The Effects of Government Spending in the Eurozone*

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Abstract

Using a newly assembled rich dataset at the regional level, this paper provides novel empirical evidence on the effects of fiscal policy in the Eurozone. Our baseline estimates reveal a government spending relative output multiplier around 2, an employment multiplier of 1.4, and a cost per job created of approximately €30,000. Moreover, we find that a regional fiscal stimulus leads to a significant increase in private investment, productivity, durable consumption, and the labor share together with a significant rise in total hours worked driven by changes in the extensive margin (total employment), whereas the intensive margin (hours per worker) barely reacts. Contrarily to the common policy narrative of strong positive spillover effects, we estimate only small regional fiscal spillovers. Finally, our findings reveal strong heterogeneities across economic sectors, states of the economy, and member states.

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1 Introduction

How does fiscal policy affect the Eurozone economy? Over the last decade, this topic has gained renewed attention among academics and policymakers alike. As the main policy interest rate of the European Central Bank (ECB) reached its lower bound, commentators have frequently asked for more fiscal actions to stimulate the economy. In one of his last press conferences, parting ECB President Mario Draghi stated that "...now it's high time I think for the fiscal policy to take charge" (Draghi 2019). Moreover, motivated by the close trade linkages among members states of the European single market, there is particular interest in how fiscal interventions spill over from one region to another (Blanchard et al. 2016). Most recently, the Covid-19 rescue package implemented by the European Commission has emphasized the urge to learn more about the influence of government spending on the Eurozone economy.[1]

Despite the increased interest in the effects of fiscal policy in the Eurozone, the literature still lacks a thorough analysis that is able to address these important questions. In this paper, we aim to fill this gap by providing new empirical evidence on the economic impact of fiscal policy and its transmission mechanism in the Eurozone. In particular, we follow recent studies on the U.S. economy (Chodorow-Reich et al. 2012; Nakamura and Steinsson 2014; Bernardini et al. 2020) and use regional variation in government spending to estimate how fiscal policy shapes the Eurozone economy. However, in contrast to most of the existing literature our analysis goes far beyond estimating fiscal spending multipliers. First, we study the underlying fiscal transmission mechanism in detail by providing novel evidence on how changes in regional government spending affect key variables like investment, wages, and productivity. Second, we rely on detailed sectoral data to estimate sector-specific multipliers. Thirdly, we combine regional data on public expenditures and economic activity with a measure of bilateral trade across European regions to assess the significance of regional fiscal spillovers. Finally, we address the potential problem of dynamic and cross-sectional heterogeneity which has been shown to pose a threat to cross-sectional multiplier estimates in the U.S. (Canova 2020).

For our empirical analysis, we use a newly assembled rich dataset, ARDECO, which offers series on output, private investment, employment, hours worked, and wages at different regional aggregations and sectoral divisions. We use the sum of gross value added and intermediate consumption of the non-market sector as a measure of regional government spending. To justify this choice, we show that our measure and government spending are closely linked by definition and that both series' statistical properties are very similar at the national level. For identification, we use a Bartik type instrument, which identifies the effect of government spending on

[1] For a general discussion on the current challenges for fiscal policy in the Eurozone, see, e.g., Pappa (2020) or Bilbiie et al. (2021).

economic activity by relating the changes in *regional* government spending to the differential regional exposure to changes in *national* government spending (Bartik 1991). We combine the Bartik instrument with instrumental variable local projections to estimate fiscal multipliers and impulse responses.

Our approach of using regional variation in government spending to trace out the impact of fiscal policy offers several advantages compared to an analysis at the national level. First, because all regions are part of the monetary union, they face the same monetary policy set by the ECB. Thus, by including time fixed effects into our regressions, we can control for confounding monetary policy interventions, which is a common challenge when studying the effects of government spending at the national level. Second, our analysis at the regional level substantially increases the number of observations such that potential state-dependencies and heterogeneous effects across economic sectors can be estimated more efficiently. Thirdly, the significant differences in intra-regional trade flows allow a highly detailed investigation into the size of fiscal spillovers. Similar to Nakamura and Steinsson (2014), our results show relative effects, that is, we estimate the impact of an increase in government spending in one region of the Eurozone relative to another on relative economic activity, the "open economy relative multiplier".

Our baseline estimates reveal a government spending relative output multiplier of 2.2, which implies a €1.2 increase (decrease) in relative private sector production for every €1 increase (decrease) in relative government production. Moreover, we find an employment multiplier of 1.4, which shows that changes in regional government spending have sizeable effects on local labor markets. In particular, our estimates imply that a €1 million increase in government spending creates 33 new jobs four years after the shock materialized or, in other words, a cost per job created of about €30,000. We show that these results are robust to several modifications of the baseline model, like different constructions of the Bartik instrument, changes in the sample, and controlling for national tax policies and sovereign risk premia. Furthermore, to account for potential anticipation concerns, we show that the results remain when constructing the Bartik instrument by only using variations in national government spending that are orthogonal to past economic conditions, due to changes in national military spending or professional forecast errors. We also demonstrate that our results are not prone to dynamic and cross-sectional heterogeneity.

To shed light on the underlying fiscal transmission mechanism, we estimate the responses of several interesting variables to the regional fiscal shock. We find that an increase in regional government spending leads to a significant increase in private investment. This crowding-in of private investment can be rationalized by a strong and persistent rise in labor productivity and total factor productivity. Thus, our evidence points towards strong positive supply-side effects of government spending changes, in line with recent U.S. evidence by Auerbach et al. (2020b), D'Alessandro et al. (2019), and Jørgensen and Ravn (2020). Furthermore, the fiscal stimulus induces a significant rise in durable consumption (measured by the number of motor vehicles) together with higher real wages and an increase (decrease) in the labor share (markup). We also take a closer look at the effects on regional labor markets and find that higher regional government spending induces a considerable increase in total hours worked. Interestingly, the bulk of this increase is accounted for by the extensive margin (total number of employees), whereas the intensive margin (hours per employee) barely responds to the regional fiscal shock.

Using the full level of detail in the dataset, we inspect which economic sectors are responsible for the significant crowding-in of private economic activity and employment by estimating sector-specific fiscal multipliers. We find that the industry and (non-financial) services sectors account for the lion's share of the increase in private demand. While both sectors together make up for less than 60% of total private activity, they contribute to more than 75% of the fiscal policy induced private economic expansion. In light of the disproportional amplification effects of these two sectors, policymakers should target them specifically when designing adequate stabilization measures. Although the close trade linkages across European regions within the European single market might suggest strong spillover effects, our estimates reveal only small (and mostly insignificant) fiscal spillovers which questions the widely shared belief among policy circles of positive and sizable fiscal spillovers (e.g., In't Veld 2016). Moreover, in light of these findings, recommendations to jump-start the European economy by increasing public spending in regions with fiscal capacity should be interpreted with caution since the positive spillover effects might be limited.

Finally, we detect significant state dependencies. First, fiscal multipliers are significantly larger in economic recessions than in economic booms. Second, fiscal policy is significantly more effective in core countries of the Eurozone compared to periphery countries. However, in contrast to recent studies at the national level (Barnichon et al. 2020; Born et al. 2019), we find no evidence that the sign of the fiscal intervention considerably affects the size of the multiplier. Government spending stimulus-multipliers do not significantly differ from consolidation-multipliers.

What do our regional estimates imply for national multipliers? As argued by Chodorow-Reich (2019), cross-sectional multipliers provide a lower bound for the closed economy, deficit-financed, no-monetary-policy-response multiplier. Thus, our results would suggest a national output multiplier of above but close to 2 which is slightly larger than the multiplier of 1.7 proposed by Chodorow-Reich (2019) for the U.S. economy. While this value might appear large at first sight, one has to keep in mind that our estimates abstract from any endogenous monetary policy tightening in response to the fiscal expansion, which according to standard theory, dampens the size of the multiplier. Against this background, time-series studies which estimate fiscal multipliers at the zero lower bound find multiplier magnitudes that are much more in line with our cross-sectional evidence (Ramey and Zubairy 2018; Miyamoto et al. 2018; Klein and Winkler

2021).

