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Does Aging Erode Fiscal Multipliers? The Role of Unemployment Insurance

Felix Ward [1]
Florian Peter-Tijs Martend van Genderen [2]
Yao Chen [3]

1 Erasmus University Rotterdam
2 Erasmus University Rotterdam
3 Erasmus University Rotterdam

Does aging erode fiscal multipliers? The role of unemployment insurance*

Yao Chen† Florian van Genderen‡ Felix Ward§

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Abstract

We document that fiscal multipliers in the euro area are largely resilient to population aging, in contrast to evidence from the U.S. The reason is that aging only erodes fiscal multipliers where fiscal shocks pass through strongly to the incomes of younger, credit-constrained households – a transmission that generous unemployment insurance systems in the euro area largely mute. Consistent with this mechanism, euro area regions with low unemployment benefits do exhibit an aging-related erosion of fiscal multipliers, reminiscent of that of the U.S. A New Keynesian model extended to incorporate age heterogeneity captures the empirical relationship between aging and fiscal multipliers across both unemployment insurance regimes.

JEL classification: E32, E62, J11.

Keywords: government spending; demography; unemployment benefits

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†Erasmus School of Economics, Erasmus University Rotterdam; CEPR; Tinbergen Institute; Email: y.chen@ese.eur.nl.

‡Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute; Email: f.p.t.m.vangenderen@ese.eur.nl

§Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute; Email: ward@ese.eur.nl.

1 Introduction

Does demographic aging threaten the effectiveness of fiscal policy? In the U.S., states at the 25th percentile of the young-share distribution have fiscal multipliers only about half the size of those at the 75th percentile (Basso & Rachedi, 2021). This pattern is attributed to the higher marginal propensity to consume of young, credit-constrained households, and the greater cyclicality of their labor income to fiscal shocks. The implication for aging economies worldwide would be a secular decline in the effectiveness of fiscal policy.

We revisit this question using euro area data and document a contrasting result: fiscal multipliers in the euro area are resilient to population aging. We trace this resilience to a key institutional difference: the generosity of unemployment benefits. Generous unemployment insurance weakens the pass-through of fiscal shocks to the disposable income of young, credit-constrained households, thereby dampening the demand channel through which aging erodes the multiplier in the U.S. This mechanism can quantitatively account for a large part of the difference between the euro area and the U.S. evidence. In fact, euro area regions in countries with comparatively low replacement rates exhibit the same aging-related erosion of fiscal multipliers documented there.

To establish these results, we build a regional panel covering 166 NUTS-2 regions across 12 euro area countries over the period 1999–2019, and estimate instrumental variable local projections (IV-LP). We exploit a Bartik-style shift-share instrument that combines shifts in national government spending with predetermined regional exposure shares (Gabriel et al., 2023, 2026), isolating variation in regional government spending that is plausibly exogenous to local economic conditions. Identification rests on the exogeneity of the regional exposure shares (Goldsmith-Pinkham et al., 2020). Interacting this instrument with regional indicators of aging and unemployment insurance generosity indicates that fiscal multipliers are resilient to aging in the euro area as a whole, but that this resilience may not extend to regions with comparatively low unemployment benefits, which instead show an aging-related decline of the fiscal multiplier reminiscent of the U.S.

We complement the empirical analysis with a New Keynesian model extended to incorporate age heterogeneity, showing that the framework can quantitatively reproduce our empirical findings across both unemployment insurance regimes. In the model, younger households are hand-to-

mouth and more often employed on flexible contracts, so their consumption responds more strongly to aggregate activity. Aging erodes the fiscal multiplier by shifting the population toward older households with a lower consumption response to government spending. Unemployment benefits weaken this mechanism by insulating younger workers' disposable income, narrowing the gap in demand responses across age groups. Calibrated to U.S. unemployment insurance, the model generates a sizable aging-related erosion of the fiscal multiplier, consistent with the U.S. evidence. Calibrated instead to euro area unemployment insurance, the link becomes negligible – consistent with our empirical results.

Our paper contributes to a literature that explores how demographic aging affects the business cycle and the effectiveness of economic policies. On the fiscal side, Honda and Miyamoto (2021), Miyamoto and Yoshino (2022), and Kopecky (2022) study different OECD panels at the country level, while Basso and Rachedi (2021) and Morita (2022) exploit regional data for U.S. states and Japanese prefectures, respectively. All of these studies find that aging dampens the fiscal multiplier. We provide the first subnational evidence for the euro area, where we can exploit extensive cross-sectional variation, and reach a different conclusion: fiscal multipliers are resilient to aging. Our findings underscore that the erosion documented elsewhere is predicated on the presence of young households whose income is imperfectly insured against unemployment risk. On the monetary side, aging has been shown to affect policy transmission through the reactivity of middle-aged entrepreneurship (Leahy & Thapar, 2022), life-cycle wealth effects (Berg et al., 2021), and a flattening of the Phillips curve (Ambrocio, 2026; Curtis et al., 2026; Mangiante, 2024). We contribute to this strand of the literature more broadly by showing that labor market institutions can be key for understanding how aging interacts with economic policy effectiveness.

Our paper also contributes to the literature that assesses the magnitude of fiscal multipliers, surveyed in Ramey (2019). A central finding of this literature is that multiplier size differs widely across economic contexts – e.g., multipliers are larger during recessions and at the zero lower bound (Auerbach & Gorodnichenko, 2012; Christiano et al., 2011), under fixed exchange rates (Ilzetzki et al., 2013), and when downward nominal wage rigidity binds (Jo & Zubairy, 2025). In the context of this literature, Basso and Rachedi (2021) have established age structure as an important determinant of the fiscal multiplier. While our findings confirm that aging can exert a

powerful influence on multiplier size, we emphasize that the effect of aging on fiscal multipliers is contingent on the generosity of unemployment insurance systems.

Our results also relate to a recent literature showing that household heterogeneity amplifies aggregate demand shocks only insofar as the income of households with high marginal propensity to consume (MPC) co-moves more strongly with aggregate activity (Bilbiie, 2020; Patterson, 2023), and that taxes and transfers can largely remove this co-movement (Bilbiie et al., 2025). We complement this work with regional evidence: differences in the age structure and in labor market institutions, which govern how strongly high-MPC households' incomes move with activity, translate into systematic differences in fiscal multipliers. Unemployment insurance is a prominent example of such a transfer, and our results also connect to work on its role as an automatic stabilizer (Di Maggio & Kermani, 2016; Kekre, 2023; McKay & Reis, 2021). That literature shows how benefits stabilize aggregate demand directly. We show that they also shape how the age structure of the economy conditions the transmission of discretionary fiscal policy.

The paper is structured as follows: Section 2 describes the dataset, Section 3 introduces the econometric methodology, and Section 4 presents the empirical results. Section 5 describes a New Keynesian model augmented with an age structure that corroborates the central role of unemployment insurance in determining how aging affects the fiscal multiplier. Section 6 concludes.

2 Data

We construct an annual dataset covering output, age structure, unemployment insurance, and government spending for 166 subnational regions across 12 euro area countries from 1999 to 2019. The countries are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.[1] Our analysis focuses on NUTS-2 regions, which correspond to medium-sized administrative units with populations typically between 800,000 and 3 million.[2]

[1] Greece enters the sample only in 2001, when it joined the euro area. Data coverage for some sub-national regions is incomplete owing to missing demographic data (Appendix A).

[2] Although data are available at the NUTS-1 to NUTS-3 levels, we focus on NUTS-2 regions because they provide greater cross-sectional variation than NUTS-1 regions. Importantly, NUTS-2 regions are less likely to influence national fiscal spending than the larger NUTS-1 regions, which is critical for our identification strategy. Compared to NUTS-3 regions, the main advantage of NUTS-2 regions is their more extensive data coverage.

Output and government spending: We use per capita gross value added (GVA) at constant prices from the European Commission's ARDECO database as our primary indicator of regional output (European Commission, Joint Research Centre, 2024). The findings are robust to using alternative measures of output, including real GDP per capita and real private-sector GVA per capita (Appendix B.2).[3]

Data on the government's final consumption expenditure are generally not available at the regional level, but can be proxied as the sum of regional non-market GVA and government consumption of intermediate goods.[4] More concretely, we calculate government consumption in region i at time t as $G_{i,t} = (1 + \xi_i)GVA_{i,t}^{non-market}$, where we use the regional non-market GVA series from ARDECO and the intermediate consumption shares ξ that Gabriel et al. (2023) derive from the PBL EUREGIO input–output tables (Thissen et al., 2018). This approach is consistent with the national accounts definition of government spending, and is validated by the high correlation between the regional proxies summed to the national level and official national government spending (Appendix A.2). The instrumental variable strategy in Section 3 also addresses classical measurement error in this proxy.

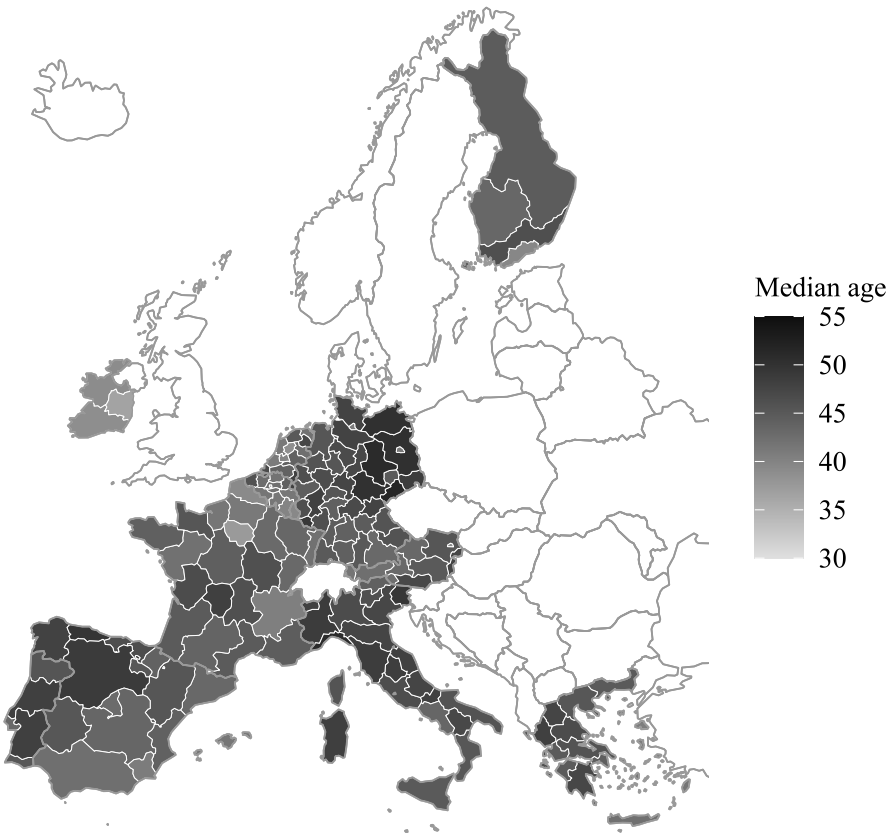
Demographic data: Demographic data at the subnational level are provided by Eurostat in five-year age brackets (0–4, 5–9, . . . , 80–84, and 85+) (Eurostat, 2025b) and by ARDECO for total regional population (European Commission, Joint Research Centre, 2024). Longitudinal variation at the region-level is characterized by an average median age increase of 6 years between 1999 and 2019 (Eurostat, 2025c). Cross-sectionally, median age ranges from 36 years in the Brussels-Capital region in Belgium to 51 years in Liguria in Italy.[5] Figure 1 illustrates this cross-sectional variation in population aging for 2019. Following Basso and Rachedi (2021), we define the young as those aged 20 to 29, and measure a region's young share as their fraction

[3]One concern with using total GVA as the regional output measure is that government spending at the regional level largely reflects public-sector wage payments, which predominantly accrue to prime-age workers. The GVA data therefore reflect the direct influence of government spending changes on the labor income of this age group. To analyze whether the results are driven by this public sector wage mechanism, we replicate the analysis using only private-sector GVA (Table B.6 in Appendix B.2). The results are robust, indicating that the results are not driven solely by the direct influence of government spending on public sector wages.

[4]Non-market GVA consists of compensation of government employees including social contributions, consumption of fixed capital, and taxes less subsidies on production. The government's intermediate consumption consists of all spending on goods and services purchased by the government for the purpose of providing public services.

[5]This min-max range is based on all continental European regions plus Ireland depicted in Figure 1. It excludes young overseas regions, such as French Guiana, La Réunion or Mayotte.

Figure 1: Median age in the euro area in 2019



Notes: The map shows median age at the regional level in 2019. For illustrative purposes the map excludes overseas regions.

of the population aged 20 and older.[6]

Unemployment insurance: We use the OECD's *unemployment replacement rate*, i.e., the fraction of income that is recovered through unemployment benefits in case of job loss, as an indicator of the generosity of the unemployment insurance system. Replacement rates are available only at the country level and differ by unemployment duration and household composition. To summarize the generosity of unemployment insurance in a single indicator, we take the unweighted average of the OECD net replacement rates for single-person households across all available earnings levels and unemployment durations of up to 12 months (OECD, 2025). This choice is motivated by around 60% of the unemployed in our sample having been unemployed for less than a year (Eurostat, 2025a, 2025d), and our primary interest being the

[6]Appendix B.2 presents similar results for different age brackets as well as the old-age dependency ratio.

short-term stabilization of disposable incomes, rather than the level of long-term income support for unemployed households.[7] The resulting unemployment replacement rate series has an average of 66% (median 67%). It exhibits little time variation, but cross-sectionally it ranges from 45% in Italy to 87% in Luxembourg.

