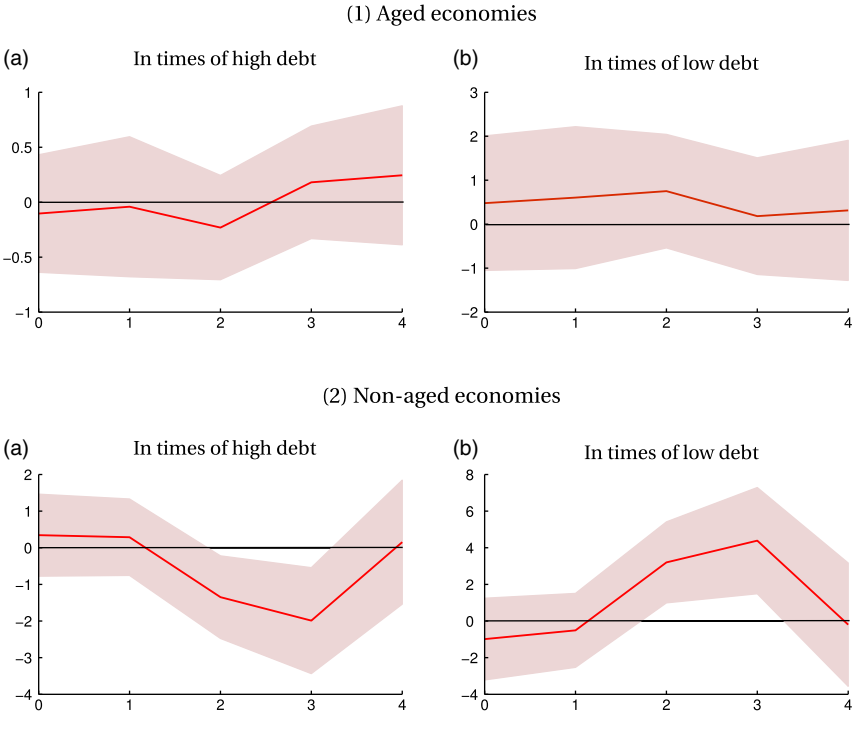

Figure 14. State-dependent impulse responses of business confidence to an unanticipated government spending shock in both aged and nonaged economies, with 90% confidence bands.

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economies, employment can be significantly affected by fiscal shocks and also rises or falls according to consumption and investment levels. For nonaged economies with high-debt levels, private agents decrease consumption and investment based on expectations of tax increases in the near future, and firms reduce employment in response to lower demand. A fall in employment tends to amplify negative output effects through a vicious cycle that raises pessimistic confidence of the private sector in the economy and reduces private demand. Finally, for nonaged economies with low-debt levels, households increase their consumption, and firms hire more workers, which, in turn, strengthens optimistic confidence in the economy, thus amplifying positive output effects.

5. Conclusion

We investigated how government debt affects the output effect of a government spending shock in the era of population aging. Furthermore, considering that government debt and population aging are highly correlated, we disentangle the two effects on fiscal multipliers. The results reveal that both the government debt level and population aging affect fiscal multipliers dramatically. A government spending shock is identified as a forecast error of government spending, and its effect on output is estimated using state-dependent local projections.

Using panel data from 24 OECD economies over the period 1985–2019, we find that, while fiscal policy is ineffective for economies with high-debt levels, it is effective for economies with low-debt levels. Furthermore, we provide evidence that fiscal policy is ineffective for aged economies regardless of the level of government debt. In contrast, for nonaged economies, while fiscal policy leads to negative effects on output in times of high debt, its positive effects on output are found to be more pronounced in times of low debt.

Our results have several policy implications. On the one hand, this implies that a government with an aged demographic structure no longer has a fiscal stimulus policy that functions to stabilize the economy. However, on the other hand, it also implies that fiscal consolidation policies can be implemented without reducing employment and output. Furthermore, our study also suggests some conditions for expansionary fiscal consolidation. That is, for nonaged economies with high government debt levels, a fiscal contraction can be expansionary. Therefore, the results in this study can alleviate major concerns about economic contraction when using fiscal consolidation policies in countries with high government debt levels. The output effects of fiscal retrenchment can be either insignificant in aged economies or rather positive in nonaged economies. Finally, for the effective implementation of fiscal stimulus policies, policy-based stimulation of employment in the labor market is essential.