Our paper contributes to the recent and fast-growing literature that uses subnational data to estimate the impact of fiscal policy (Becker et al. 2010, 2013; Nakamura and Steinsson 2014; Dupor and Guerrero 2017; Bernardini et al. 2020; Auerbach et al. 2020b). So far, this literature mainly focuses on the U.S. economy, with only limited evidence for the Eurozone.[2] In general, one could expect that fiscal multipliers differ between the U.S. and the European economy due to non-trivial differences in institutional constraints and characteristics of financial services, goods markets, and labor mobility, for example.

Some previous papers rely on sub-national data to study the economic effects of regional funds from the European Union (EU) (Becker et al. 2010, 2013; Coelho 2019; Canova and Pappa 2021). While these structural funds typically face a significant implementation lag and primarily intend to foster long-run growth of lagging regions, our analysis focuses on discretionary fiscal policy and our identification relies on variation in government spending and economic activity in the Eurozone.

Brueckner et al. (2019) use a similar dataset and investigate how the size of the fiscal spending multiplier depends on the degree of local autonomy across European regions. In contrast to their paper and much of the existing U.S. evidence, we take on a more general perspective and provide new insights into several important aspects of the fiscal transmission mechanism in the Eurozone. To be more precise, given the detailed level of the dataset, we are able to zoom into a wide range of fiscal policy effects. In particular, the underlying drivers of our fiscal multiplier estimates, like the influence of fiscal policy on investment, productivity, (public and private) employment, or earnings can be considered carefully. Moreover, the dataset enables us to conduct a thorough investigation into regional fiscal spillovers and heterogeneous effects across economic sectors, states of the economy, and member states. Overall, we think that our new insights have the potential to fruitfully stimulate discussions among academics and policymakers about the gains and limitations of fiscal policy in the Eurozone.

The remainder of the paper is organized as follows. Section 2 describes the data we use. Section 3 presents the methodology. Section 4 shows our empirical results. Finally, Section 5 concludes.

[2]Studies on the Italian and Portuguese economies, respectively, are Acconcia et al. (2014) and Carvalho et al. (2020). We refer the reader to Chodorow-Reich (2019) for an extensive survey on the cross-sectional evidence on fiscal stimulus using subnational data.

2 Data

We use data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy (ARDECO), which is maintained and updated by the Joint Research Centre.[3] It is a highly disaggregated dataset across both sectoral and regional dimensions. The database contains a set of various long time-series indicators for EU regions at several statistical scales. It expands the Cambridge Econometrics Dataset used by much of the literature on European regional dynamics (e.g., Badinger et al. 2004).

The database provides regional measures for output (gross domestic product (GDP) and gross value added (GVA)), investment, earnings, hours worked and employment for different economic sectors like industry, construction, financial, non-financial, and non-market services. The dataset is an annual unbalanced panel covering the period 1980–2017 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. By construction, ARDECO's regional data is consistent with the commonly used national accounts data (see Lequiller and Blades (2006, 2014) for more details on the construction of the national accounts data). In particular, the regional ARDECO time series are constructed in such a way that the country aggregates equal the corresponding time series in the National Accounts reported in the AMECO dataset.[4]

The data are divided into NUTS (Nomenclature of Territorial Units for Statistics) regions. NUTS is a geocode standard for referencing the subdivisions of countries for statistical purposes. The hierarchy of three NUTS levels (NUTS 1, 2, 3) is established by Eurostat in agreement with each member state, and for most countries the respective NUTS level corresponds to a specific administrative division within the country. ARDECO provides all data series at these regional disaggregation levels except for the NUTS 3, for which it reports only population, employment, GDP, and GVA.

Our baseline Eurozone sample covers 12 countries, namely the first Euro adopters Austria, Belgium, Finland, France, Ireland, Italy, Luxembourg, Germany, Greece, the Netherlands, Portugal, and Spain. We exploit NUTS 2 level data from 1999 (when the Euro was introduced) until 2017 for all countries except Greece, which joined the Euro in 2001. Therefore, we only use Greek data from 2001 onwards.[5] Our sample thus consists of regions that are part of a monetary union with a common policy interest rate set by the ECB. As the policy interest rate is the same for all regions of the Eurozone, our approach of estimating regional fiscal multipliers has the advantage that we can directly control for confounding monetary policy reactions, which is a common challenge for estimates at the country level (Nakamura and Steinsson 2014). In total, our sample consists

[3]It can be found online here.
[4]See Appendix A.1 for more information.
[5]See Table A.1 for more details on the NUTS 2 classification for the countries used in the sample.

of 167 European regions which generates a much larger cross-sectional variation compared to previous studies on the U.S. states level (Nakamura and Steinsson 2014; Bernardini et al. 2020).

For our main analysis, we use data on demography (total population), labor markets (employment, employee compensation, total hours worked), capital formation (gross fixed capital formation) and output (GDP and GVA).[6]

2.1 Regional Government Spending Data

Official data on final consumption expenditure of the general government (henceforth, government spending) is not available at the European regional level. Hereinafter, in the spirit of Brueckner et al. (2019), we use the sum of GVA and intermediate consumption of the non-market sector as a proxy for government spending. GVA of the non-market sector is computed as the sum of compensation to employees (including social contributions), consumption of fixed capital (which measures the decline in value of fixed assets owned as a result of normal wear and tear and obsolescence), and taxes less subsidies on production.[7] [8] Because GVA of the non-market sector does not include intermediate consumption, which is, however, one of the main components of government spending, we use input-output (IO) tables from the PBL EUREGIO database to calculate regional intermediate consumption shares of the non-market sector which we then add to the GVA of the non-market sector.

Our regional measure (GVA plus intermediate consumption of the non-market sector) is a valid proxy for government spending for several reasons. First, as previously mentioned, ARDECO's regional data is consistent with the national accounts data by construction. By definition, there exists a close link between government spending and the GVA of the non-market sector. In particular, even though the non-market sector includes other institutional units, the general government is the main actor responsible for changes in the non-market GVA. The non-market sector consists of six sub-sectors from which the three largest are also closely linked to the general government in the national accounts. Taking the example of Finland, the only country in our sample which publishes the required detailed information, on average, 86% of the GVA of the three largest sub-sectors (public administration and defense, education, human health and social work activities) was booked by the general government during our sample period.[9] Consequently,

[6] The construction of all variables used in the paper is described in the appendix, see Table A.2.

[7] For more details, see the Manual on Regional Accounts from Eurostat. Importantly, net taxes on production does not include neither consumption nor corporate taxes.

[8] Data from PBL EUREGIO indicate that, for the regions in our sample and the period of 2000-2010, GVA of the non-market sector is composed on average of 67% compensation to employees, 30% consumption of fixed capital, and 3% net taxes on production. The PBL EUREGIO database is discussed in more detail in Appendix A.3.

[9] Data for other countries not considered in our sample confirm this pattern. For example, for Estonia in 2018, 89% of public administration and defense, education, human health and social work activities GVA was booked by the general government, comparable to the 89% for Lithuania in 2019, 90% for Latvia in 2010, and 95% for Ukraine in

almost the entire variation in the GVA of the non-market sector refers to activities by the general government.