3 Econometric methodology

We examine how population aging shapes the fiscal multiplier by estimating impulse response functions (IRFs) using local projections (Jordà, 2005). Our specification allows the real output effect of government spending $G_{i,t}$ to vary with demographic structure $D_{i,t}$:

$$\sum_{m=0}^{h} \frac{Y_{i,t+m} - Y_{i,t-1}}{Y_{i,t-1}} = \beta_h \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h (D_{i,t-1} - \overline{D}) \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} \tag{1}$$
$$+ \nu_h(L) X_{i,t} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h}.$$

$(Y_{i,t+m} - Y_{i,t-1})/Y_{i,t-1}$ equals the cumulative growth rate in real per capita GVA in region i between time period $t+m$ and $t-1$. $(G_{i,t+m} - G_{i,t-1})/Y_{i,t-1}$ denotes the difference between real per capita regional government spending in time $t+m$ and $t-1$, normalized by per capita GVA in period $t-1$. β_h denotes the fiscal GVA-multiplier at horizon h. Demographic structure is indicated by the percentage of 20 to 29 year-olds in the population aged 20 and above $D_{i,t-1}$, where we use the lagged value to sidestep potential endogenous changes in demographic structure due to migration responding to fiscal policy.[8] We demean $D_{i,t-1}$ by its sample average across regions and time, $\overline{D} = \sum_i \sum_t (D_{i,t}/n_i n_t)$, where n_i denotes the number of regions and n_t number of years. Thus, β_h represents the fiscal multiplier for a region with the average demographic structure in our sample. To assess how aging influences the fiscal multiplier, we interact government spending with our measure of demographic structure, $(D_{i,t-1} - \overline{D}) \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}}$. The coefficient of interest is γ_h, which captures how the cumulative multiplier differs with a one-percentage-point higher share of young people. A positive γ_h thus indicates that aging lowers the multiplier.

[7] Appendix A.3 shows that results are robust when using replacement rates averaged over longer unemployment durations.

[8] Migration may already adjust in anticipation of future fiscal policy changes, potentially affecting even the lagged demographic structure. To address this concern, we instrument the demographic variable with its two-, five-, and ten-year lags. The results remain robust under this approach, suggesting that the findings are not driven by anticipatory migration responses to fiscal policy (Table B.6 in Appendix B.2).

The vector $\nu_h(L)X_{i,t}$ includes additional controls – specifically, one lag of real per capita GVA growth, real per capita government spending growth, and the demographic variable D. Region and time fixed effects, $\alpha_{i,h}$ and $\delta_{t,h}$, absorb time-invariant regional heterogeneity and common temporal variation.[9] Because the time fixed effects absorb all common shocks, including the ECB's monetary policy, β_h is a relative multiplier: it measures the output response of a region to an increase in its own government spending, relative to other regions.[10]

Causal identification: Estimating equation (1) by OLS yields biased estimates due to a range of endogeneity concerns – most notably that government spending may be directed toward regions experiencing adverse economic conditions, but also measurement error in the constructed regional government spending proxy. Therefore, we adopt an instrumental variable strategy and estimate instrumental variable local projections (IV-LP). Following Nekarda and Ramey (2011), Dupor and Guerrero (2017), and Gabriel et al. (2023), we construct a Bartik-type instrument (Bartik, 1991) that interacts government spending changes at the national level with predetermined regional exposure shares. This approach isolates variation in regional government spending that is plausibly exogenous to local economic conditions, with identification resting on the exogeneity of the exposure shares (Goldsmith-Pinkham et al., 2020).[11]

We construct two instruments: $Z_{i,t}$ for cumulative changes in regional government spending and $ZD_{i,t}$ for its interaction with aging:

$$
\begin{aligned}
Z_{i,t} &= s_i \times \frac{G_{I,t} - G_{I,t-1}}{Y_{I,t-1}}, \\
ZD_{i,t} &= (D_{i,t-1} - \overline{D}) \times s_i \times \frac{G_{I,t} - G_{I,t-1}}{Y_{I,t-1}},
\end{aligned} \tag{2}
$$

where $G_{I,t}$ and $Y_{I,t}$ denote country I's per capita government spending and real output at the national level. The term s_i measures region i's exposure to national spending shocks. To ensure the exposure shares are not contaminated by contemporaneous local economic conditions,

[9] A more parsimonious specification including only region and time fixed effects yields similar results (Table B.7 in Appendix B.2). We compute Driscoll and Kraay (1998) standard errors to account for cross-sectional dependence, heteroskedasticity, and serial correlation.

[10] Relative multipliers difference out responses common to all regions, such as monetary policy and union-wide financing, and therefore differ conceptually from aggregate multipliers, which depend on these responses (Chodorow-Reich, 2019; Nakamura & Steinsson, 2014).

[11] An alternative route relies on many quasi-randomly assigned shocks (Borusyak et al., 2022); with country-level shifts, we place the identifying weight on the shares.

we follow Gabriel et al. (2023) and compute them as predetermined constants: $s_i = \bar{G}_i/\bar{G}_I$, where $\bar{G}_i$ and $\bar{G}_I$ denote average per capita government spending in region i and country I, respectively, computed over the five years preceding euro area entry.[12] Appendix B.2 shows that our baseline results are robust to controlling for a range of regional characteristics that could plausibly confound identification.

National spending should further be unresponsive to conditions in the regions most exposed to it. To test this, we follow Gabriel et al. (2023) and regress changes in national government spending on regional business-cycle indicators interacted with exposure shares (Appendix B.1.3). We find no statistically significant relationship, indicating that national spending does not systematically respond to regional economic conditions of highly exposed regions (Table B.3, column 1). The same holds for the triple interaction of regional business-cycle indicator, exposure shares, and age structure, which assuages concerns that regional demographic composition might affect fiscal policy at the national level (Table B.3, column 2).

Regarding instrument relevance, panel A of Table B.2 reports weak-instrument diagnostics for specification (1). The Kleibergen–Paap F-statistic ranges from 61 on impact to 12 at the four-year horizon. The test of Lewis and Mertens (2025) for multiple endogenous regressors likewise rejects weak instruments at all horizons.

4 Findings

4.1 Aging and the fiscal multiplier in the euro area

How does aging affect the fiscal multiplier in the euro area? Table 1 reports the IV-LP estimates. The relative fiscal multiplier equals 1.7 on impact and settles around 1.9 at longer horizons.[13] The interaction with the share of young people is quantitatively moderate – a 1 ppt increase in the share of young people *lowers* the short-horizon multiplier by 0.04 – and statistically insignificant

[12] The choice of the predetermined window is not critical, as exposure shares display limited time variation. The average within-region standard deviation of $G_{i,t}/G_{I,t}$ is 0.03, whereas the average cross-sectional standard deviation is 0.24 (Appendix B.1.1, Table B.1). Results are also robust to using sample-average spending shares (Table B.6 in Appendix B.2).

[13] These estimates are consistent with the existing literature on regional fiscal multipliers. Coelho (2019) reports an impact multiplier of approximately 1.8 using European Commission structural funds, while Gabriel et al. (2023), employing a closely related specification over a shorter sample (1999–2017), find multipliers between 2.1 and 2.2. These estimates are somewhat larger than regional multipliers in the U.S. (Nakamura & Steinsson, 2014).

at all horizons. Aging does not appear to erode the fiscal multiplier in the euro area. This null result holds across alternative measures of output and aging, alternative constructions of the instrument, additional controls, and sample composition (Appendix B.2).[14]

Table 1: The effect of aging on the fiscal multiplier

	Impact	1 Year	2 Years	3 Years	4 Years
$\sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	1.661‡	1.902‡	1.920‡	1.968‡	1.868‡
	(0.273)	(0.263)	(0.222)	(0.170)	(0.185)
$(D_{i,t-1} - \overline{D}) \sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	-0.039	-0.040	-0.014	0.009	0.036
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Observations	3061	2895	2729	2563	2397
Adj. R^2	0.414	0.520	0.599	0.669	0.741

Notes: The table reports the estimates of local projection panel regressions (1) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the cumulative change in real GVA per capita. The reported independent variables are the cumulative change in real per capita government spending as a fraction of real per capita GVA and its interaction with the demeaned aging indicator D. Regional level government spending is instrumented with the government spending Bartik as defined in equation (2). The specification includes both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

Why are fiscal multipliers in the euro area resilient to aging? This question is particularly pertinent, against the backdrop of evidence for the U.S., where aging appears to considerably weaken the fiscal multiplier (Basso & Rachedi, 2021). The U.S. results point toward young, credit-constrained households' having more cyclical labor income and cutting back on consumption spending in response to fiscal policy shocks – the young thus amplify the initial fiscal shock. As a consequence, in regions where the population share of young cohorts dwindles, so do fiscal multipliers. Relatively generous unemployment benefits in the euro area suggest that this mechanism is muted there, because young households' (disposable) incomes are better insulated against fiscal shocks.

[14]On measurement, results hold using GDP or private-sector GVA. On identification, results are unchanged when exposure shares are computed as sample averages rather than predetermined constants. The results also hold when we instrument the aging interaction with the two-, five- or ten-year lag of the aging indicator. Results survive controlling for regional income, unemployment, public-sector age composition, service-sector share, and savings rate, each entered separately and interacted with government spending. Finally, estimates are stable across balanced-panel and island-exclusion samples and in leave-one-country-out estimation, with the interaction being insignificant in nearly all specifications.

4.2 The role of unemployment insurance

To analyze the extent to which the unemployment insurance system moderates the effect of aging on fiscal multipliers, we interact the government spending term with both the demeaned young share and the demeaned one period lag of the unemployment replacement rate, $(I_{i,t-1} - \overline{I})$. The resulting specification extends our baseline with a triple interaction term:

$$\begin{aligned}\sum_{m=0}^{h} \frac{Y_{i,t+m} - Y_{i,t-1}}{Y_{i,t-1}} = \beta_h^1 \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \beta_h^2 (D_{i,t-1} - \overline{D}) \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} \\ + \beta_h^3 (I_{i,t-1} - \overline{I})(D_{i,t-1} - \overline{D}) \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} \\ + \tilde{\nu}_h(L)\tilde{X}_{i,t} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h}.\end{aligned} \tag{3}$$

The extended control vector $\tilde{\nu}_h(L)\tilde{X}_{i,t}$ now additionally includes the replacement rate, $(I_{i,t-1} - \overline{I})$, its interaction with the change in government spending, $(I_{i,t-1} - \overline{I}) \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}}$, and its interaction with demographics, $(I_{i,t-1} - \overline{I})(D_{i,t-1} - \overline{D})$. These terms absorb, respectively, the direct effect of unemployment insurance on economic performance, its effect on the fiscal multiplier irrespective of aging, and any effect of the interaction between demographics and unemployment insurance on economic performance. All other variables are defined as above. The coefficients $\{\beta_h^2\}_{h=0}^4$ capture the effect of aging on the fiscal multiplier at the euro area mean replacement rate, and $\{\beta_h^3\}_{h=0}^4$ capture how this effect varies with the generosity of unemployment insurance. Measured in $t-1$, the replacement rate is predetermined with respect to the period-t spending shock.[15]

Table 2 suggests that the generosity of unemployment insurance shapes whether aging erodes the fiscal multiplier (fourth row). At the euro area mean replacement rate, aging has only a small effect on the fiscal multiplier (second row), consistent with our baseline finding. As unemployment benefits become less generous, however, the aging effect strengthens: each percentage point reduction in the replacement rate deepens the multiplier erosion from a 1 ppt decline in the young share by about 0.01 (fourth row). This is consistent with the proposed mechanism, in which unemployment benefits matter for the multiplier because they compress the

[15]Moreover, replacement rates are set by legislation and change only through infrequent reforms, whereas government spending shocks occur at an annual frequency. The generosity of unemployment insurance can therefore be treated as an institutional feature of the labor market that is predetermined.

Table 2: Aging, the fiscal multiplier, and the role of unemployment insurance

	Impact	1 Year	2 Years	3 Years	4 Years
$\sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	1.757‡	1.992‡	1.989‡	2.025‡	1.910‡
	(0.243)	(0.224)	(0.187)	(0.170)	(0.167)
$(D_{i,t-1} - \overline{D}) \times \sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	-0.057	-0.065	-0.055	-0.045	-0.022
	(0.034)	(0.038)	(0.039)	(0.041)	(0.037)
$(I_{i,t-1} - \overline{I}) \times \sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	0.009	0.001	0.001	-0.009	-0.014
	(0.014)	(0.012)	(0.012)	(0.011)	(0.013)
$(I_{i,t-1} - \overline{I})(D_{i,t-1} - \overline{D}) \times \sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	-0.004	-0.007†	-0.008‡	-0.008†	-0.009†
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Observations	2904	2738	2572	2406	2240
Adj. R^2	0.436	0.544	0.625	0.690	0.757

Notes: The table reports the estimates of local projection panel regressions (3) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the cumulative change in real GVA per capita. The reported independent variables are the cumulative change in real per capita government spending as a fraction of real per capita GVA, its interactions with the demeaned aging indicator D and with the demeaned unemployment replacement rate I, and their triple interaction. Regional level government spending is instrumented with the government spending Bartik as defined in equation (2). The specification includes both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

gap in disposable income responses between young and old households. Because the replacement rate varies mainly across countries, the triple interaction is less precisely identified than the baseline, and we read its magnitude as indicative.[16] Section 5 provides independent quantitative support: estimated on model-simulated data, the same specification yields a moderation of the aging effect of similar magnitude.