Notes

1 Gechert (2015) finds that fiscal multipliers tend to vary with study design through a meta-regression analysis.

2 In a related study, Cho and Rhee (2013) analyze the nonlinear effect of government debt on private consumption in 16 OECD countries. They show that a higher level of government debt crowds out more private consumption and that the degree of crowding out effects has deteriorated since the global financial crisis.

3 Monacelli et al. (2010) investigate the effects of fiscal policy on the labor market in the USA and find that an increase in government spending leads to a rise in both output and unemployment multipliers.

4 Corsetti et al. (2012) identify government spending shocks given the assumption that public spending is based on past economic fundamentals, and that the residual is orthogonal to current economic fundamentals. Furthermore, using identified government spending shocks based on the method of Corsetti et al. (2012), Cho and Pyun (2020) show that increasing capital mobility implies that the effects of the savings offset have become smaller in more integrated financial markets.

5 Our study is based on a subsample analysis of aged and nonaged economies. After dividing the countries in our sample into aged and nonaged economies, we employ a state-dependent or regime-switching approach using the debt-to-GDP ratio as a transition variable.

6 As pointed out by Blanchard and Perotti (2002), the government expenditure variable is defined as total purchases of goods and services, that is, government consumption and government investment. In our study, government spending denotes government consumption spending.

7 As suggested by an anonymous reviewer, it would be useful to measure the old-age dependency ratio using the official retirement age of each country instead of assuming it as 65 years old across all the countries. However, the official retirement

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age varies across 24 OECD countries in our sample, and the data on the old-age dependency ratio based on the official retirement age of each country is not available.

8 A group of aged economies includes 15 countries of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Japan, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. A group of nonaged economies includes 9 countries of Australia, Canada, Iceland, Ireland, Luxembourg, the Netherlands, New Zealand, Turkey, and the USA.

9 While the old-age dependency ratio for Japan was only 14.82 in 1985, it notably rose to 47.12 in 2019.

10 As pointed out by an anonymous reviewer, it is difficult to judge whether this difference is significant enough to pose a serious problem given that our sample includes only 24 countries. However, we carefully explain this issue on the ground that if the debt-to-DGP ratio considerably differs across aged and nonaged economies, it would be possible to compare "the aged group with high debt" to "the nonaged group with low debt". To avoid this, we implement a further analysis by excluding one country with an extreme outlier for the debt level in each group.

11 The estimation results with some adjustments for discrepancy are quite similar to those of the baseline case. They are omitted to conserve space but are available on request from the authors.

12 It is worth noting that fiscal multipliers obtained using logs of real GDP in the previous year and fiscal variables tend to be higher than those estimated using scaled variables as in our analysis.

13 The main results remain qualitatively unaltered when γ is set to 1.5, 2, 3, 4, or 5.

14 Using quarterly data for the US, Auerbach and Gorodnichenko (2012) show that fiscal policy is more effective during recessions with the transition variable being a 7-quarter moving average of the real GDP growth rate.

15 To consider a public pension system for aged economies, we investigate whether population aging is more problematic if there is a generous public pension system without taking into account government debt. Interestingly, while fiscal policy leads to negative effects on output in economies with a generous public pension system, its positive effects on output are more pronounced in economies with a less generous public pension system. Thus, the results suggest that population aging is more problematic if there is a generous public pension system. We are grateful to an anonymous reviewer for pointing this out.

16 We further discuss the linkages between markets' confidence regarding the future economy, employment, and the fiscal multiplier in aged and nonaged economies in Section 4.3.

17 As suggested by an anonymous reviewer, we have reported the *p*-values for state-dependent impulse responses in Table A1 of the Appendix.

18 The magnitudes of the cumulative fiscal multipliers in Figure 3 are higher than those in Figure 8 with the inclusion of additional control variables such as lagged short-term interest rates and tax revenues. It appears that it is associated with the correlation between monetary and fiscal policy resolved in the robustness check, including interest rates. While monetary and fiscal policy work in different ways, they tend to interact with each other. Thus, it could be driven by the interaction between them.