Second, government spending and our proxy measure show very similar statistical properties. When running regressions at the national and regional level, we find a strong and significant relationship between both measures with estimated coefficients close to 1. We will thus refer to our regional proxy as government spending throughout the rest of the paper. More details on the series, data sources, and justification of our proxy choice are given in Appendix A.2.[10]

3 Methodology

In estimating the effects of a regional government spending shock, we closely follow Bernardini et al. (2020). Particularly, we study the impact of regional government spending in the Eurozone by first examining the dynamics of the cumulative GDP and employment multipliers. To that end, we use local projections (Jordà 2005) and estimate for each horizon $h = 0, ..., 4$, the following equation:

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

where $z_{i,t+m}$ is either the change in real per capita GDP, $\frac{Y_{i,t+m}-Y_{i,t-1}}{Y_{i,t-1}}$, or the change in the employment rate, $\frac{E_{i,t+m}-E_{i,t-1}}{E_{i,t-1}}$, in region i between time $t-1$ and time $t+m$. Following Nakamura and Steinsson (2014), the employment multiplier is measured in terms of the employment ratio. $\frac{G_{i,t+m}-G_{i,t-1}}{Y_{i,t-1}}$ is the change in real per capita government spending in region i between time $t-1$ and time $t+m$, relative to real per capita GDP in $t-1$.[11] When $z_{i,t+m}$ indicates the change in real GDP, as government spending and GDP are in the same units, β_h directly yields, for each horizon h, the output multiplier. In the case of employment, β_h measures the employment multiplier as the change in the employment rate in response to a one percent increase in government spending relative to GDP.

$(L)X_{i,t-k}$ is a vector of control variables with $k = 2$, and $\alpha_{i,h}$ and $\delta_{t,h}$ are respectively region and time fixed effects, which are included in the regressions to control for region-specific characteristics and common aggregate changes like, for example global shocks, and shocks that

2015.

[10]One should keep in mind that our regional government spending measure does not include investment expenditure and thus, does not account for procurement contracts related to fixed capital formation. Thus, our estimates have to be interpreted as government consumption multipliers.

[11]Weighing by population is important to obtain more representative population average treatment effect estimates (Chodorow-Reich 2020).

originate in another country and spill over to the Eurozone. Importantly, the time fixed effects absorb any endogenous monetary policy reaction by the ECB in response to an increase in government spending. Thus, our approach of using regional data to trace out the dynamic effects of a government spending shock does not face the problem of properly controlling for changes in the monetary policy stance, which is a common challenge for fiscal policy analyses at the national level. The vector of control variables includes two lags of the variable of interest (GDP growth or the growth rate in the employment ratio) and the growth rate in real per capita government spending. We use Driscoll and Kraay (1998) standard errors, which take into account the potential residual correlation across regions, as well as serial correlation and heteroskedasticity among the residuals over time.[12]

For identification, we follow, among others, Nekarda and Ramey (2011), Dupor and Guerrero (2017), and Perotti et al. (2007) and instrument the change in government spending with a Bartik-type instrument (Bartik 1991). We compute the instrument as

$$Bartik_{i,t} = s_i \times \frac{(G_{I,t} - G_{I,t-1})}{Y_{I,t-1}}, \tag{2}$$

where $s_i = \dfrac{\overline{G_i}}{\overline{G_I}}$ and $\overline{G_i}$ and $\overline{G_I}$ are averages of per capita government spending in region i and country I, respectively, in the five years preceding country I's Eurozone accession. In order to compute these averages, we use data from 1994 to 1998 for all countries in the sample except Greece, which joined the Eurozone in 2001 and for which we use 1996 to 2000. Intuitively, if s_i is above 1, region i spends more per capita than the national average. This implies that a disproportionate amount is spent in this region compared to other regions in the country. Figure B.1 in the appendix shows a heat map depicting the share s_i for the considered NUTS 2 regions. There is considerable cross-sectional variation in this measure, ranging from 0.38 to 2.27. We calculate the lowest shares for Mayotte (France, 0.38), Peloponnese (Greece, 0.70), and Andalucia (Spain, 0.70), and the highest shares for Melilla (Spain, 2.27), Ceuta (Spain 2.16), and Brussels Capital District (Belgium, 2.10).[13] There is only small variation in the shares over time. When calculating time-varying shares for each region, we find that the average standard deviation is 0.03. This low time variation justifies our choice of constant regional shares.[14]

[12]In the appendix, we show that our main results change marginally when dropping additional control variables and only including region and time fixed effects in the regressions (see Panel C from Table B.1).

[13]We show that our results change little when, instead of using per capita values, the regional shares are constructed using absolute values. In this case, the shares indicate a scaling factor and add up to one at the country level. We choose the per capita specification of the Bartik instrument as the baseline because it provides a higher F-statistic compared to the absolute level specification. We drop the region of Guadeloupe from our entire analysis because it shows an extremely high government spending share (above 100).

[14]Nevertheless, in a robustness exercise in Section 4.2, following Nekarda and Ramey (2011) and acknowledging that there might have been structural changes throughout the sample, we use the full Eurozone sample to compute

The idea of the Bartik instrument is to scale national government spending such that spending varies more in regions with a larger predetermined share of national government spending. Moreover, as the predetermined share of average spending measures the differential exposure in regions to common national government spending changes, it helps to avoid confounding effects as argued by Goldsmith-Pinkham et al. (2020).[15]

More precisely, our identifying assumption is that central governments do not change spending because regions that receive a disproportionate amount of government spending are doing poorly relative to other regions. Intuitively, this assumption might be violated when focusing on high aggregation levels with only few regions within a country because politically and economically important regions could directly influence central government decisions. There is evidence that our analysis at the NUTS 2 level is not subject to this concern. In particular, for each region we construct a measure of the relative stance of the business cycle defined as the difference between the regions annual GDP growth rate and the average annual growth rate of all other regions within the same country. We regress the growth rate of national government spending on this regional business cycle indicator interacted with the regional shares, s_i. A negative coefficient would indicate a violation of our identifying assumption in the sense that national government spending would increase when regions spending relatively more are doing poorly compared to other regions. However, we find a small positive and insignificant coefficient suggesting that our identification strategy is valid.[16] Notably, in Section 4.2, we also conduct an additional robustness check where we show that the main results remain when going to the NUTS 3 level (with 922 regions in total), where direct influence of some regions on the central government should not be a severe concern after all.

Another potential concern with our estimation strategy would arise if regions receiving large amounts of national spending were more cyclically sensitive than other regions. We use the standard deviation of output growth to compare the cyclical sensitivity of regions that receive large and small amounts of national spending. The standard deviations are almost identical in regions with above median national spending shares and in regions with below median national spending shares (0.028 versus 0.029), indicating that a difference in overall cyclical sensitivity does not bias our approach.

Notably, in Section 4.2, we demonstrate that our main findings are robust to replacing national government spending in the construction of the Bartik instrument by different measures of unexpected changes in national government expenditure. For this purpose, we will use the

the share s_i instead of the five years preceding the Eurozone accession. The main findings remain unchanged.

[15]Figure B.2 shows the evolution of $\frac{G_{i,t}}{G_{I,t}}$ over time for four selected regions. It reassures that the relationship between regional and national government spending per capita is very stable during the sample period.

[16]We find similar results when running the regression only for the regions with the top 5%, top10%, or top 20% highest shares.

residual of an estimated fiscal spending rule, military spending changes, and the forecast error of government spending.

Besides computing output and employment multipliers, we further estimate impulse response functions for other important variables as

$$w_{i,t+m} = \beta_h \frac{G_{i,t} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h(L)X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m}, \tag{3}$$

where $w_{i,t+m}$ is the growth rate of the variable of interest, $\frac{W_{i,t+m}-W_{i,t-1}}{W_{i,t-1}}$, for all variables except the labor share, for which we consider $w_{i,t+m}$ to be the difference in levels, $W_{i,t+m} - W_{i,t-1}$. $(L)X_{i,t-k}$ is a vector of control variables and $\alpha_{i,h}$ and $\delta_{t,h}$ are again region and time fixed effects, respectively. The vector of control variables now includes two lags of the respective variable of interest and real per capita government spending growth. β_h directly yields the response of the variable of interest to a one percent increase in government spending relative to GDP instrumented by the Bartik measure. One important difference between equations (1) and (3) is that equation (1) estimates the cumulated response to the cumulated government spending increase, whereas equation (3) estimates the cumulated response to a one-year change in government spending.