Comparison with the U.S. The economic significance of this estimate emerges when we take it to the U.S. There, fiscal multipliers decline by 19 percent of their level per 1 ppt decline in the young share (Basso & Rachedi, 2021),[17] whereas in the euro area the effect is small and statistically insignificant (Table 1). How much of this gap can differences in unemployment insurance account for? The U.S. net replacement rate lies 33.5 ppt below the euro area mean, i.e. $(I_{i,t-1} - \bar{I}) = -33.5$ in our estimation setting. At this level of benefit generosity, the estimates in the "1 Year" column of Table 2, which cumulate output and spending over two years and thus match the two-year horizon of Basso and Rachedi (2021), imply that a 1 ppt decline in the young share lowers the fiscal multiplier by $33.5 \times 0.007 = 0.235$ more than at the euro area mean, or 12 percent of the baseline multiplier of 1.99. Differences in benefit generosity thus account for about 60 percent of the gap between the U.S. and the euro area evidence, an estimate obtained purely from euro area data.[18] The flip side is the euro area itself: given relatively generous unemployment benefits, young households appear not to amplify fiscal impulses to begin with, and there is accordingly little amplification for aging to erode.

In sum, the evidence suggests that unemployment insurance shapes how aging affects the fiscal multiplier: by insulating young households' disposable incomes from fiscal shocks, generous benefits dampen the consumption amplification channel through which aging operates. The next section subjects this interpretation to an independent validation check: a calibrated model with population aging should generate a quantitatively similar sensitivity of the fiscal

[16] In this specification the Kleibergen–Paap F-statistic is low and the robust test of Lewis and Mertens (2025) does not reject weak instruments (Panel B of Table B.2). The replacement rate varies mainly across countries and little over time, so the instruments interacted with it add limited independent variation, and conventional standard errors may overstate the precision of the triple interaction.

[17] Basso and Rachedi (2021), Table 1, column 1: $\gamma/\beta = 0.047/1.511$, i.e., a 3.1 percent increase in the multiplier per 1 percent increase in the young share. Because the young share enters in logs, a 1 ppt increase from their mean young share of 16 percent is a $1/0.16 = 6.25$ percent increase, hence $3.1 \times 6.25 = 19.4$ percent per ppt.

[18] The U.S. replacement rate lies below the lowest value in our sample (45 percent in Italy), so this calculation extrapolates the linear interaction beyond the range of the data. Given the weak instruments in this specification (footnote 16), we read it as indicative.

multiplier to aging. We show that it does, corroborating unemployment insurance as the key source of the gap between the U.S. and euro area evidence.

5 Model-based analysis of aging and the fiscal multiplier

This section introduces a New Keynesian model with modifications for the population's age structure. We use the model to first analyze the effect of aging on the fiscal multiplier, and then to examine the role of unemployment insurance in moderating this effect. In line with the unit of observation underlying our empirical analysis, the model depicts a small open economy within a monetary union. The union has two regions, Home and Foreign, where the Home region is assumed to be small relative to the rest of the union, so that Home-specific shocks have a negligible effect on union-wide aggregates and foreign variables are exogenous from Home's perspective. As in the data, the model multiplier is a relative regional multiplier. Demographic structure enters the model along two margins. Young households are hand-to-mouth, while older households save and borrow to smooth consumption. Young workers are also disproportionately employed under temporary contracts, whose hours and wages adjust freely, while older workers hold mostly rigid, permanent contracts.[19]

In what follows we outline the Home economy. Subscripts H and F index goods produced at Home and abroad, and an asterisk denotes variables of the Foreign economy. Variables without a time subscript denote steady-state values, and hatted variables denote log-deviations from steady state.

5.1 Model

Production and price setting. Time is discrete, $t = 0, 1, 2, \ldots$. A perfectly competitive composite-good producer aggregates intermediate outputs from two sectors: a flexible sector (T) that employs workers under *temporary* contracts, with hours and wages fully flexible; a rigid sector (P) that employs workers under *permanent* contracts, with both hours and wages sticky.

[19]The labor-market segmentation feature is motivated by high employment protection legislation in the euro area, which concentrates flexibility among labor-market entrants, who are predominantly young. This segmentation is not required for the qualitative result, which already follows from the hand-to-mouth channel alone, but is necessary for a young-share gradient of empirically relevant magnitude. Basso and Rachedi (2021) obtain similar amplification through labor demand: their production function features capital-experience complementarity, tying demand for experienced labor to the capital stock.

The production function is

$$Y_t = (Y_t^T)^{\eta}(Y_t^P)^{1-\eta}, \qquad \eta \in (0,1). \tag{4}$$

In each sector $s \in \{T, P\}$, a continuum of firms indexed by $i \in [0,1]$ produces $Y_t^s(i) = A_t^s N_t^s(i)$ under Dixit–Stiglitz (Dixit & Stiglitz, 1977) monopolistic competition and Calvo price stickiness (Calvo, 1983) with common parameter θ_p. Firms discount future profits at $Q_{t,t+k} = \beta^k$.[20] Standard derivations yield a sectoral (log-linearized) New Keynesian Phillips curve in marginal-cost form,

$$\hat{\pi}_{H,t}^s = \beta\, \mathbb{E}_t \hat{\pi}_{H,t+1}^s + \Gamma\, \widehat{mc}_t^s, \qquad \Gamma = \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p}, \qquad s \in \{T, P\}. \tag{5}$$

$\pi_H^s \equiv P_{H,t}^s / P_{H,t-1}^s$ is the inflation rate of Home-produced goods price $P_{H,t}^s$ in sector s.

Households. The Home population is divided into four representative types indexed by age $a \in \{o, y\}$ and contract type $s \in \{T, P\}$, with population shares $\mu^{o,T} = \mu^o(1-\lambda^o)$, $\mu^{o,P} = \mu^o\lambda^o$, $\mu^{y,T} = \mu^y(1-\lambda^y)$, $\mu^{y,P} = \mu^y\lambda^y$. $\mu^o \in (0,1)$ is the share of old households and λ^a the permanent-contract share within age group a. A larger fraction of older workers is employed in the permanent-contract sector as compared to the share in younger workers: $\lambda^o > \lambda^y$. Old households (o,T) and (o,P) trade a union-wide risk-free bond, while young households do not have asset-market access and are thus hand-to-mouth.

All types have the same GHH period utility (Greenwood et al., 1988),

$$U_t^{a,s} = \frac{(z_t^{a,s})^{1-\sigma}}{1-\sigma}, \qquad z_t^{a,s} \equiv c_t^{a,s} - \psi\, \frac{(n_t^{a,s})^{1+\varphi}}{1+\varphi}. \tag{6}$$

Consumption $c_t^{a,s}$ is a CES composite of Home- and Foreign-produced goods, $c_t^{a,s} = [(1-\alpha)^{1/\epsilon}(c_{H,t}^{a,s})^{\frac{\epsilon-1}{\epsilon}} + \alpha^{1/\epsilon}(c_{F,t}^{a,s})^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}}$, with associated price index $P_t = [(1-\alpha)P_{H,t}^{1-\epsilon} + \alpha P_{F,t}^{1-\epsilon}]^{\frac{1}{1-\epsilon}}$, common across types. $n_t^{a,s}$ denotes hours worked. $\sigma > 0$ governs the curvature of consumption utility, $\varphi > 0$ the curvature of the disutility of labor, and $\psi > 0$ is a scaling factor. Households maximize their expected discounted utility subject to their budget constraints, which differ

[20] Because we solve the model to first order around a zero-inflation steady state, this choice is without loss of generality.

across household types. For each old type $s \in \{T, P\}$, the nominal budget constraint is $P_t c_t^{o,s} + B_t^{o,s} = W_t^s n_t^{o,s} + \Pi_t^{o,s} + B_{t-1}^{o,s}(1 + i_{t-1}) + P_t t_t^{o,s}$, where $B_t^{o,s}$ is the risk-free bond paying interest rate i_t, $\Pi_t^{o,s}$ is profit income, and $t_t^{o,s}$ a net lump-sum real transfer. Young households do not trade bonds and consume their current labor income, thus $P_t\, c_t^{y,s} = W_t^s\, n_t^{y,s}$.

The modeling of labor supply and wage setting follows Carreño and Uras (2024). Temporary-contract households are wage takers and choose hours optimally. Their intratemporal labor supply condition equates the negative of the marginal rate of substitution between labor and consumption (MRS) to the real wage: $W_t^T/P_t = \psi(n_t^{a,T})^{\varphi}$. Because the marginal rate of substitution depends only on hours, temporary-contract households of both ages supply identical hours $n_t^{o,T} = n_t^{y,T} = n_t^T$.

Permanent-contract households supply a fixed amount of labor, $n_t^{a,P} = n$, and instead set wages optimally while facing a Calvo friction: a fraction $1 - \theta_w$ can reset their nominal wage each period. The resulting wage Phillips curve, using that the MRS is constant under fixed hours and GHH preferences, is

$$\hat{\pi}_{\omega,t}^P + \hat{\pi}_t = \beta\, \mathbb{E}_t[\hat{\pi}_{\omega,t+1}^P + \hat{\pi}_{t+1}] - \kappa_W^P\, \hat{\omega}_t^P, \qquad \kappa_W^P \equiv \frac{(1-\theta_w)(1-\beta\theta_w)}{\theta_w}, \tag{7}$$

where $\pi_t \equiv P_t/P_{t-1}$ denotes CPI inflation, $\pi_{\omega,t}^P \equiv \omega_t^P/\omega_{t-1}^P$ is the change in real wage, and $\omega_t^P \equiv W_t^P/P_t$ is the permanent-contract-sector real wage.

We now aggregate consumption within each age group; these aggregates are used below to derive the equilibrium. For old households with temporary contracts, using $n_t^{o,T} = n_t^T$, intertemporal optimization yields the Euler equation in log-linearized form

$$\hat{c}_t^{o,T} - \phi_n^T \hat{n}_t^T = \mathbb{E}_t[\hat{c}_{t+1}^{o,T} - \phi_n^T \hat{n}_{t+1}^T] - \frac{1}{\sigma_c}(\hat{i}_t - \mathbb{E}_t\hat{\pi}_{t+1}), \tag{8}$$

where $\phi_n^T \equiv \psi(n^{o,T})^{1+\varphi}/c^{o,T} = Wn/(Pc) > 0$, and $\sigma_c \equiv \sigma(1+\varphi)/[(1+\varphi) - \phi_n^T]$. Throughout we impose $\phi_n^T < 1 + \varphi$, so that GHH felicity is well defined and $\sigma_c > 0$. For old households with permanent contract, $n_t^{o,P} = n$ is fixed and the Euler equation simplifies to

$$\hat{c}_t^{o,P} = \mathbb{E}_t \hat{c}_{t+1}^{o,P} - \frac{1}{\sigma_c}(\hat{i}_t - \mathbb{E}_t\hat{\pi}_{t+1}). \tag{9}$$

Taking the population-share-weighted average of (8) and (9) yields the combined old-household

Euler equation

$$\hat{c}_t^o - \phi_n \hat{n}_t^T = \mathbb{E}_t[\hat{c}_{t+1}^o - \phi_n \hat{n}_{t+1}^T] - \frac{1}{\sigma_c}(\hat{i}_t - \mathbb{E}_t\hat{\pi}_{t+1}), \tag{10}$$

with $\hat{c}_t^o \equiv (1-\lambda^o)\hat{c}_t^{o,T} + \lambda^o \hat{c}_t^{o,P}$ and $\phi_n \equiv (1-\lambda^o)\,\phi_n^T$.

Young households are hand-to-mouth and their consumption depends only on their real wage income. Using their budget constraint and the fact that young rigid households work fixed hours n, we have the combined block

$$\hat{c}_t^y = (1-\lambda^y)(1+\varphi)\,\hat{n}_t^T + \lambda^y\,\hat{\omega}_t^P, \tag{11}$$

where the wage of young households with temporary contract is substituted out with hours using their intratemporal labor supply condition.

Relative prices and exports. We assume that the law of one price holds. Defining the terms of trade as $q_t \equiv P_{H,t}/P_{F,t}$, the CES price index implies $\hat{p}_t - \hat{p}_{H,t} = -\alpha\hat{q}_t$. Foreign households have an analogous CES demand for Home-produced goods, with weight α^* on Home goods. Log-linearizing the Home and Foreign demand schedules yields

$$\hat{x}_t = \hat{C}_t^* - \epsilon(1-\alpha^*)\hat{q}_t, \qquad \hat{C}_{H,t} = \hat{C}_t - \epsilon\,\alpha\,\hat{q}_t, \tag{12}$$

where X_t denotes exports, $C_{H,t} = \mu^o c_{H,t}^o + \mu^y c_{H,t}^y$ is the domestic demand for Home goods, and $C_t = \mu^o c_t^o + \mu^y c_t^y$ the total Home consumption. CPI and producer price inflation are linked by $\hat{\pi}_t = (1-\alpha)\hat{\pi}_{H,t} + \alpha\hat{\pi}_{F,t}$ and $\hat{\pi}_t^* = (1-\alpha^*)\hat{\pi}_{F,t} + \alpha^*\hat{\pi}_{H,t}$, and the terms of trade follow $\hat{q}_t - \hat{q}_{t-1} = \hat{\pi}_{H,t} - \hat{\pi}_{F,t}$.