19 We estimate the model using the elderly population ratio instead of the old-age dependency ratio for the transition variable. Furthermore, since Japan is the highest ranked country in terms of both government debt and population aging, we estimate the model after excluding Japan to determine whether our main results are driven by Japan. The estimation results remain qualitatively unchanged and are available on request from the authors.

20 Since the data on both consumer confidence and business confidence indices are not available for some of the countries such as Iceland (no data on the consumer confidence index is available for Canada and Norway) in our sample, we estimate the model for those countries that have available data for the period 1985–2019.

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Appendix

Table A1. Robustness checks and further analysis: state-dependent impulse responses to an unanticipated government spending shock

	Aged economies		Nonaged economies		Aged economies		Nonaged economies	
h	High debt	Low debt	High debt	Low debt	High debt	Low debt	High debt	Low debt
	(a) Including additional control variables				(b) Aged group w/o Japan and nonaged group w/o the Netherlands			
0	−0.630	0.889	−1.033*	1.425*	−0.655*	0.726	−4.238***	5.696***
	[0.144]	[0.159]	[0.068]	[0.073]	[0.060]	[0.192]	[0.007]	[0.005]
1	−1.152	1.905	−1.465**	1.925**	−1.339	1.917	−5.424***	7.631***
	[0.226]	[0.244]	[0.021]	[0.050]	[0.226]	[0.298]	[0.002]	[0.001]
2	−1.515	2.788	−1.373**	1.566	−2.118	3.393	−5.635***	7.868***
	[0.216]	[0.232]	[0.047]	[0.174]	[0.183]	[0.233]	[0.010]	[0.007]
3	−1.619	3.250	−1.524*	1.815	−2.809	4.745	−5.634**	8.014**
	[0.213]	[0.191]	[0.067]	[0.167]	[0.101]	[0.117]	[0.030]	[0.020]
4	−1.787	3.616	−2.363**	3.391**	−3.447*	5.800*	−5.312*	7.939*
	[0.177]	[0.166]	[0.005]	[0.039]	[0.088]	[0.098]	[0.078]	[0.052]
	(c) Alternative government spending shock				(d) Including current and lagged output growth shocks			
0	−0.348	0.538	−2.405*	3.581**	−0.464	0.431	−0.776***	1.351**
	[0.361]	[0.397]	[0.073]	[0.041]	[0.297]	[0.531]	[0.010]	[0.016]
1	−0.663	1.052	−2.353*	3.560*	−0.823	0.948	−1.924***	3.227***
	[0.372]	[0.439]	[0.070]	[0.064]	[0.400]	[0.575]	[0.001]	[0.001]
2	−1.221	2.012	−1.590	2.580	−1.187	1.636	−2.096***	3.417**
	[0.267]	[0.342]	[0.369]	[0.297]	[0.352]	[0.480]	[0.007]	[0.013]
3	−1.711	2.946	−1.678	2.941	−1.486	2.282	−2.222***	3.807***
	[0.198]	[0.246]	[0.388]	[0.272]	[0.289]	[0.348]	[0.009]	[0.008]
4	−2.088	3.326	−1.087	1.871	−1.778	2.681	−2.743***	4.858***
	[0.156]	[0.224]	[0.572]	[0.524]	[0.240]	[0.306]	[0.002]	[0.002]
	(e) Including a measure for labor market tightness							
0	−0.428**	0.353	−1.306**	1.455**				
	[0.030]	[0.514]	[0.022]	[0.019]				
1	−0.618	0.791	−2.447***	2.820***				
	[0.256]	[0.536]	[0.001]	[0.001]				
2	−1.062	1.522	−2.635***	3.036***				
	[0.146]	[0.387]	[0.001]	[0.001]				
3	−1.344	2.159	−2.671**	3.131**				
	[0.189]	[0.159]	[0.023]	[0.015]				
4	−1.296*	2.178	−1.593	1.872				
	[0.091]	[0.225]	[0.345]	[0.312]				

Notes. In panels (a)–(e), the state-dependent impulse responses of output to an unanticipated government spending shock are reported as robustness checks. The *p*-value is in brackets below the corresponding estimate. *, **, and *** indicate 10%, 5%, and 1% statistical significance, respectively.

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