4 Results

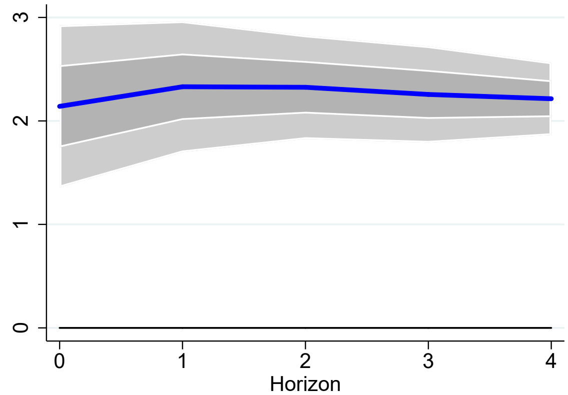
4.1 Output and Employment Multipliers

We start by presenting the estimates of the output and employment multiplier of the baseline model. The main results are shown in Figure 1. Panels 1a and 1b show the cumulative GDP and employment multipliers estimated according to Equation (1). The solid line shows the point estimate β_h over a horizon of four years. Panels 1c, 1d, and 1e plot respectively the cumulated impulse responses of GDP, employment ratio, and government spending estimated according to Equation (3). The dark and light shadings are 68% and 95% Driscoll and Kraay (1998) adjusted confidence bands. Finally, Panel 1f depicts the F-Statistic test of weak instruments for the first-stage regression of the output multiplier.[17] For just-identified specifications, it is equivalent to the Olea and Pflueger (2013) F-Statistic and the threshold is 23.1 for the 5% critical value. For easier visual comparison, we set an upper bound of 200 on the reported F-Statistic.

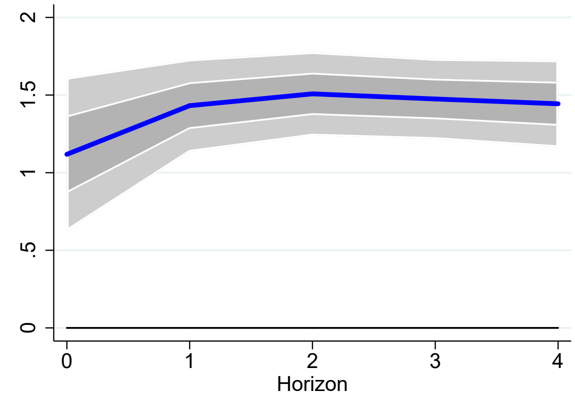
As Panel 1f shows, the Bartik measure is a strong instrument for regional government spending for all years of the forecast horizon. The computed F-Statistic is well above the threshold value of 23.1, suggesting that weak instruments are unlikely to be a concern for our analysis.

[17] The F-Statistic for the first-stage regression of the employment multiplier is very similar to the one in Panel 1f since the only difference is the lagged control variables (GDP for the output multiplier and the employment ratio for the employment multiplier).

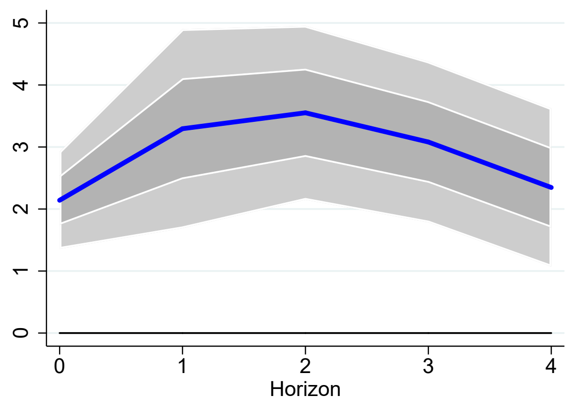
Figure 1: Output and Employment Multipliers



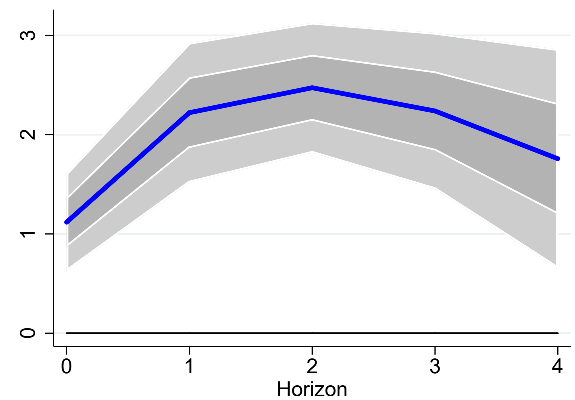
(a) Output Multiplier



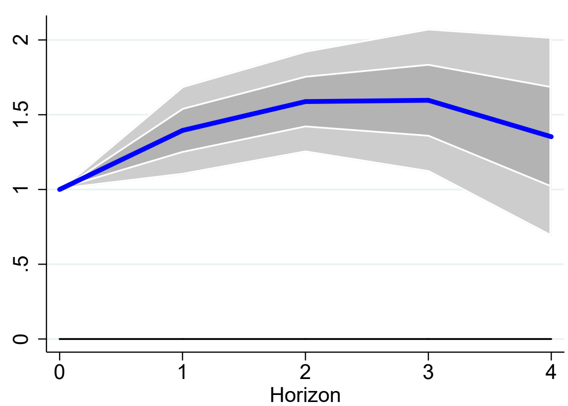
(b) Employment Multiplier



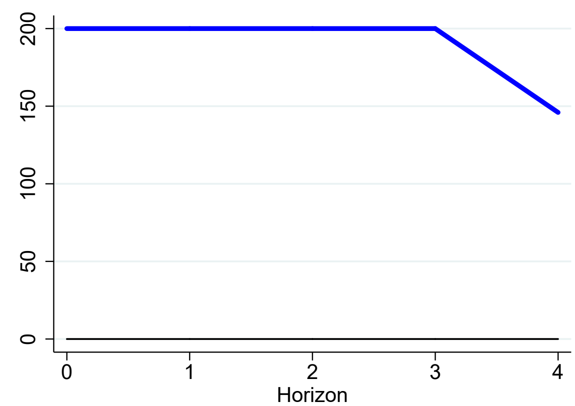
(c) Output Cumulative



(d) Employment Cumulative



(e) Government Spending Cumulative



(f) F-Statistic

Notes: Panels 1a and 1b show the cumulative relative fiscal and employment multipliers estimated according to Equation (1). Panels 1c and 1d depict the underlying impulse responses of GDP and employment rate to the cumulative change in government spending which is plotted in Panel 1e and estimated according to Equation (3). Panel 1f shows the related first-stage F-Statistics over a four-year horizon. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

Our baseline estimates reveal an output multiplier of 2.14 on impact, which slowly increases to 2.21 four years after the shock materialized. This implies that a €1 increase (decrease) in relative government production leads to a €1.2 increase (decrease) in relative private sector production. The four-year multiplier is estimated relatively precisely with the 95% confidence band ranging from 1.86 to 2.56. Panels 1c and 1e show that the fairly stable output multiplier is due to similar hump-shaped responses in output and government spending. Government spending continuously increases up until three years after the shock and then converges back to steady state. Output shows a similar pattern, although the decline starts already in year 2. Importantly, GDP rises persistently by more than €2, which leads to the reported multiplier.

The employment multiplier as reported in Panel 1b behaves similarly to the output multiplier. On impact, we estimate an employment multiplier of 1.12, which then rises slightly to 1.44 at the end of the forecast horizon. Thus, besides boosting real economic activity, changes in regional government spending also have sizeable effects on local labor markets. Again, the estimates are highly significant and the 95% confidence band of the four-year employment multiplier ranges from 1.17 to 1.71. As shown in Panel 1d, employment significantly increases on impact and then rises for two years after the shock before slowly decreasing.

When decomposing the employment multiplier into employment in the private and public sectors, we find that both contribute to the positive impact of government spending on total employment. Figure B.3 in the appendix shows the private and public employment multipliers. On average, private employment accounts for more than 2/3 of the total employment multiplier. Thus, the lion's share of the positive labor market effect of regional fiscal stimulus is due to employment changes in the private sector. Taken together, an increase in relative government spending leads to a strong and significant rise in relative private economic activity and employment implying that discretionary fiscal policy constitutes a powerful tool to stimulate regional economies in the Eurozone.