Monetary and fiscal policy. The monetary union's central bank sets the nominal interest rate in response to aggregate conditions in the union:

$$\hat{i}_t = \rho_i\hat{i}_{t-1} + (1-\rho_i)(\phi_\pi\hat{\pi}_t^U + \phi_y\hat{y}_t^U), \tag{13}$$

where $\rho_i \in [0,1)$ captures the persistence of the policy rate. $\hat{\pi}_t^U = \upsilon\hat{\pi}_t + (1-\upsilon)\hat{\pi}_t^*$ is the union-average CPI inflation, with $\upsilon \in (0,1)$ denoting the Home region's (small) GDP share, and

$\hat{y}_t^U = \upsilon \hat{y}_t + (1-\upsilon)\hat{y}_t^*$ is the union-average output.[21]

Regional government spending is assumed to fall entirely on Home-produced goods, allocated across varieties using the same aggregator as household consumption, and follows an AR(1) process in logs $\hat{g}_t = \rho_g \hat{g}_{t-1} + u_t^g$, $|\rho_g| < 1$. The spending is financed by lump-sum taxes levied on old, optimizing households: $P_{H,t} G_t + P_t \mu^o t_t^o = 0$. This financing assumption rules out demand effects arising from distortionary taxation or liquidity constraints and allows us to isolate how demographic structure shapes the transmission of fiscal shocks.[22]

Market clearing and aggregation. Home-produced output, Y_t, is absorbed by domestic consumption of Home goods, government spending, and exports: $Y_t = C_{H,t} + G_t + X_t$. Let $s_c \equiv C_H/Y$, $s_g \equiv G/Y$ and $s_x \equiv X/Y$ denote the corresponding steady-state shares, with $s_c + s_g + s_x = 1$. Bond market clearing requires $\upsilon\, B_t + (1-\upsilon)\, B_t^* = 0$, where $B_t = \mu^o B_t^o$ is total Home bond holdings and B_t^* denotes Foreign bond holdings. Combining the resource constraint with (12) gives

$$\begin{aligned} \hat{y}_t &= A_c \hat{C}_t + A_g \hat{g}_t + A_c^* \hat{C}_t^* - A_p \hat{q}_t \\ &= A_c(\mu^o \hat{c}_t^o + \mu^y \hat{c}_t^y) + A_g \hat{g}_t + A_c^* \hat{C}_t^* - A_p \hat{q}_t \end{aligned} \tag{14}$$

with $A_c \equiv s_c$, $A_g \equiv s_g$, $A_c^* \equiv s_x$, and $A_p \equiv s_x \epsilon (1-\alpha^*) + s_c\, \epsilon\, \alpha$.

Equilibrium. Under the production technology described above, real marginal cost in each sector is $\widehat{mc}_t^s = \hat{\omega}_t^s - \hat{A}_t^s + (\hat{p}_t - \hat{p}_t^s)$. Using the rigid sector's real wage, the flexible sector's intratemporal condition, the composite goods production function, and aggregating (5) across sectors with weights η, $1-\eta$, we have the Home New Keynesian Phillips curve

$$\hat{\pi}_{H,t} = \beta\, \mathbb{E}_t \hat{\pi}_{H,t+1} + \Gamma \Big[\varphi\, \hat{y}_t + (1-\eta)\hat{\omega}_t^P - (1+\varphi)\hat{A}_t - \alpha \hat{q}_t \Big], \tag{15}$$

[21] We take υ to be small. In our dataset, regional GDP amounts on average to 0.4% of total union GDP, so that Home-specific shocks have a negligible effect on union-wide aggregates. We thus model Foreign variables $\hat{y}_t^*$, and $\hat{\pi}_t^*$ as exogenous processes.

[22] From the perspective of a small region, this is equivalent to financing through union- or national-level transfers that do not directly affect local disposable income. This modeling choice is also supported by our empirical evidence. As shown in Appendix B.1.4, regional taxation does not respond systematically to changes in government spending.

with $\hat{A}_t \equiv \eta \hat{A}_t^T + (1-\eta)\hat{A}_t^P$. Combining (14) with (10), (11), and the production function gives the Home dynamic IS curve:

$$\begin{aligned}\hat{y}_t = \mathbb{E}_t \hat{y}_{t+1} - \phi_{IS}(\hat{i}_t - \mathbb{E}_t \hat{\pi}_{t+1}) + \gamma_p(\mathbb{E}_t \hat{q}_{t+1} - \hat{q}_t) + \gamma_g\, \hat{g}_t \\ - \gamma_c^*(\mathbb{E}_t \hat{C}_{t+1}^* - \hat{C}_t^*) - \gamma_\omega(\mathbb{E}_t \hat{\omega}_{t+1}^P - \hat{\omega}_t^P) + \gamma_A(\mathbb{E}_t \hat{A}_{t+1} - \hat{A}_t),\end{aligned} \tag{16}$$

with $\phi_{IS} = A_c \mu^o/(\sigma_c J)$, $\gamma_p = A_p/J$, $\gamma_g = A_g(1-\rho_g)/J$, $\gamma_c^* = A_c^*/J$, $\gamma_\omega = A_c \mu^{y,P}/J$, $\gamma_A = A_c[(1+\varphi)\mu^{y,T} + \mu^o \phi_n]/(\eta J)$, and $J \equiv 1 - \frac{A_c}{\eta}\Big[(1+\varphi)\mu^{y,T} + \mu^o \phi_n\Big]$.

Age structure and the multiplier. The age structure does not affect the slope of the Phillips curve (15).[23] On the demand side, it enters the coefficients of the dynamic IS curve through the amplification term J, which can be rewritten as

$$\begin{aligned} J =& 1 - \frac{A_c}{\eta}\Big[(1+\varphi)(1-\mu^o)(1-\lambda^y) + \mu^o(1-\lambda^o)\phi_n^T\Big], \\ \frac{\partial J}{\partial \mu^y} =& -\frac{\partial J}{\partial \mu^o} = -\frac{A_c}{\eta}[(1+\varphi)(1-\lambda^y) - (1-\lambda^o)\phi_n^T] < 0. \end{aligned}$$

A larger young-population share μ^y lowers J and thereby raises γ_g.

Result 1. *A larger share of young population strengthens the fiscal multiplier to the extent that young, hand-to-mouth households' consumption responds more strongly to aggregate activity than that of old households.*

5.2 The role of unemployment insurance

The effect of aging on the fiscal multiplier is moderated by the unemployment insurance system, which shapes how strongly age structure affects the demand side. The model embeds a condition familiar from the heterogeneous-agent literature: heterogeneity amplifies demand shocks when the income of high-MPC households is more cyclical than average (Bilbiie, 2020; Patterson, 2023), and taxes and transfers can largely neutralize this amplification (Bilbiie et al., 2025). In our setting, heterogeneity runs along the age dimension: young households have both higher

[23] This reflects our modeling choice to abstract from age-dependent price- and wage-setting frictions and to focus on the demand-side channel; a separate strand of the literature instead emphasizes how demographics may affect the slope of the Phillips curve. See, e.g., Mangiante (2024).

MPCs and more cyclical labor income. By compressing the gap in income cyclicality between young and old households, generous unemployment insurance dampens the effect of aging on the multiplier.

We consider a simple policy that offsets a fraction $\iota \in [0, 1)$ of the cyclical component of real labor income for households employed under temporary contracts; we refer to ι as benefit generosity. The purpose of this policy block is not to model legal eligibility rules of specific transfer programs, but to provide a reduced-form representation of their effective cyclical incidence: income-support programs activate when earnings fall, and their incidence is concentrated among workers with more volatile earnings and weaker labor-market attachment, which in our framework are the temporary-contract households.[24]

Let real temporary-contract labor income be $\ell_t \equiv W_t^T n_t^T / P_t$, and define a per-household transfer $\tau_t \equiv -\iota(\ell_t - \ell)$, financed by lump-sum taxes on old, optimizing households. Because taxes are lump-sum, the policy is neutral from the supply side at first order.[25] The budget constraint of a young household with temporary contract becomes $P_t c_t^{y,T} = W_t^T n_t^T + P_t \tau_t$, so that, in log-linearized form,

$$\hat{c}_t^{y,T} = (1 - \iota)(1 + \varphi)\, \hat{n}_t^T. \tag{17}$$

Relative to the benchmark case without transfers, the consumption response of young households with temporary contract is attenuated by the factor $(1 - \iota)$. Old temporary-contract households' Euler equation is unaffected at first order, since the transfer does not depend on their own choices. Substituting (17) into the aggregation step leaves the dynamic IS curve and its coefficients unchanged in form, with the first and cross derivatives of the amplification term

$$\frac{\partial J}{\partial \mu^y} = -\frac{A_c}{\eta}[(1 + \varphi)(1 - \iota)(1 - \lambda^y) - (1 - \lambda^o)\phi_n^T],$$
$$\frac{\partial^2 J}{\partial \mu^y \partial \iota} = \frac{A_c}{\eta}(1 + \varphi)(1 - \lambda^y) \; > \; 0.$$

More generous insurance weakens the demographic sensitivity of aggregate demand.

Result 2. *Unemployment insurance to temporary-contract households attenuates the demand-*

[24] We map ι to the net replacement rate as a reduced-form measure of income insurance. While the replacement rate applies conditional on job loss and the mapping is imperfect, the modeling choice captures what matters for our mechanism in a tractable manner: the extent to which benefits insulate young households' disposable income.

[25] Households take τ_t as given, since it depends on average temporary-contract income; because the transfer and its financing are lump-sum from the household's perspective, the policy leaves labor supply unaffected.

side mechanism through which age structure affects the fiscal multiplier, by reducing the cyclicality of disposable income for households with high marginal propensities to consume.

5.3 Calibration

The model is calibrated at quarterly frequency to match euro area regional data over 1999–2019. Table 3 summarizes the parameter values.

We set the discount factor to $\beta = 0.995$, implying a steady-state annual real interest rate of two percent. We set the consumption curvature parameter to $\sigma = 1$, following Nakamura and Steinsson (2014), and the inverse Frisch elasticity to $\varphi = 5$. The implied Frisch elasticity of 0.2 lies at the lower end of the micro estimates summarized by Chetty et al. (2011). The baseline young share, $\mu^y = 0.16$, is the sample average of the 20–29 population share in the population aged 20 and older, so the baseline old share is $\mu_0^o = 0.84$. Permanent-contract shares come from the Eurostat Labour Force Survey: $\lambda^y = 0.72$ for young workers (20–29) and $\lambda^o = 0.89$ for older workers (30–74).[26] The transfer parameter is set to $\iota = 0.66$, the average of our replacement-rate indicator across the country-years in the estimation sample. In the U.S. counterfactual, we set $\iota^{low} = 0.325$, the U.S. net replacement rate, and hold all other parameters at their euro area values.

The government spending and export shares are set to $s_g = 0.23$ and $s_x = 0.35$, matching sample means from the PBL EUREGIO regional input-output tables (Thissen et al., 2018). The Home-goods consumption share follows residually as $s_c = 1 - s_g - s_x = 0.42$. The import share of domestic consumption, $\alpha = s_m/(s_c + s_m) = 0.47$, uses the sample-mean import share of output $s_m = 0.37$ from the same tables, and the Home-good share of foreign absorption, $\alpha^* = 0.001$, matches the sample mean of regional exports relative to foreign absorption. The Armington elasticity is $\epsilon = 2$, following Nakamura and Steinsson (2014), and the Home region's share of monetary union output is $\upsilon = 0.004$, the average regional GDP share in the data.

[26] These shares also pin down the flexible-sector weight in production, $\eta = (1 - \lambda^y) - \mu^o(\lambda^o - \lambda^y)$, which varies with μ^o in the aging experiments.

Table 3: Model Calibration

Parameter	Description	Value	Source / Target
A. Households and preferences			
β	Discount factor	0.995	Standard quarterly value
σ	Consumption utility curvature	1	Nakamura and Steinsson (2014)
φ	Labor disutility curvature	5	Chetty et al. (2011)
μ^o	Baseline share of prime-age and older population	0.84	Eurostat
B. Labor market structure			
λ^y	Rigid-contract share, young workers	0.72	Eurostat LFS
λ^o	Rigid-contract share, prime-age and older	0.89	Eurostat LFS
ι	Share of temporary-contract labor income offset by transfers	0.66	OECD, euro area net replacement rate for a single household
ι^{low}	Share of temporary-contract labor income offset by transfers, U.S. counterfactual	0.325	OECD, U.S. net replacement rate for a single household
C. Open-economy steady-state shares			
s_g	Government spending share of output	0.23	PBL EUREGIO; sample mean
s_x	Export share of output	0.35	PBL EUREGIO; sample mean
s_c	Home-goods consumption share of output	0.42	Residual: $1 - s_g - s_x$
α	CES weight on foreign goods (import share of consumption)	0.47	Derived: $\alpha = s_m/(s_c + s_m)$, pinned by steady state $M = \alpha C$
α^*	Home-good share of foreign absorption	0.001	Set to ≈ 0: Home is negligible in union-wide absorption
ϵ	Armington elasticity (home vs. foreign goods)	2	Nakamura and Steinsson (2014)
υ	Home region share of monetary union output	0.004	PBL EUREGIO; avg. regional GDP share
D. Nominal rigidities			
θ_p	Calvo price stickiness	0.98	Set to match the euro area baseline multiplier (Table 2)
θ_w	Calvo wage stickiness	0.74	Smets and Wouters (2003); posterior mode
E. Monetary policy (Taylor rule)			
ϕ_π	Inflation response coefficient	1.5	Standard
ϕ_y	Output response coefficient	0.5	Standard
ρ_i	Interest-rate smoothing	0.85	Nakamura and Steinsson (2014)
F. Shock processes			
ρ_g	Persistence of government spending shock	0.85	Consistent with Smets and Wouters (2003) shock range
ρ_{C^*}	Persistence of foreign demand shock	0.85	Consistent with Smets and Wouters (2003) shock range
ρ_{π_F}	Persistence of foreign inflation shock	0.85	Consistent with Smets and Wouters (2003) shock range
ρ_{y^*}	Persistence of foreign output shock	0.85	Consistent with Smets and Wouters (2003) shock range

Notes: Quarterly calibration.