Our estimates are comparable to previous regional fiscal multipliers documented for both Europe and the U.S.. Coelho (2019) finds an impact multiplier of 1.8 for European regions relying on structural funds distributed by the European Commission. Using provincial expenditure cuts in Italy, Acconcia et al. (2014) report a multiplier of 1.55 on impact and of 1.95 for the 1-year cumulative multiplier. For the U.S., Nakamura and Steinsson (2014) use regional variation in military buildups to compute 2-year output multipliers ranging from 1.4 in their baseline specification up to 2.5 when applying a Bartik instument approach as we do, and Bernardini et al. (2020) estimate an impact output multiplier of around 2 when applying a Bartik instrument and of 1.3 when using a Blanchard and Perotti (2002) recursive identification.[18] Regarding employment multipliers, evidence in the literature is more mixed. Contrarily to us, Becker et al. (2010) and Coelho

[18]For a survey on regional fiscal multiplier estimates, see Chodorow-Reich (2019).

(2019) find no significant responses of employment to fiscal spending for European regions. For Portugal, using changes in government spending prior to local elections, Carvalho et al. (2020) find an employment multiplier of 1.5. For the U.S., Nakamura and Steinsson (2014) find regional employment multipliers ranging from 1.3 in their preferred specification to 1.8 when applying a Bartik instument approach.

4.2 Robustness

In this section, we demonstrate that our main Eurozone multiplier estimates are robust to several modifications of the baseline model. The estimates change only little when applying alternative ways to construct the Bartik instrument and using different ways to extract unexpected variation in national government spending. Moreover, our findings are robust to changes in the sample and to additionally controlling for national tax policies and sovereign spreads. Finally, we also demonstrate that our results are not prone to dynamic and cross-sectional heterogeneity.

4.2.1 Instrument Construction

We start by exploring alternative ways to construct the Bartik instrument. In the baseline, we use the five years preceding the Eurozone accession to compute the regional share of government spending, s_i. However, as suggested by Nekarda and Ramey (2011), there might have been important structural changes over time that affect the regional distribution of government spending. Taking this possibility into account, we follow Nekarda and Ramey (2011) and compute the regional shares based on all years of the sample. Table 1 presents the results for the output and employment multipliers, and the first rows also report the baseline estimates. The second panel of Table 1 (Alternative s_i (I)) shows that our results barely change when using this alternative instrument construction. As a second check, we use absolute levels in regional and national government spending to construct the share s_i. In this case, the regional shares indicate scaling factors and add up to one at the national level. The second panel of Table 1 (Alternative s_i (II)) presents the results of this exercise, indicating that the multiplier estimates do not change much.

So far, we have used our proxy for government spending at both the NUTS 2 level and the national level. Although official government spending data are not available at the regional level, they are published at the national level and thus, it can be used to compute the Bartik instrument. To be precise, we measure G_I in Equation (2) as national government spending. The results from Panel B in Table 1 (National Accounts) show that the multipliers increase slightly, but the overall dynamics remain unchanged.

Table 1: Output and Employment Multipliers: Robustness

	Output Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Alternative instrument construction										
Alternative s_i (I)	1.89***	2.05***	2.05***	1.99***	1.96***	1.10***	1.41***	1.48***	1.43***	1.39***
	(0.39)	(0.31)	(0.25)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.14)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Alternative s_i (II)	1.74***	1.90***	1.84***	1.82***	1.82***	0.99***	1.22***	1.22***	1.17***	1.02***
	(0.29)	(0.37)	(0.40)	(0.37)	(0.24)	(0.21)	(0.23)	(0.25)	(0.27)	(0.24)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
National Accounts	2.64***	2.71***	2.72***	2.63***	2.49***	1.60***	1.88***	1.96***	1.93***	1.79***
	(0.57)	(0.30)	(0.18)	(0.19)	(0.15)	(0.30)	(0.23)	(0.21)	(0.19)	(0.17)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Panel C: Exogenous variation in national spending										
Fiscal Rule	2.00***	2.27***	2.34***	2.30***	2.33***	0.94***	1.32***	1.46***	1.42***	1.49***
	(0.31)	(0.36)	(0.29)	(0.28)	(0.19)	(0.21)	(0.19)	(0.20)	(0.19)	(0.21)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Military Spending	3.27***	3.22***	3.22***	2.99***	2.96***	1.63***	1.71***	1.82***	1.68***	1.76***
	(0.67)	(0.27)	(0.17)	(0.15)	(0.15)	(0.57)	(0.23)	(0.28)	(0.26)	(0.29)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Forecast Errors	3.91***	3.47***	3.03***	2.95***	2.82***	2.14***	1.97***	1.88***	1.95***	1.87***
	(1.02)	(0.34)	(0.29)	(0.19)	(0.23)	(0.77)	(0.34)	(0.29)	(0.25)	(0.27)
# Obs	2410	2258	2119	1967	1813	2410	2258	2119	1967	1813

Notes: Panel A shows the estimates for the baseline fiscal and employment multipliers. Panel B presents the estimates for alternative instrument constructions. First, following Nekarda and Ramey (2011), the share of regional spending used in the instrument is constructed as an average across the whole sample rather than predetermined as in the baseline. In the second alternative specification of s_i, we use the levels of government spending at regional and aggregate levels rather than the per capita values. Then, instead of using the aggregate government spending proxy to compute the Bartik instrument, we use the government spending from National Accounts. Panel C explores alternative identification strategies. Here, we use the residual of an estimated fiscal spending rule, national military spending, and forecast errors on government spending to obtain exogenous and unanticipated national government spending changes to construct the Bartik instrument.

4.2.2 Unexpected Variation in National Spending

The baseline instrument relies on observed national government spending changes to instrument for regional changes. To account for the possibility of anticipated changes in aggregate government spending, we explore three alternative ways.

First, we rely on a timing assumption to extract unexpected changes in government spending. In particular, we follow the approach by Blanchard and Perotti (2002) that policymakers need time to decide on, approve, and implement discretionary changes in fiscal policy. We proceed by first, estimating a government expenditure rule, where we regress the growth rate of per capita national government spending on lagged growth rates of per capita government spending, GDP, and tax revenues, time and country fixed effects. We then interpret the residual of this regression, $\hat{u}_{I,t}$, as the unexpected component of national government spending and use it to construct the Bartik instrument as follows:[19]

$$Bartik_{i,t} = s_i \times \hat{u}_{I,t},$$

Second, we use military spending as an instrument for unanticipated aggregate spending changes. Hall (2009), Barro and Redlick (2011), and Miyamoto et al. (2019), among others, also use aggregate military spending data to identify government spending shocks. Changes in military spending are often large and regularly respond to foreign policy developments, suggesting that these changes are exogenous in the sense that they are less likely to be driven by domestic cyclical forces. In particular, military spending is not correlated with the state of the economy like the state of the business cycle or financial conditions of the private sector.[20] Following Miyamoto et al. (2019), we use national variation in per capita military spending to compute the Bartik instrument as follows:[21]

$$Bartik_{i,t} = s_i \times \Delta M_{I,t},$$

where $\Delta M_{I,t}$ is the change in per capita national military spending.

Third, we use professional forecast errors on national government spending from the study by Born et al. (2020). The underlying idea is that unpredicted changes in government spending by professional forecasters provide a direct measure of fiscal news that is unrelated to the state of the economy (Ramey 2011). Similarly to the military spending procedure, we use the forecast errors directly in the Bartik instrument construction.[22] Importantly, the respective first stages

[19] While Blanchard and Perotti (2002) apply their identification strategy on quarterly data, we have to rely on annual time series. Note, though, that Born and Müller (2012) provide robust evidence that the recursive identification is appropriate for annual post-WWII U.S. time-series data. In addition, Beetsma and Giuliodori (2011) point out that budget decisions are typically made once a year, and argue that, consequently, annual data provide a more natural way to reconcile discretionary fiscal policy changes.

[20] Nakamura and Steinsson (2014), Dupor and Guerrero (2017), and Auerbach et al. (2020b) use variation in regional military government spending to estimate the effect of a government spending change. However, because regional military spending data are not available for European regions, we combine the idea of unanticipated public spending changes due to military expenditures at the national level with spending changes at the regional level to construct the Bartik instrument.

[21] See Appendix A.4 for more details on the military data used and its source.

[22] Because our analysis is conducted on annual data, we aggregate the quarterly forecast error series by Born et al. (2020) to the annual level.

are sufficiently strong. The F-Statistic varies across horizons and estimates lying between 76 and 281 for the fiscal rule, 16 and 44 for the military spending, and 6 and 18 for the forecast error exercise. Thus, all instruments are sufficiently strong predictors of variations in regional government spending.

The results of the regional multiplier estimates when applying these alternative strategies to extract unexpected government spending changes at the national level are presented in Panel C of Table 1. When relying on the residual of the fiscal rule estimation, the multipliers are very similar to our baseline estimates. The four-year output multiplier becomes 2.33 and the respective employment multiplier is estimated to be 1.49. For the other two measures, the estimates are somewhat larger than the baseline results. The four-year output multiplier is 2.96 in the case of the military spending instrument and 2.82 for the forecast errors instrument; the employment multiplier is 1.76 and 1.87, respectively. However, these estimates still support our main finding: an increase in regional government spending significantly boosts regional output and employment. Importantly, our baseline results are robust to using unexpected changes in national spending for constructing the Bartik instrument instead of observed changes in national government expenditures.

4.2.3 Alternative Samples and Controlling for Financing Sources

As additional robustness checks, we test whether our results are robust to changes in the sample. First, we use NUTS 3 level data to estimate output and employment multipliers. This considerably increases the number of regions and therefore the total number of observations. At the NUTS 3 level, the sample consists of 922 regions, compared to 167 in the baseline, and the total number of observations is more than five times larger compared to the NUTS 2 level analysis. Moreover, as previously mentioned, moving to the more disaggregated NUTS 3 level should minimize the problem that individual regions have a direct influence on national government decisions since their economic and political power is further reduced when compared to the NUTS 2 level. As Panel B of Table 2 shows, the results are similar to our baseline estimates. The four-year output multiplier is now estimated to be 2.5 and the four-year employment multiplier takes a value of 1.58.

Second, we add the late Euro adopters to the sample — namely Slovenia, Malta, Slovakia, Estonia, Latvia, and Lithuania. Panel B of Table 2 shows that our results hardly change. Notwithstanding, the total number of observations increases only slightly when including the late Euro adopters.

Finally, an important difference between the Eurozone and the U.S. is that the Eurozone does not share a common fiscal authority. While the common monetary policy is conducted by the ECB, fiscal policy is conducted at the national level. In our baseline specification, regional fixed

Table 2: Output and Employment Multipliers: Robustness (continued)

	Output Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Alternative samples										
NUTS 3 Data	2.64***	2.71***	2.64***	2.57***	2.50***	1.35***	1.61***	1.64***	1.63***	1.58***
	(0.34)	(0.27)	(0.19)	(0.17)	(0.12)	(0.29)	(0.15)	(0.11)	(0.10)	(0.10)
# Obs	14192	13303	12414	11525	10630	14192	13303	12414	11525	10630
Late Adopter	2.10***	2.28***	2.30***	2.25***	2.20***	1.09***	1.40***	1.48***	1.44***	1.43***
	(0.39)	(0.33)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2666	2494	2323	2152	1979	2666	2494	2323	2152	1979
Panel C: Controlling for financing sources										
Country homogeneity	1.95***	2.22***	2.16***	2.03***	2.04***	0.85***	1.15***	1.11***	0.92***	0.87***
	(0.30)	(0.37)	(0.32)	(0.32)	(0.22)	(0.21)	(0.20)	(0.20)	(0.19)	(0.18)
# Obs	2617	2453	2289	2125	1959	2617	2453	2289	2125	1959
Country heterogeneity	1.65***	2.06***	2.06***	1.92***	2.15***	0.75***	1.03***	0.86***	0.49**	0.52**
	(0.21)	(0.25)	(0.23)	(0.28)	(0.20)	(0.15)	(0.17)	(0.23)	(0.24)	(0.24)
# Obs	2617	2453	2289	2125	1959	2617	2453	2289	2125	1959

Notes: Panel A shows the estimates for the baseline fiscal and employment multipliers. Panel B shows the estimated multipliers using NUTS 3 level data and data for the late Euro adopters. Panel C specifications include additional controls to the baseline. The first estimates in Panel C include the contemporaneous and one-year lag of the change in the national total tax receipts per capita and sovereign spreads. The second estimates include these controls interacted with country fixed effects.

effects absorb heterogeneity across regions and countries and should therefore also capture different national fiscal reactions to the regional government spending change. However, it might be argued that additional covariates are needed to control for country-specific fiscal policies. Thus, we expand our baseline specification and additionally control for per capita national tax receipts and sovereign risk premia. While taxes control for the financing side of the public spending change, risk premia capture financing costs of the government. The risk premia have been shown to play a particular role in the transmission of national government spending in the Eurozone (Corsetti et al. 2013).[23] In particular, we add the contemporaneous and one-year lag of both variables to the vector of control variables. We estimate separate specifications. First, we assume

[23] We compute sovereign spreads as the difference between the national and Germany's 10-year government bond rate. For Germany, we instead use its 10-year government bond rate as control.

homogeneity and estimate average coefficients across countries. Second, we allow for full country heterogeneity and interact both covariates with country fixed effects such that we estimate specific fiscal policy reactions for all countries of the sample. Panel C of Table 2 shows that the multiplier estimates slightly change when additionally controlling for the financing sources of the national governments. The impact output multiplier decreases mildly compared to the baseline estimates. However, four years after the shock, both specifications deliver very similar output multipliers relative to the baseline. The differences are somewhat larger for the employment multiplier, which becomes smaller when controlling for national fiscal policies. Nevertheless, the regional fiscal stimulus still leads to a significant increase in the employment ratio although the four-year employment multiplier drops below 1.[24]

4.2.4 Dynamic and Cross-Sectional Heterogeneity

As shown by Canova (2020) for the case of the U.S., not accounting for dynamic heterogeneity may pose a potential threat to cross-sectional multiplier estimates. As suggested by Canova (2020), we analyze the time-series properties of output and employment by estimating the AR(1) process of these series for each region in the sample. Figure B.5 in the appendix plots the cross-sectional distribution of the output and employment AR(1) coefficients. Because the persistence coefficients are distributed fairly homogeneously, dynamic heterogeneity does not seem as important here as in the case of the U.S. presented by Canova (2020). Yet, we re-estimate the multipliers excluding the regions with very extreme persistence coefficients, namely the top and bottom 10%. The results are presented in Panel A from Table B.1 in the appendix and reassure that the baseline multipliers are robust.