Wage stickiness follows the euro area estimates of Smets and Wouters (2003): $\theta_w = 0.74$, implying an average wage duration of roughly four quarters. The Calvo price parameter, $\theta_p = 0.98$, is high, but necessary to match the euro area baseline multiplier from our empirical estimates. The Taylor rule coefficients are standard: $\phi_\pi = 1.5$ and $\phi_y = 0.5$. Interest-rate smoothing is set to $\rho_i = 0.85$, following Nakamura and Steinsson (2014). The persistence of all shocks is set to 0.85, the prior mean for shock persistence in Smets and Wouters (2003).

5.4 Simulation results

Using the calibrated model, we assess how aging affects the fiscal multiplier and how this effect depends on benefit generosity. Table 4 summarizes the results. The column Model reports two-year cumulative multipliers after an increase in regional government spending. The column Empirics reproduces the corresponding estimates from Table 2.

Table 4: Fiscal Multiplier: Empirical Estimates and Model Predictions

	Empirics	Model
A. Fiscal multiplier		
Baseline multiplier	1.99	1.99
B. Young-share gradient (simulated regression)		
At mean benefit generosity	-0.065	0.038
Moderation by benefit generosity	-0.007	-0.005
C. Age effect (% change in multiplier per ppt young share)		
Euro area benefit generosity	-3.3	1.5
U.S. benefit generosity	19.4[†]	13.1

Notes: Two-year cumulative multipliers. Panel B Model reports the specification of Table 2 estimated on model-simulated multipliers: the model is solved on a grid of young shares ($\mu_0^o = 0.84 \pm 5$ ppt) and replacement rates spanning the 10th to 90th percentile of the estimation sample (0.46 to 0.76), and the multiplier is regressed on the demeaned young share, the demeaned replacement rate and their interaction. Both columns of Panel B report the regression coefficients: the first row is the coefficient on the young share, i.e., the change in the multiplier per 1 ppt increase in the young share at the mean replacement rate; the second row is the coefficient on the interaction, i.e., the change in this slope per 1 ppt increase in the replacement rate. Panel C expresses the age effect relative to the multiplier level. The U.S. row sets $\iota = 0.325$, 33.5 ppt below the euro area mean, and holds all other parameters at euro area values.

[†] Basso and Rachedi (2021), Table 1, column 1, converted to a 1 ppt change in the young share (see footnote 17).

The model reproduces the two patterns in the data: at euro area levels of benefit generosity, aging leaves the fiscal multiplier essentially unchanged, while at U.S. levels it lowers the multiplier markedly. Panel A shows the baseline multiplier, which the model matches by construction.

Panel B estimates the specification of Table 2 on model-simulated time series. At the euro area mean replacement rate, a 1 percentage point increase in the young share changes the multiplier by 0.038 in the model and by −0.065 in the data. Relative to the multiplier level (Panel C), this amounts to 1.5 percent in the model and −3.3 percent in the data, so in both the effect of aging is close to zero.[27] Benefit generosity moderates the age effect by a comparable amount in the model and in the data: a 1 percentage point increase in the replacement rate lowers the young-share gradient by 0.005 and 0.007, respectively. Because benefits moderate the age effect, aging has a clear negative effect on the multiplier at U.S. benefit levels. With the replacement rate set to its U.S. value and all other parameters held at euro area values, a 1 percentage point decline in the young share lowers the multiplier by 13.1 percent, as compared to 19.4 percent implied by Basso and Rachedi (2021).[28]

6 Conclusion

Does demographic aging threaten the effectiveness of fiscal policy? This paper shows that the answer depends on the unemployment insurance system. While aging substantially erodes fiscal multipliers across U.S. states, we find no such effect in the euro area. We attribute this divergence to the comparatively generous unemployment benefits of the euro area, which stabilize the incomes and consumption of younger, credit-constrained households and thereby mute fiscal amplification through the demand side. Consistent with this mechanism, the aging-related erosion of the fiscal multiplier reemerges in euro area regions where unemployment benefits are low – and our euro area estimates, extrapolated to U.S. benefit levels, quantitatively reproduce the erosion documented for the U.S. A New Keynesian model with population aging confirms that observed differences in unemployment benefit generosity are sufficient to account for most of the contrasting evidence across the two economies.

[27] While the model and the data differ in the sign of this effect, both are close to zero, with the empirical estimate being small and not significantly different from zero at all five horizons in Table 2.

[28] The model entries in Panel C come from separate solutions at the euro area and the U.S. replacement rate, dividing the young-share gradient by the multiplier at that replacement rate. The euro area entry therefore differs slightly from the Panel B coefficient divided by the baseline multiplier, since that coefficient comes from a regression across the whole replacement-rate grid. The model's U.S. entry is larger than the age effect implied by the empirical estimates at U.S. benefit levels mainly because the model starts from a positive age effect at euro area benefit levels. Lower benefits raise the age effect by a similar amount in both: 11.6 percent in the model (13.1 − 1.5) and 12 percent in the data (Section 4.2).

Our findings imply that the effect of aging on fiscal multipliers is not a demographic constant but depends on the policy environment. Concerns about declining fiscal policy effectiveness in aging societies are warranted where unemployment insurance is thin, but not where it is generous. This also points to a dimension of unemployment insurance that is typically absent from analyses of its costs and benefits: by compressing the gap in disposable income and hence consumption responses between young and old households, benefit generosity insulates the transmission of fiscal policy against demographic change.

References

Ambrocio, G. (2026). Demographic aging and the New Keynesian Phillips curve. *European Economic Review*, *184*, 105273.

Auerbach, A. J., & Gorodnichenko, Y. (2012). Measuring the output responses to fiscal policy. *American Economic Journal: Economic Policy*, *4*(2), 1–27.

Bartik, T. J. (1991). *Who benefits from state and local economic development policies?* W.E. Upjohn Institute for Employment Research.

Basso, H. S., & Rachedi, O. (2021). The young, the old, and the government: Demographics and fiscal multipliers. *American Economic Journal: Macroeconomics*, *13*(4), 110–141.

Berg, K. A., Curtis, C. C., Lugauer, S., & Mark, N. C. (2021). Demographics and monetary policy shocks. *Journal of Money, Credit and Banking*, *53*(6), 1229–1266.

Bilbiie, F. O. (2020). The New Keynesian cross. *Journal of Monetary Economics*, *114*, 90–108. https://doi.org/https://doi.org/10.1016/j.jmoneco.2019.03.003

Bilbiie, F. O., Galaasen, S. M., Gürkaynak, R. S., Mæhlum, M., & Molnar, K. (2025). *HANKSSON* (CEPR Discussion Paper No. 20090). Centre for Economic Policy Research.

Borusyak, K., Hull, P., & Jaravel, X. (2022). Quasi-experimental shift-share research designs. *The Review of Economic Studies*, *89*(1), 181–213.

Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics*, *12*(3), 383–398.

Carreño, J. G., & Uras, B. (2024). Macro welfare effects of flexible labor contracts. *European Economic Review*, *161*, 104633.

Chetty, R., Guren, A., Manoli, D., & Weber, A. (2011). Are micro and macro labor supply elasticities consistent? A review of evidence on the intensive and extensive margins. *American Economic Review*, *101*(3), 471–475.

Chodorow-Reich, G. (2019). Geographic cross-sectional fiscal spending multipliers: What have we learned? *American Economic Journal: Economic Policy*, *11*(2), 1–34.

Christiano, L., Eichenbaum, M., & Rebelo, S. (2011). When is the government spending multiplier large? *Journal of Political Economy*, *119*(1), 78–121.

Coelho, M. (2019). Fiscal stimulus in a monetary union: Evidence from Eurozone regions. *IMF Economic Review*, *67*(3), 573–617.

Curtis, C., Garín, J., & Lester, R. (2026). Does the Phillips curve lie down as we age? *Journal of Money, Credit and Banking*. https://doi.org/https://doi.org/10.1111/jmcb.13254

Di Maggio, M., & Kermani, A. (2016). *The importance of unemployment insurance as an automatic stabilizer* (Working Paper No. 22625). National Bureau of Economic Research. https://doi.org/10.3386/w22625

Dixit, A. K., & Stiglitz, J. E. (1977). Monopolistic competition and optimum product diversity. *American Economic Review*, *67*(3), 297–308.

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *The Review of Economics and Statistics*, *80*(4), 549–560.

Dupor, B., & Guerrero, R. (2017). Local and aggregate fiscal policy multipliers. *Journal of Monetary Economics*, *92*, 16–30.

European Commission, Joint Research Centre. (2024). *ARDECO: Annual Regional Database of the European Commission*. https://territorial.ec.europa.eu/ardeco

Eurostat. (2025a). *Persons in long-term unemployment (12 months or more) by educational attainment level and NUTS 2 region (lfst_r_lfu2ltu)*. https://doi.org/10.2908/LFST_R_LFU2LTU

Eurostat. (2025b). *Population on 1 January by age group, sex and NUTS 2 region (demo_r_pjangroup)*. https://doi.org/10.2908/DEMO_R_PJANGROUP

Eurostat. (2025c). *Population structure indicators by NUTS 2 region (demo_r_pjanind2)*. https://doi.org/10.2908/DEMO_R_PJANIND2

Eurostat. (2025d). *Unemployed persons by educational attainment level and NUTS 2 region (lfst_r_lfu3pers)*. https://doi.org/10.2908/LFST_R_LFU3PERS

Gabriel, R. D., Klein, M., & Pessoa, A. S. (2023). The effects of government spending in the Eurozone. *Journal of the European Economic Association*, *21*(4), 1397–1427.

Gabriel, R. D., Klein, M., & Pessoa, A. S. (2026). The political costs of austerity. *The Review of Economics and Statistics*, *108*(1), 145–161.

Goldsmith-Pinkham, P., Sorkin, I., & Swift, H. (2020). Bartik instruments: What, when, why, and how. *American Economic Review*, *110*(8), 2586–2624.

Greenwood, J., Hercowitz, Z., & Huffman, G. W. (1988). Investment, capacity utilization, and the real business cycle. *The American Economic Review*, *78*(3), 402–417.

Honda, J., & Miyamoto, H. (2021). How does population aging affect the effectiveness of fiscal stimulus over the business cycle? *Journal of Macroeconomics*, *68*, 103288.

Ilzetzki, E., Mendoza, E. G., & Végh, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, *60*(2), 239–254.

Jo, Y. J., & Zubairy, S. (2025). State-dependent government spending multipliers: Downward nominal wage rigidity and sources of business cycle fluctuations. *American Economic Journal: Macroeconomics*, *17*(1), 379–413.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, *95*(1), 161–182.

Kekre, R. (2023). Unemployment insurance in macroeconomic stabilization. *The Review of Economic Studies*, *90*(5), 2439–2480.

Kopecky, J. (2022). The age for austerity? Population age structure and fiscal consolidation multipliers. *Journal of Macroeconomics*, *73*, 103444.

Leahy, J. V., & Thapar, A. (2022). Age structure and the impact of monetary policy. *American Economic Journal: Macroeconomics*, *14*(4), 136–173.

Lewis, D. J., & Mertens, K. (2025). A robust test for weak instruments for 2SLS with multiple endogenous regressors. *The Review of Economic Studies*, rdaf103. https://doi.org/10.1093/restud/rdaf103

Mangiante, G. (2024, January). *Demographic trends and the transmission of monetary policy* [SSRN Working Paper 4149657]. http://dx.doi.org/10.2139/ssrn.4149657

McKay, A., & Reis, R. (2021). Optimal automatic stabilizers. *The Review of Economic Studies*, *88*(5), 2375–2406.

Miyamoto, H., & Yoshino, N. (2022). A note on population aging and effectiveness of fiscal policy. *Macroeconomic Dynamics*, *26*(6), 1679–1689.

Morita, H. (2022). On the relationship between fiscal multipliers and population aging in Japan: Theory and empirics. *Economic Modelling*, *108*, 105772.

Nakamura, E., & Steinsson, J. (2014). Fiscal stimulus in a monetary union: Evidence from US regions. *American Economic Review*, *104*(3), 753–792.

Nekarda, C. J., & Ramey, V. A. (2011). Industry evidence on the effects of government spending. *American Economic Journal: Macroeconomics*, *3*(1), 36–59.

OECD. (2025). *Net replacement rates in unemployment (DSD_TAXBEN_NRR@DF_NRR)*. https://data-explorer.oecd.org/vis?df%5Bds%5D=dsDisseminateFinalDMZ&df%5Bid%5D=DSD_TAXBEN_NRR%40DF_NRR&df%5Bag%5D=OECD.ELS.JAI

Patterson, C. (2023). The matching multiplier and the amplification of recessions. *American Economic Review*, *113*(4), 982–1012. https://doi.org/10.1257/aer.20210254

Ramey, V. A. (2019). Ten years after the financial crisis: What have we learned from the renaissance in fiscal research? *Journal of Economic Perspectives*, *33*(2), 89–114.

Smets, F., & Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. *Journal of the European Economic Association*, *1*(5), 1123–1175.

Thissen, M., Lankhuizen, M., van Oort, F., Los, B., & Diodato, D. (2018). *EUREGIO: The construction of a global IO database with regional detail for Europe for 2000–2010* (Discussion Paper No. TI 2018-084/VI). Tinbergen Institute. https://data.europa.eu/data/datasets/pbl-euregio-database-2000-2010

Online Appendix

to *"Does aging erode fiscal multipliers? The role of unemployment insurance"*

Yao Chen[1] Florian van Genderen[2] Felix Ward[3]

[1]Erasmus School of Economics, Erasmus University Rotterdam; CEPR; Tinbergen Institute (y.chen@ese.eur.nl).
[2]Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute (f.p.t.m.vangenderen@ese.eur.nl).
[3]Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute (ward@ese.eur.nl).

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A Data appendix

A.1 Data overview

Table A.1 presents an overview of the NUTS territories in our sample. Some regions lack demographic data for some years and are therefore only partially included in our sample: Emilia-Romagna (ITH5) and Marche (ITI3) (2001-onwards), Chemnitz (DED4) and Leipzig (DED5) (2011-onwards), Guadeloupe (FRY1) (2013-onwards), and Mayotte (FRY5), Northern and Western (IE04), Southern (IE05) and Eastern and Midland (IE06) (2014-onwards). The results are robust to excluding these regions (Panel B of Table B.8 in Appendix B.2).

All variables in the dataset are listed in Table A.2. In addition, we construct several variables, which are described in Table A.3. The following sections describe variables we construct.

Table A.1: NUTS classifications by country

NUTS-0	**NUTS-1**	**#**	**NUTS-2**	**#**
Austria	Groups of states	3	States (Länder)	9
Belgium	Regions	3	Provinces and Brussels	11
Finland	Mainland, Åland	2	Large areas (Suuralueet/Storområden)	5
France	ZEAT and Overseas regions	14	Regions	27
Germany	States (Bundesländer)	16	Government regions (Regierungsbezirk)	38
Greece	Groups of regions	4	Regions	13
Ireland	–	1	Regional Assemblies	3
Italy	Groups of regions	5	Regions (Trentino-Alto Adige split in 2)	21
Luxembourg	–	1	–	1
Netherlands	Groups of provinces	4	Provinces	12
Portugal	Mainland and 2 autonomous regions	3	5 Coord. regions and 2 auton. regions	7
Spain	Groups of communities	7	17 Auton. commun. and 2 auton. cities	19
Total		63		166

Notes: The table reports the full NUTS classification structure for the twelve euro area countries in our sample, based on the Eurostat NUTS 2021 vintage. Counts reflect all NUTS-2 regions in these countries. Source: Eurostat.

Table A.2: Variables

Variable	*Detailed description*	*Source*	*Sample*
Economic variables			
Nominal GDP	in mil. EUR	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1999-2019
Real GDP	at constant 2015 national prices (in mil. 2015EUR)	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1999-2019
Real non-market GVA	NACE2 sections O–U, at constant 2015 national prices (in mil. 2015EUR)	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1994-2019
Real private GVA	NACE2 sections A, B–E, F, G–J and K–N, at constant 2015 national prices (in mil. 2015EUR)	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1999-2019
Nominal taxes on income and wealth	in mil. EUR	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1999-2019
Gov. final consumption expenditure	general government, at current prices (in mil. EUR), at the national level	OECD (OECD, 2025a)	all countries, 1999-2019
Demographic variables			
Population	average annual population, in number of people	ARDECO 2024 winter update (European Commission, Joint Research Centre, 2024)	all countries, 1994-2019
Population by age	in number of people, by 5-year age bin	Eurostat (Eurostat, 2025b)	all countries, 1999-2019
Median age	in years	Eurostat (Eurostat, 2025c)	all countries, 1999-2019
Labor market variables			
Unemployment rate	in %	Eurostat (Eurostat, 2025d)	all countries, 1999-2019
Unemployment replacement rates	net replacement rates per household type and unemployment duration, at the national level	OECD (OECD, 2025c)	all countries, 2001-2019
Gov. employees by age	in thousands of employees, by age, at the national level	Eurostat (Eurostat, 2023, 2025a)	all countries, 1999-2019
Remaining variables			
Government intermediate consumption shares	proxy for intermediate consumption	(Gabriel et al., 2023; Thissen et al., 2018)	all countries, PBL EUREGIO 2000-2010
National savings rate	net savings as % of GDP, at the national level	OECD (OECD, 2025b)	all countries, 1999-2019

Notes: Unless otherwise specified, all variables are available at the NUTS-2 level and at the national level. Real non-market GVA and population are used from 1994 onwards to construct the predetermined government spending shares (1996 onwards for Greece).

Table A.3: Constructed variables

Variable	*Computation*	*Detailed description*
Economic variables		
Real per capita GVA	(real private GVA + real non-market GVA) / Population	in EUR per capita
Real per capita private GVA	real private GVA / Population	in EUR per capita
Real per capita GDP	real GDP / Population	in EUR per capita
Real per capita government spending	real non-market GVA × (1 + gov. intermediate consumption share) / Population	in EUR per capita
GDP deflator	nominal GDP / real GDP	index, 2015 = 1
Real per capita taxes	nominal taxes on income and wealth / (GDP deflator × Population)	in EUR per capita
Gov. spending shares	per capita regional / per capita national government spending, averaged over 1994–1998	time-invariant, 1996–2000 for Greece, see Section 3
Service share	real GVA NACE2 G–J and K–N / real private GVA	as a fraction
Regional business-cycle indicator	GVA growth of region i − GVA growth of the rest of the country	growth rate; rest of the country population-weighted
Demographic variables		
Population shares	100 × Population age bin a / Population	in %, by 5-year age bin
Share young	100 × Population 20–29 / Population 20+	in %
Alternative young shares	100 × Population 15–29 / Population 15+; 100 × Population 20–34 / Population 20+; 100 × Population 15–34 / Population 15+	in %
Old age dependency ratio	100 × Population 65+ / Population 20-64	in %, OECD/Eurostat
Instruments		
Gov. spending Bartik	see Eq. (2)	baseline instrument
Bartik, alternative output	Eq. (2) with private GVA or GDP instead of GVA	see Table B.6, Panel B
Bartik, sample-average shares	Eq. (2) with spending shares averaged over 1999–2019	see Table B.6, Panel C
Remaining variables		
Unemployment replacement rate	average net replacement rate over household types and unemployment durations of up to 1, 2 or 4 years	in %, at the national level; singles without children and with two children, excluding social assistance and housing benefits; 1 year is the baseline
Empl. share government	100 × public-sector employees aged 15–39 / public-sector employees aged 15–64	in %, at the national level, see Section B.2

Notes: Unless otherwise specified, all variables are available at the NUTS-2 level and at the national level.

A.2 The regional government spending measure

We follow Gabriel et al. (2023) in assessing the quality of our regional government spending proxy through a comparison of the regional government spending proxies summed to the national level with a national government spending measure. Specifically, we sum up the regional, intermediate consumption adjusted, non-market GVAs, and compare this sum to final government consumption expenditure at the national level from the OECD (OECD, 2025a).

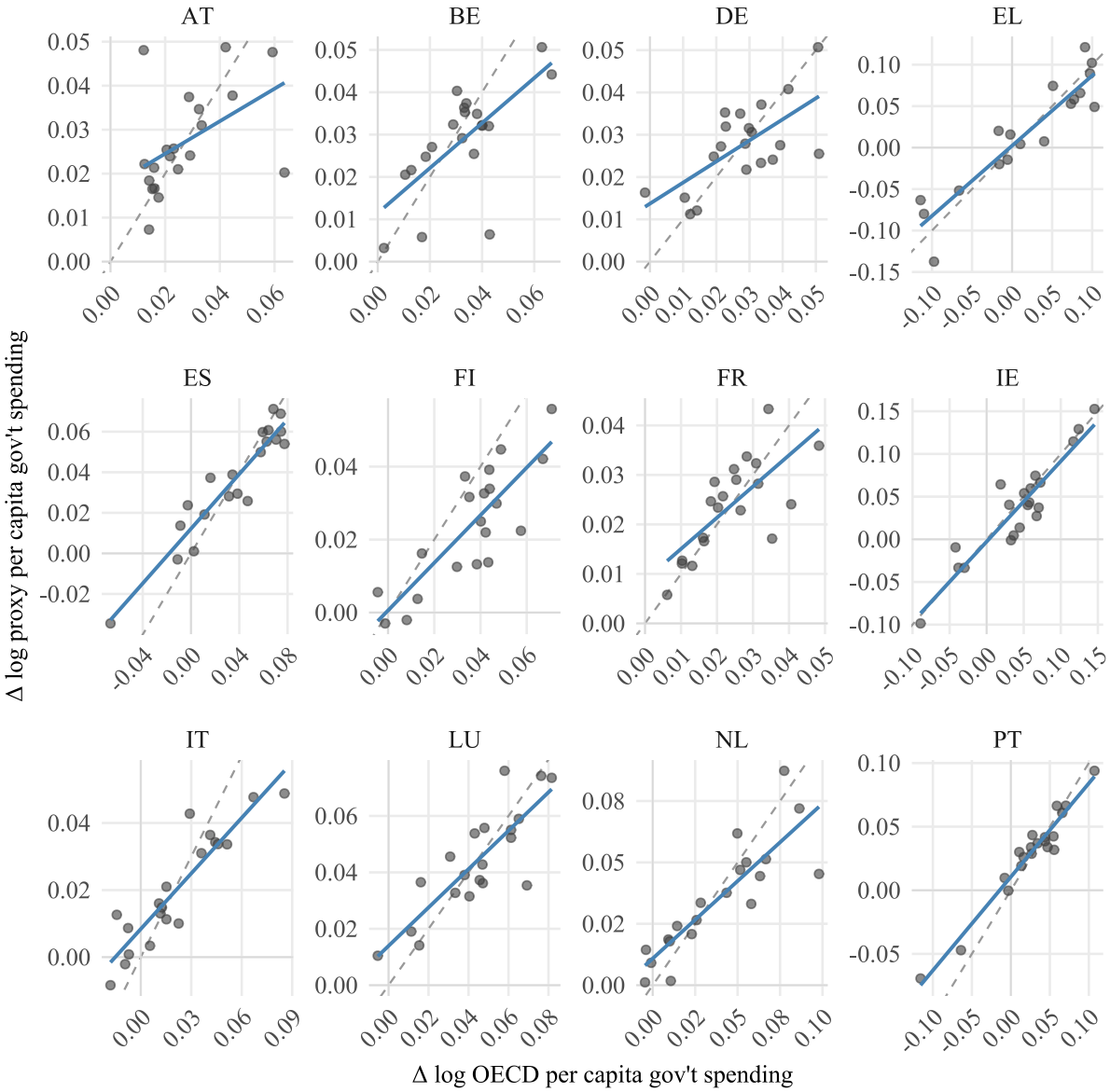
Table A.4 displays the growth rate correlation of the two series. Across the entire sample, the correlation is 0.9. The correlations within individual countries range from 0.47 (Austria) to 0.97 (Portugal). Figure A.1 illustrates this correlation through scatter plots. Overall, the high correlation confirms that the regional government spending proxy is defined in a way that is consistent with national government spending aggregates.

Table A.4: Correlation of regional proxy with national government spending (growth rates)

Country	Correlation coefficient
Austria	0.47
Belgium	0.68
Finland	0.83
France	0.72
Germany	0.67
Greece	0.93
Ireland	0.93
Italy	0.91
Luxembourg	0.83
Netherlands	0.86
Portugal	0.97
Spain	0.94
All	0.90

Notes: The table reports the correlation between the growth rates of the regional government spending proxies summed to the national level and the national government spending data from the OECD.

Figure A.1: Regional government spending proxy validation



Notes: Scatter plots display annual log-differences of the summed up regional government spending proxies against annual log-differences of the national government spending series from the OECD. Dashed line – 45 degree line. Blue line – within-country OLS slope. Sample: 1999–2019.

A.3 The unemployment replacement rate

Table A.5 presents coefficient estimates for the interaction term of interest in equation (3) where the unemployment replacement rate $I_{i,t}$ is defined on the basis of the 1 year and longer-term unemployment replacement rate horizons – 2 years and 4 years, respectively. Both longer term replacement rates yield similar coefficients. This suggests that the effect of aging on the fiscal multiplier is moderated by the level of income support for unemployed households, regardless of the length of the unemployment replacement rate series.