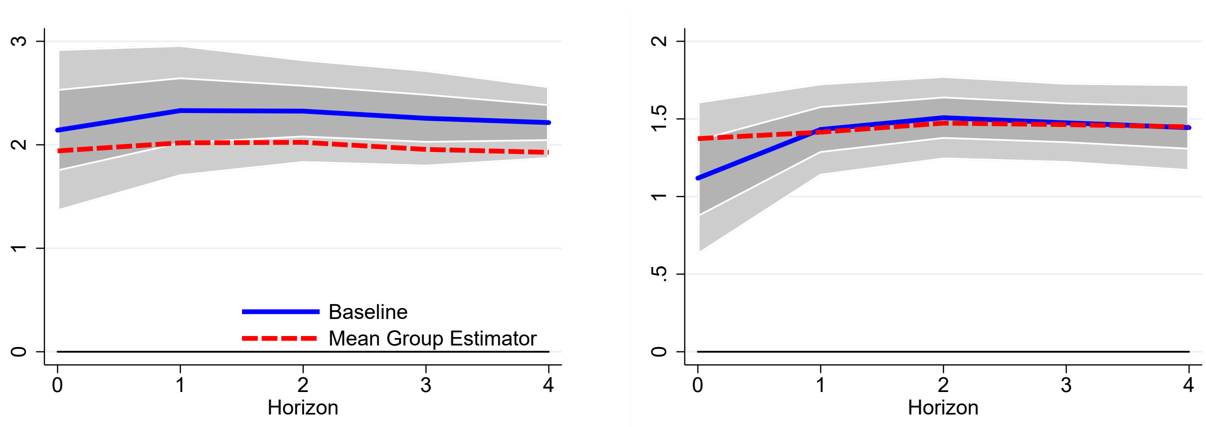
Moreover, in the presence of strong cross-sectional heterogeneity, pooling observations across regions and estimating common slope coefficients might not be appropriate. To address this potential problem, we follow Bernardini et al. (2020) and estimate output and employment multipliers with a mean group approach that allows for cross-region heterogeneity in the slope coefficients. Since this mean group estimator (MGE) requires a relatively long period of time, we rely on Bayesian methods to calculate fiscal multipliers. In particular, as suggested by Canova (2020) and Miranda-Agrippino and Ricco (2021), we estimate Bayesian local projections employing a normal prior for the output and employment multiplier estimates.[25] Motivated by the existing U.S. evidence on regional fiscal multipliers (Nakamura and Steinsson 2014; Chodorow-Reich 2019), the prior mean for the output multiplier is set to 1.9, the one for employment to 1.4, and both variances are set to 2.

[24]It is also important to note that, when estimating country-specific fiscal policies, the number of estimated coefficients increases significantly and the F-Statistic of the first stage decreases substantially for longer horizons, with the lowest value being 27.

[25]Thanks are due to an anonymous referee for pointing out this possibility.

Figure 2 shows the estimated responses for the output and employment multipliers when applying the MGE Bayesian local projections (dashed lines) together with the baseline (pooled) estimates (solid lines and shaded areas for the coefficients and confidence bands, respectively). Notably, the MGE estimates are very similar to the baseline multipliers and lie within the respective confidence bands for all periods of the forecast horizon. The employment multiplier of the MGE estimation is almost identical to the pooled estimation, while the estimated output multiplier is somewhat smaller compared to our baseline results reaching a value slightly below two four years after the fiscal stimulus. Interestingly, also the shape of the responses is similar across both estimation approaches which again supports our pooling assumption. The relatively large cross-sectional dimension and low frequency of our dataset seem to limit the erratic component in the calculated impulse responses which is a more severe problem when estimating local projections on time series with a higher frequency like quarterly and monthly data (Miranda-Agrippino and Ricco 2021). Overall, we interpret these results as evidence that cross-sectional heterogeneity is not a severe threat for our regional multiplier estimates in the Eurozone and therefore, proceed with the pooled specification in what follows.

Figure 2: Output and Employment Multipliers: Baseline and Mean Group Estimator



(a) Output Multiplier

(b) Employment Multiplier

Notes: Panels 2a and 2b show the baseline (blue solid) and the mean group estimator (red dashed) fiscal and employment multipliers using Bayesian local projections. Normal prior with variance 2 and means 1.9 and 1.4 for output and employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals of the baseline (pooled) estimation .

4.2.5 Further Checks

In the appendix, we show results for additional robustness checks. First, the baseline multiplier estimates are robust when following closely Nakamura and Steinsson (2014) and using national military spending interacted with region fixed effects as instrument (Panel B of Table B.1 in the appendix). Furthermore, the results do not change much when not including lagged control variables in the regressions or excluding regions that spend disproportionately more per capita than the national average (Panels C and D of Table B.1 in the appendix). We also re-estimated the baseline model when excluding intermediate consumption from our proxy regional government spending series. Then, regional government spending is measured by the GVA of the non-market sector. As expected, the multipliers increase because the shock size (1% of GDP per capita) becomes larger relative to the baseline proxy used (Panel E of Table B.1 in the appendix).

Secondly, to assess how important any individual country is for the results, we re-estimate the baseline regressions by sequentially dropping one country at a time. The obtained results are comparable to the baseline in every case (Table B.2 in the appendix).

Finally, we use a Bayesian approach and estimate multipliers by means of Bayesian local projections. As shown by Miranda-Agrippino and Ricco (2021), Bayesian local projections might reduce erratic movements in impulse response computed with standard local projections. As for the mean group estimator exercise, we employ a normal prior with mean 1.9 for output and 1.4 for employment and set both variances to 2 based on recent U.S. regional multiplier estimates (Nakamura and Steinsson 2014; Chodorow-Reich 2019). Figure B.6 in the appendix shows the estimated multipliers when using Bayesian local projections. The results are similar to our baseline estimates which implies that Bayesian local projections do not deliver a significant improvement for our analysis. As already mentioned above, the small differences in the estimated shapes of the responses might be due to the large cross section at annual frequency which already limits the erratic component in the impulse responses.

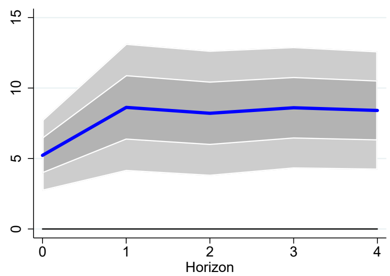
In this section, we have shown that our baseline findings are robust to several modifications. In the following, we will thus rely on our baseline specification to produce additional new insights into the fiscal transmission mechanism in the Eurozone.

4.3 Impulse Response Analysis

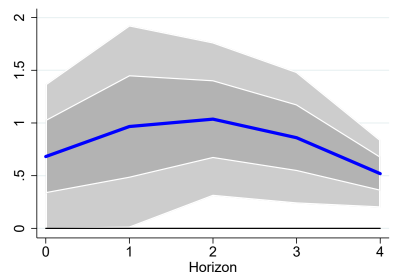
To get a better understanding of the fiscal transmission mechanism in the Eurozone, this section presents additional impulse responses to a regional fiscal spending shock. More precisely, we report responses to a one percent increase in regional government spending relative to regional GDP, calculated based on Equation (3). The solid lines in Figure 3 show point estimates and the dark and light shadings again indicate 68% and 95% Driscoll and Kraay (1998) confidence bands. All responses are expressed in percent changes (growth rates) with the exception of the labor share response, which is presented as a percentage point change.

Our estimated regional output multiplier speaks in favor of a strong crowding-in of private