Table A.5: Aging, the fiscal multiplier and the unemployment replacement rate

	Impact	1 year	2 years	3 years	4 years
Panel A: Baseline replacement rate					
1 year	-0.004	-0.007†	-0.008‡	-0.008†	-0.009†
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Panel B: Alternative replacement rates					
Longer term (2 years)	-0.002	-0.003	-0.004‡	-0.004†	-0.004
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Longest term (4 years)	-0.002	-0.004†	-0.005‡	-0.005†	-0.006†
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)

Notes: The table reports the estimates of local projection panel regressions (3) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the cumulative change in real GVA per capita. The reported independent variable is the triple interaction of the cumulative change in real per capita government spending as a fraction of real per capita GVA with the demeaned aging indicator D and the demeaned unemployment replacement rate I. Panel A reproduces the triple-interaction estimate from Table 2, where the replacement rate is averaged over unemployment durations of up to one year. Panel B uses replacement rates averaged over unemployment durations of up to two and four years, respectively. Regional level government spending is instrumented with the government spending Bartik as defined in equation (2). The specification includes time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

B Additional results and robustness checks

B.1 Instrument validation

B.1.1 Variation in regional government spending shares

Table B.1 presents the standard deviation of the regional spending shares over time and between regions. The overall variation in regional spending shares is dominated by cross-sectional variation between regions, whereas temporal variation is small, highlighting the stability of regional spending shares over time. This justifies the use of stable regional spending shares in the construction of the instrumental variables.

Table B.1: Variation regional spending shares

Overall std. deviation	Avg cross-sectional std. deviation	Avg temporal std. deviation
0.25	0.24	0.03

Notes: The table reports standard deviations of regional government spending shares, defined as per capita regional fiscal spending divided by per capita national fiscal spending ($G_{i,t}/G_{I,t}$), in the estimation sample. Columns (1) and (2) use the time-invariant spending shares that enter the instrument. Column (1) reports the overall standard deviation, pooled over all region-year observations. Column (2) reports the standard deviation across regions within each country, averaged across countries; countries with a single region are excluded. Column (3) uses the time-varying spending shares and reports the standard deviation over time within each region, averaged across regions.

B.1.2 Instrument relevance

Table B.2: Instrument relevance

	Impact	1 year	2 years	3 years	4 years
Panel A: Baseline specification					
Kleibergen-Paap F	60.78	45.94	33.21	20.46	11.87
Lewis-Mertens g_{min} − c.v.	121.37	114.34	90.89	53.26	25.37
Panel B: Triple interaction specification					
Kleibergen-Paap F	4.90	3.44	2.69	1.62	0.85
Lewis-Mertens g_{min} − c.v.	−6.36	−12.54	−15.73	−21.48	−26.38

Notes: The table reports weak-instrument diagnostics for the baseline local projection specification (Table 1) in Panel A and the triple interaction specification (Table 2) in Panel B. The empirical specifications are estimated on annual data from 1999 to 2019 for euro area NUTS-2 regions. Columns denote horizons $h = 0, 1, ..., 4$. Kleibergen-Paap F is the Kleibergen-Paap rk Wald statistic based on a Driscoll-Kraay covariance matrix. Lewis-Mertens g_{min} − c.v. is the test statistic of Lewis and Mertens, 2025 minus its critical value under the relative bias criterion, for a bias tolerance of 10% and a significance level of 10%; positive values reject the null hypothesis of weak instruments. It is computed with a Newey-West heteroskedasticity- and autocorrelation-consistent covariance matrix (Bartlett kernel, two lags). All specifications include time and region fixed effects.

B.1.3 National fiscal policy and regional economic conditions

For our identification, national spending should be unresponsive to conditions in the regions most exposed to it. We measure regional conditions as the growth rate of per capita GVA in region i minus the growth rate of per capita GVA in the rest of the country to which region i belongs, $\Delta\tilde{Y}_{i,t}$. Following Gabriel et al. (2023), we regress changes in national government spending on regional business-cycle indicators interacted with exposure shares, $s_i\Delta\tilde{Y}_{i,t}$. In addition, we also regress changes in national government spending on the triple interaction of regional business-cycle indicators, exposure shares, and aging, $s_i(D_{i,t-1} - \bar{D})\Delta\tilde{Y}_{i,t}$ to assess whether a region's demographic composition influences the national fiscal policy decision. Specifically, we estimate

$$\left(\frac{G_{I,t} - G_{I,t-1}}{Y_{I,t-1}}\right)_{i,t} = \alpha_i + \delta_t + \beta\, X_{i,t} + \varepsilon_{i,t}, \tag{B.1}$$

where the dependent variable is the country-level fiscal shift assigned to each region i in country I. $X_{i,t}$ is either $s_i\Delta\tilde{Y}_{i,t}$ or $s_i(D_{i,t-1} - \bar{D})\Delta\tilde{Y}_{i,t}$. The specification includes region and year fixed effects, α_i and δ_t.[4] Neither coefficient is significantly different from zero (Table B.3); thus national fiscal policy is not associated with a region's economic performance, neither on its own nor in interaction with aging.[5]

[4]Standard errors are computed using a wild cluster bootstrap at the country level. The small number of countries in our panel renders asymptotic cluster-robust inference unreliable (Cameron et al., 2008).

[5]Restricting the sample to regions in the top 5% or top 10% of fiscal exposure shares yields similar results.

Table B.3: National fiscal policy predictability based on regional economic performance

	$\left(\frac{G_{I,t}-G_{I,t-1}}{Y_{I,t-1}}\right)_{i,t}$	
	(1)	(2)
$s_i\Delta\tilde{Y}_{i,t}$	-0.0113	
	(0.0128)	
$s_i(D_{i,t-1}-\bar{D})\Delta\tilde{Y}_{i,t}$		0.0022
		(0.0018)
Observations	3033	3033

Notes: The table reports the estimates of panel regressions across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the GVA-weighted change in national government spending for region i in year t and by construction identical for all regions belonging to the same country. The independent variables are either $s_i\Delta\tilde{Y}_{i,t}$ or $s_i(D_{i,t-1}-\bar{D})\Delta\tilde{Y}_{i,t}$. The regional business-cycle indicator $\Delta\tilde{Y}_{i,t}$ is the GVA growth rate of region i minus the national GVA growth rate excluding region i. Luxembourg, which consists of a single NUTS-2 region, is excluded because this indicator is undefined. The specification includes both time and region fixed effects. Wild cluster bootstrapped standard errors at the national level are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

B.1.4 The response of taxation to government spending shocks

To assess whether regional taxes endogenously respond to our government spending shocks we regress income and wealth taxes (at the NUTS-2 regional level) (European Commission, Joint Research Centre, 2024) on our government spending shock measure according to the following specification:

$$\sum_{m=0}^{h}\frac{T_{i,t+m}-T_{i,t-1}}{Y_{i,t-1}}=\beta_h\sum_{m=0}^{h}\frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}+\nu_h(L)X_{i,t}+\alpha_{i,h}+\delta_{t,h}+\varepsilon_{i,t+h}, \tag{B.2}$$

where $T_{i,t}$ equals the per capita real taxes on income and wealth for region i at time t. All other notational definitions carry over from equation (1).

Table B.4 displays the results for the baseline government spending shock. The results indicate that regional taxes do not change in response to changes in regional government spending. All coefficients are close to zero and statistically insignificant.

To assess whether the tax rate, which we proxy by the ratio of tax revenues to GVA,

Table B.4: Taxation response to government spending shocks

	Impact	1 Year	2 Years	3 Years	4 Years
$\sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	0.074	0.033	0.007	0.004	0.009
	(0.061)	(0.077)	(0.093)	(0.092)	(0.082)
Observations	3028	2862	2696	2530	2364
Adj. R^2	0.126	0.185	0.215	0.217	0.237

Notes: The table reports the estimates of local projection panel regressions (B.2) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the cumulative change in real per capita taxes on income and wealth as a fraction of real per capita GVA. The reported independent variable is the cumulative change in real per capita government spending as a fraction of real per capita GVA. Regional level government spending is instrumented with the government spending Bartik as defined in equation (2). The specification includes time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

endogenously responds to changes in fiscal spending, we estimate the following specification:

$$\sum_{m=0}^{h}\left(\frac{T_{i,t+m}}{Y_{i,t+m}}-\frac{T_{i,t-1}}{Y_{i,t-1}}\right)=\beta_h\sum_{m=0}^{h}\frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}+\nu_h(L)X_{i,t}+\alpha_{i,h}+\delta_{t,h}+\varepsilon_{i,t+h}. \tag{B.3}$$

Table B.5 shows the results. The regional tax rate typically remains unaffected by changes in regional government spending.

Table B.5: Tax rate response to government spending shock

	Impact	1 Year	2 Years	3 Years	4 Years
$\sum_{m=0}^{h} \frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$	-0.041	-0.105	-0.136	-0.135	-0.122
	(0.068)	(0.089)	(0.110)	(0.109)	(0.097)
Observations	3028	2862	2696	2530	2364
Adj. R^2	0.092	0.152	0.194	0.229	0.263

Notes: The table reports the estimates of local projection panel regressions (B.3) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent variable is the cumulative change in the regional tax rate, measured as taxes on income and wealth relative to GVA. The reported independent variable is the cumulative change in real per capita government spending as a fraction of real per capita GVA. Regional level government spending is instrumented with the government spending Bartik as defined in equation (2). The specification includes time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

B.2 Robustness

This section presents various analyses that explore the robustness of the baseline finding that aging does not affect the fiscal multiplier in the euro area. The results shown in Table B.6 address concerns surrounding the output measure and instrumental variable definition. Table B.7 explores alternative aging measure and control vector specifications. Tables B.8 and B.9 focus on matters of sample selection.

Alternative output measures: Panel B of Table B.6 shows that the baseline results are robust to using alternative output measures, including GDP per capita and private-sector GVA per capita. Using real private-sector GVA, which excludes government activity, ensures that our findings are not mechanically driven by the accounting fact that regional government spending partly reflects public-sector wage payments, which predominantly accrue to prime-aged workers.

Alternative instrument definition: Following Nekarda and Ramey (2011), Panel C shows results based on sample-average government spending shares instead of predetermined shares (row "Sample average shares"). The former better accounts for potential structural changes in government spending shares over the sample period, but at the cost of potential contamination from contemporaneous regional economic conditions. The coefficient estimates are very similar to the baseline estimates, which is expected given the small amount of temporal variation in government spending shares documented earlier (Section B.1.1).

Next, we address the concern that anticipated fiscal policy changes could elicit a migration response which affects a region's age structure by instrumenting the aging variable with two-, five-, and ten-year lags of itself. Lagged aging is predictive of current aging, but less likely to be affected by anticipation effects. The results are robust to instrumenting the aging variable in this way (rows "2/5/10-year lagged aging").

Alternative measures of aging: The results displayed in Panel B of Table B.7 show that the results are robust to using alternative indicators of aging. First, we vary the share of the young to be either (i) 15-29, (ii) 20-34, and (iii) 15-34 which yields very similar results. Next, we replace the share of the young by the old-age dependency ratio. Again, the results are qualitatively similar: age structure does not seem to affect the fiscal multiplier in the euro area.

Table B.6: Robustness: output measure and instrument definition

	Impact	1 year	2 years	3 years	4 years
Panel A: Baseline specification					
Baseline	-0.039	-0.040	-0.014	0.009	0.036
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Panel B: Output measures					
Private GVA	-0.048	-0.053	-0.026	-0.002	0.023
	(0.045)	(0.043)	(0.043)	(0.043)	(0.042)
GDP	-0.108	-0.141‡	-0.123†	-0.113	-0.087
	(0.056)	(0.047)	(0.057)	(0.063)	(0.074)
Panel C: Instrument definition					
Sample average shares	-0.030	-0.031	-0.006	0.015	0.038
	(0.041)	(0.041)	(0.041)	(0.039)	(0.037)
2-year lagged aging	-0.043	-0.048	-0.023	-0.002	0.024
	(0.045)	(0.044)	(0.043)	(0.041)	(0.042)
5-year lagged aging	0.015	0.023	0.053	0.083	0.141
	(0.078)	(0.087)	(0.083)	(0.084)	(0.100)
10-year lagged aging	-0.110	-0.160	-0.121	-0.120	-0.108
	(0.098)	(0.072)	(0.078)	(0.085)	(0.097)

Notes: The table reports the estimates of local projection panel regressions (1) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent, independent and instrumental variables are those of the baseline specification (Table 1) unless noted otherwise. The reported coefficient estimates are those on the interaction of government spending with the demeaned aging indicator D. In Panel C, the "Sample average shares" specification constructs the Bartik instrument with spending shares averaged over 1999–2019 instead of predetermined shares. The lagged aging specifications keep the aging indicator at $t-1$ in the interaction term, but instrument this interaction term with the Bartik interacted with the aging indicator at $t-2$, $t-5$ or $t-10$. All specifications include both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

Additional covariates: Panel C of Table B.7 displays the results related to alternative control vector specifications. We begin by including control variables that potentially affect the fiscal multiplier and, at the same time, are potentially correlated with regional demographic structure. The additional control variables are included on their own and in interaction with government spending. These robustness checks yield results that are similar to the baseline ones.

First, we include the level of per capita GVA (row "GVA"), because Ilzetzki et al. (2013) and Sheremirov and Spirovska (2022) show that the fiscal multiplier increases with economic development. Next, we include the regional unemployment rate from Eurostat (Eurostat, 2025d) to account for economic slack (row "Unemployment rate"), which also has been shown to affect fiscal multipliers (Brueckner et al., 2023; Gabriel et al., 2023).

We also address the concern that the baseline result may reflect aging among public-sector

workers, rather than overall regional aging. We do so by controlling for aging among government employees. In particular, we look at the share of government employees in the 15 to 39 bracket (row "Empl. share 15–39...") (Eurostat, 2023, 2025a).[6]

Next, we include controls that are related to mechanisms through which aging could affect the fiscal multiplier, but which are not emphasized by our model. We control for the regional service sector share (row "Service sector share"), which tends to be higher in older regions and which has been associated with greater price rigidity (Cravino et al., 2022; Mangiante, 2024). We also control for the local savings rate to account for differences in fiscal amplification stemming from differences in savings behavior (row "National savings rate") (OECD, 2025b).[7] The baseline finding remains robust when these variables are included, suggesting that neither the service sector share nor the savings rate acts as a mediating channel driving the result.

Next, we include shock times country fixed effects, thereby controlling for country-specific responses to the fiscal shock measure. Similarly, including shock times year fixed effects accounts for year-specific responses to the fiscal shock measure (rows "Shock ×..."). Finally, row "FE only" reports results for a parsimonious specification that includes only region and time fixed effects, which again yields results very similar to the baseline.

[6]We use national data because regional data on the age structure of government employees are not readily available. Also, the 20–29 bracket is not available hence we approximate it by the bracket of 15–39.

[7]Regional savings rates data are not readily available, and therefore we use national-level data.

Table B.7: Robustness: aging measure and control variables

	Impact	1 year	2 years	3 years	4 years
Panel A: Baseline specification					
Baseline	-0.039	-0.040	-0.014	0.009	0.036
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Panel B: Aging measures					
Share young 15-29	-0.052	-0.064	-0.039	-0.017	0.008
	(0.035)	(0.032)	(0.033)	(0.033)	(0.035)
Share young 20-34	-0.028	-0.028	-0.013	-0.001	0.011
	(0.029)	(0.031)	(0.032)	(0.031)	(0.029)
Share young 15-34	-0.038	-0.043	-0.028	-0.016	-0.002
	(0.027)	(0.026)	(0.027)	(0.027)	(0.026)
Old-age dependency ratio	0.025	0.040‡	0.035†	0.030	0.029
	(0.014)	(0.013)	(0.014)	(0.015)	(0.014)
Panel C: Control variables					
GVA	-0.093†	-0.086	-0.071	-0.041	-0.013
	(0.037)	(0.042)	(0.039)	(0.041)	(0.041)
Unemployment rate	-0.047	-0.038	-0.011	0.016	0.052
	(0.043)	(0.048)	(0.051)	(0.052)	(0.051)
Empl. share 15-39 in nat. gov't	-0.066	-0.073	-0.058	-0.038	-0.013
	(0.039)	(0.040)	(0.036)	(0.035)	(0.035)
Service sector share	-0.040	-0.033	-0.003	0.030	0.059
	(0.058)	(0.065)	(0.065)	(0.065)	(0.065)
National savings rate	-0.050	-0.064	-0.055	-0.042	-0.033
	(0.039)	(0.040)	(0.036)	(0.039)	(0.048)
Shock × country FE	-0.025	-0.032	-0.013	0.011	0.027
	(0.043)	(0.041)	(0.040)	(0.039)	(0.039)
Shock × year FE	-0.038	-0.050	-0.013	-0.041	-0.026
	(0.046)	(0.042)	(0.053)	(0.048)	(0.052)
FE only	-0.048	-0.040	-0.007	0.017	0.041
	(0.042)	(0.043)	(0.045)	(0.043)	(0.043)

Notes: The table reports the estimates of local projection panel regressions for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. Each specification modifies regression (1) as described below; all other variables, instruments and controls are as in (1). The reported coefficient estimates are those on the interaction of government spending with the demeaned aging indicator D. In Panel B, the aging indicator D is replaced by alternative measures: young shares starting at age 15 are measured relative to the population aged 15+, and the old-age dependency ratio is the population aged 65+ relative to the population aged 20-64. In Panel C, one covariate at a time is added, demeaned at $t-1$, both in levels and interacted with government spending; the latter interaction is instrumented with the Bartik interacted with the covariate. All specifications include both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

Sample selection: Table B.8 shows that the results are robust to several relevant sample selection tests. First, we omit all regions with only partial data coverage to estimate our specification with a balanced panel. Second, we exclude all islands and overseas regions

Table B.8: Robustness: regional sample selection

	Impact	1 year	2 years	3 years	4 years
Panel A: Baseline specification					
Baseline	-0.039	-0.040	-0.014	0.009	0.036
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Panel B: Sample selection					
No partially covered regions	-0.041	-0.044	-0.017	0.008	0.033
	(0.045)	(0.045)	(0.044)	(0.042)	(0.042)
No islands or overseas departments	-0.026	-0.015	0.012	0.018	0.038
	(0.038)	(0.028)	(0.028)	(0.025)	(0.024)

Notes: The table reports the estimates of local projection panel regressions (1) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent, independent and instrumental variables are those of the baseline specification (Table 1) unless noted otherwise. The reported coefficient estimates are those on the interaction of government spending with the demeaned aging indicator D. In Panel B, "No partially covered regions" excludes regions with incomplete data coverage over the sample period (ITH5, ITI3, DED4, DED5, FRY1, FRY5, IE04, IE05, IE06). "No islands or overseas departments" excludes the French overseas departments (FRY1–FRY5), the Spanish autonomous cities of Ceuta (ES63) and Melilla (ES64), and the following island regions: Corsica (FRM0), the Balearic Islands (ES53), the Canary Islands (ES70), the Azores (PT20), Madeira (PT30) and Åland (FI20). All specifications include both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

including Guadeloupe (FRY1), Martinique (FRY2), French Guiana (FRY3), La Réunion (FRY4), Mayotte (FRY5), Corsica (FRM0), Balearic Islands (ES53), Ceuta (ES63), Melilla (ES64), Canary Islands (ES70), Azores (PT20), Madeira (PT30), and Åland (FI20).

Leave-one-country-out: We also conduct a leave-one-country-out analysis to evaluate the influence of particular countries. Table B.9 shows that the coefficient estimates for the aging × spending interaction remain stable across subsamples, indicating that the results are not driven by individual outlier countries.

Table B.9: Robustness: leave-one-country out analysis

Country	Impact	1 year	2 years	3 years	4 years
Baseline	-0.039	-0.040	-0.014	0.009	0.036
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Observations	3061	2895	2729	2563	2397
Excluding AT	-0.041	-0.042	-0.015	0.008	0.035
	(0.044)	(0.044)	(0.045)	(0.043)	(0.042)
Observations	2890	2733	2576	2419	2262
Excluding BE	-0.034	-0.038	-0.011	0.013	0.040
	(0.050)	(0.050)	(0.049)	(0.047)	(0.046)
Observations	2852	2697	2542	2387	2232
Excluding DE	-0.009	-0.013	0.010	0.038	0.064
	(0.046)	(0.048)	(0.049)	(0.050)	(0.052)
Observations	2361	2233	2105	1977	1849
Excluding EL	-0.064	-0.097†	-0.105‡	-0.090	-0.068
	(0.043)	(0.040)	(0.036)	(0.044)	(0.052)
Observations	2814	2661	2508	2355	2202
Excluding ES	0.014	0.029	0.058	0.079	0.095†
	(0.039)	(0.043)	(0.044)	(0.046)	(0.044)
Observations	2700	2553	2406	2259	2112
Excluding FI	-0.057	-0.057	-0.030	-0.011	0.017
	(0.040)	(0.039)	(0.040)	(0.036)	(0.036)
Observations	2966	2805	2644	2483	2322
Excluding FR	-0.039	-0.044	-0.015	0.005	0.032
	(0.047)	(0.048)	(0.049)	(0.045)	(0.044)
Observations	2575	2436	2297	2158	2019
Excluding IE	-0.041	-0.044	-0.016	0.010	0.036
	(0.044)	(0.044)	(0.045)	(0.043)	(0.042)
Observations	3046	2883	2720	2557	2394
Excluding IT	-0.062	-0.058	-0.034	-0.018	0.006
	(0.037)	(0.043)	(0.042)	(0.040)	(0.042)
Observations	2664	2519	2374	2229	2084
Excluding LU	-0.039	-0.040	-0.014	0.009	0.035
	(0.044)	(0.044)	(0.045)	(0.042)	(0.042)
Observations	3042	2877	2712	2547	2382
Excluding NL	-0.047	-0.050	-0.024	-0.003	0.021
	(0.042)	(0.038)	(0.038)	(0.035)	(0.035)
Observations	2833	2679	2525	2371	2217
Excluding PT	-0.048	-0.047	-0.013	0.009	0.034
	(0.050)	(0.050)	(0.051)	(0.049)	(0.047)
Observations	2928	2769	2610	2451	2292

Notes: The table reports the estimates of local projection panel regressions (1) for horizons $h = 0, 1, ..., 4$, across euro area NUTS-2 regions on annual data from 1999 to 2019. The dependent, independent and instrumental variables are those of the baseline specification (Table 1). The reported coefficient estimates are those on the interaction of government spending with the demeaned aging indicator D. The rows report the baseline specification and, in turn, the specification excluding one country at a time. All specifications include both time and region fixed effects. Driscoll-Kraay standard errors are reported in parentheses. †, and ‡ denote significance at the 5% and 1% levels, respectively.

References

Brueckner, M., Pappa, E., & Valentinyi, A. (2023). Geographic cross-sectional fiscal spending multipliers and the role of local autonomy: Evidence from European regions. *Journal of Money, Credit and Banking*, *55*(6), 1357–1396.

Cameron, A. C., Gelbach, J. B., & Miller, D. L. (2008). Bootstrap-based improvements for inference with clustered errors. *The Review of Economics and Statistics*, *90*(3), 414–427.

Cravino, J., Levchenko, A., & Rojas, M. (2022). Population aging and structural transformation. *American Economic Journal: Macroeconomics*, *14*(4), 479–498.

European Commission, Joint Research Centre. (2024). *ARDECO: Annual Regional Database of the European Commission*. https://territorial.ec.europa.eu/ardeco

Eurostat. (2023). *Employed persons by economic activity (NACE rev. 1.1) (1992–2008) (lfsa_egana)*. https://doi.org/10.2908/LFSA_EGANA

Eurostat. (2025a). *Employed persons by economic activity (NACE rev. 2) (lfsa_egan2)*. https://doi.org/10.2908/LFSA_EGAN2

Eurostat. (2025b). *Population on 1 January by age group, sex and NUTS 2 region (demo_r_pjangroup)*. https://doi.org/10.2908/DEMO_R_PJANGROUP

Eurostat. (2025c). *Population structure indicators by NUTS 2 region (demo_r_pjanind2)*. https://doi.org/10.2908/DEMO_R_PJANIND2

Eurostat. (2025d). *Unemployment rates by sex, age, educational attainment level and NUTS 2 region (lfst_r_lfu3rt)*. https://doi.org/10.2908/LFST_R_LFU3RT

Gabriel, R. D., Klein, M., & Pessoa, A. S. (2023). The effects of government spending in the Eurozone. *Journal of the European Economic Association*, *21*(4), 1397–1427.

Ilzetzki, E., Mendoza, E. G., & Végh, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, *60*(2), 239–254.

Lewis, D. J., & Mertens, K. (2025). A robust test for weak instruments for 2SLS with multiple endogenous regressors. *The Review of Economic Studies*, rdaf103. https://doi.org/10.1093/restud/rdaf103

Mangiante, G. (2024, January). *Demographic trends and the transmission of monetary policy* [SSRN Working Paper 4149657]. http://dx.doi.org/10.2139/ssrn.4149657

Nekarda, C. J., & Ramey, V. A. (2011). Industry evidence on the effects of government spending. *American Economic Journal: Macroeconomics*, *3*(1), 36–59.

OECD. (2025a). *Annual government expenditure by function (COFOG) (DSD_NASEC10@DF_TABLE11)* (Version 1.1). https://data-explorer.oecd.org/vis?df%5Bds%5D=dsDisseminateFinalDMZ&df%5Bid%5D=DSD_NASEC10%40DF_TABLE11&df%5Bag%5D=OECD.SDD.NAD&df%5Bvs%5D=1.1&dq=A.AUT%2BBEL%2BFIN%2BFRA%2BDEU%2BGRC%2BIRL%2BLUX%2BNLD%2BPRT%2BESP%2BITA.S13..D.P3..._T...V..&pd=1999%2C2019

OECD. (2025b). *National Accounts at a Glance: Income (DSD_NAAG@DF_NAAG_II)*. https://data-explorer.oecd.org/vis?df%5Bds%5D=dsDisseminateFinalDMZ&df%5Bid%5D=DSD_NAAG%40DF_NAAG_II&df%5Bag%5D=OECD.SDD.NAD&dq=A.ESP%2BAUT%2BBEL%2BFIN%2BFRA%2BDEU%2BGRC%2BIRL%2BITA%2BLUX%2BNLD%2BPRT.B8N.PT_B1GQ.&pd=1999%2C2019

OECD. (2025c). *Net replacement rates in unemployment (DSD_TAXBEN_NRR@DF_NRR)*. https://data-explorer.oecd.org/vis?df%5Bds%5D=dsDisseminateFinalDMZ&df%5Bid%5D=DSD_TAXBEN_NRR%40DF_NRR&df%5Bag%5D=OECD.ELS.JAI

Sheremirov, V., & Spirovska, S. (2022). Fiscal multipliers in advanced and developing countries: Evidence from military spending. *Journal of Public Economics*, *208*, 104631.

Thissen, M., Lankhuizen, M., van Oort, F., Los, B., & Diodato, D. (2018). *EUREGIO: The construction of a global IO database with regional detail for Europe for 2000–2010* (Discussion Paper No. TI 2018-084/VI). Tinbergen Institute. https://data.europa.eu/data/datasets/pbl-euregio-database-2000-2010