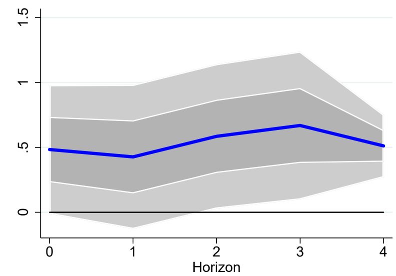
Figure 3: Impulse Responses



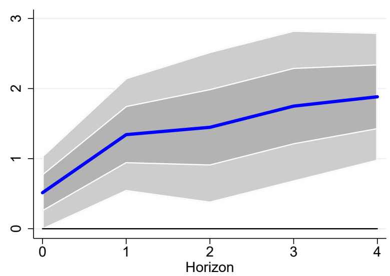
(a) Investment



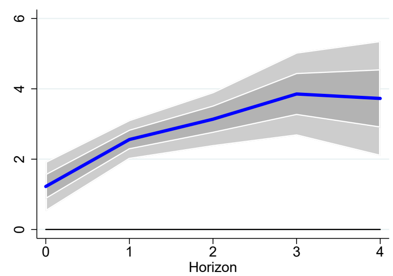
(b) TFP



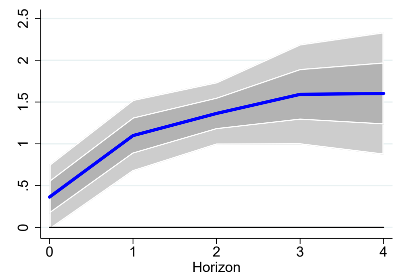
(c) Labor Productivity



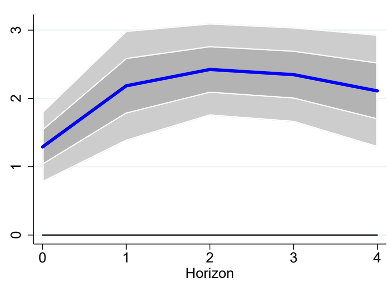
(d) Motor Vehicles



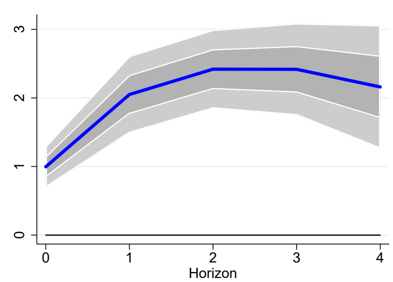
(e) Hourly Wage



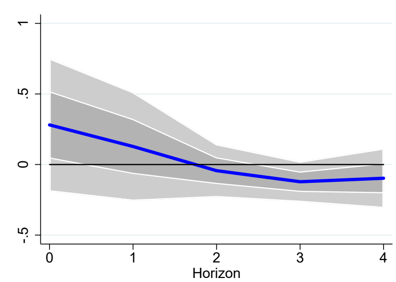
(f) Labor share



(g) Total Hours



(h) Employment (# employees)



(i) Hours per Worker

Notes: These figures plot the response of a one percent increase of per capita government spending relative to per capita GDP. All responses are expressed in percent changes (growth rates) with the exception of the labor share variable, which is presented as a percentage point change (its difference). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

demand following the regional fiscal expansion. Panel 3a of Figure 3 shows that a substantial component of the increase in private demand is due to an increase in private investment. The fiscal expansion leads to a significant and persistent increase in regional private investment expenditures. On impact, private investment increases by around 5%, which is roughly twice as large as the output response reported in Figure 1. Investment further increases in the first year after the shock and then slowly converges back to its pre-shock level. A complementary metric to quantify the investment response is the investment multiplier, which can be estimated in close analogy with the output multiplier described in Equation (1). The estimated private investment multiplier is presented in Figure B.4 in the appendix, and we find that it is about half the size of the output multiplier. On impact, the investment multiplier is estimated to be around 1, slightly increasing to 1.1 four years after the spending increase. This finding supports the evidence reported in other studies which also find a rise in private investment following a fiscal spending stimulus at the national U.S. level (D'Alessandro et al. 2019) and at the regional level as a response to an increase in EU structural funds (Becker et al. 2013).

Panels 3b and 3c of Figure 3 provide a rationale for the strong private investment response. We find that productivity significantly increases in response to higher regional government expenditures. This is true when measuring productivity by total factor productivity (TFP) or labor productivity.[26] The maximum increase in TFP is slightly larger than the maximum rise in labor productivity and the peak response of TFP occurs somewhat earlier than the peak of labor productivity. The positive labor productivity response is in line with the regional U.S. evidence by Nekarda and Ramey (2011) and Auerbach et al. (2020b). In addition, D'Alessandro et al. (2019) and Jørgensen and Ravn (2020) find that an aggregate government spending shock leads to a rise in (utilization-adjusted) TFP. To reconcile these positive supply side effects of fiscal policy, Auerbach et al. (2020b) propose a model with endogenous firm entry in which increasing government spending leads to a rise in the number of firms together with higher labor productivity. D'Alessandro et al. (2019) show that extending a standard DSGE model with a learning-by-doing mechanism is able to account for the positive TFP and investment responses following a fiscal shock. Moreover, by introducing variable technology utilization into an otherwise standard New Keynesian model, Jørgensen and Ravn (2020) demonstrate that productivity and investment increase after a fiscal expansion.[27] By making a rise in productivity an endogenous response to a government spending shock, all these model extensions produce a crowding-in of private demand, which ultimately increases the government spending output multiplier. Our regional Eurozone evidence on a significant crowding in of private investment coupled with higher productivity following a fiscal spending shock reinforces these modeling choices and points towards an important role of fiscal policy in driving movements in productivity.[28]

[26] More details on the construction of our TFP variable can be found in Appendix A.5.

[27] A model with variable capital utilization can also generate a productivity increase following a fiscal spending expansion. However, as shown by Jørgensen and Ravn (2020), the required substantial increase in capital utilization is not supported by the data.

[28] Another important indicator for positive supply side effects following a government spending shock is the price response. In a standard New Keynesian model, higher government spending raises aggregate demand and pushes up prices. However, this price increase can be overturned when allowing for endogenous productivity (D'Alessandro et al. 2019; Jørgensen and Ravn 2020). Unfortunately, regional price data are only available for a small group of

Official data for private consumption expenditure, the second-most important component of private demand, are not available at the regional European level. Nonetheless, we rely on a common proxy for durable consumption to learn more about households' consumption decisions following a regional fiscal expansion. We follow a related literature and use the per capita number of motor vehicles as a measure for durable consumption (Mian et al. 2013; Demyanyk et al. 2019).[29] Figure 3d shows that the number of vehicles rises significantly after a fiscal expansion. On impact, there is an increase of around 0.6%, which then persistently builds up to almost 2% at the end of the forecast horizon. Thus, higher public spending crowds in consumption expenditure and, in particular, durable purchases in line with the U.S. evidence by Demyanyk et al. (2019) and Auerbach et al. (2020b).

Households' consumption expenditure should be closely linked to their disposable income stream in the sense that an increase in income might well lead to higher (durable) consumption spending. Panel 3e indeed supports this hypothesis. Here, we report the real wage response expressed as average real compensation per hour worked. Wages increase significantly and persistently in response to the fiscal stimulus. On impact, wages rise by more than 1% and continue to increase until the end of the forecast horizon. The wage response to an aggregate government spending shock is the subject of a considerable debate with different results emerging from different identification schemes (Galí et al. 2007; Ramey 2011). At the regional level, the results are also mixed. While Auerbach et al. (2020b) find a positive earnings response, Nekarda and Ramey (2011) report a fall in wages following higher government spending. Our finding of a significant increase in real wages is in line with standard New Keynesian models, where a positive government spending shock lowers the markup of price over marginal costs and thus leads to a rise in real wages.[30]

The labor share response as shown in Panel 3f further supports this line of reasoning.[31] The labor share significantly increases in response to the regional fiscal expansion. Four years after the fiscal shock, the labor share is around 1.6 percentage points higher. In accordance with our evidence, Cantore and Freund (2021) find that an aggregate government spending shock leads to a rise in the labor share, whereas Auerbach et al. (2020b) estimate an acyclical labor share response.[32] The inverse of the labor share is commonly used as a measure for the price-cost

countries in our sample, and we therefore do not further investigate the price response to a regional fiscal spending change.

[29]Data on the per capita number of motor vehicles are taken from Eurostat. For details, see Table A.2 in the appendix.

[30]Figure B.7 shows that disposable income also increases following the regional fiscal stimulus. Contrary to our hourly wage measure, disposable income is calculated after taxes and additionally includes capital income.

[31]Here, the labor share is defined as the ratio between total private compensation and gross value added in the private sector.

[32]Cantore and Freund (2021) rationalize the increase of the labor share following a government spending shock in a two-agent New Keynesian model populated by capitalists and workers. Capitalists do not supply labor, and,

markup (Nekarda and Ramey 2020; Auerbach et al. 2020b).[33] When following this argument, our evidence implies that a government spending shock lowers the markup, thus giving rise to a countercyclical markup behavior. While other studies also report evidence in favor of a countercyclical markup at the aggregate U.S. level (Bils 1987; Rotemberg and Woodford 1999), Nekarda and Ramey (2020) show that an increase in government spending increases output and leads to a rise in the markup.

Finally, we take a closer look at the labor market responses to the regional fiscal spending expansion. Our estimates reveal a significant and persistent increase in total hours worked as shown in Panel 3g. On impact, hours worked rise by more than 1% and then increase to 2.5% two years after the shock before slowly converging back to equilibrium. To better understand the driving forces of the increase in hours, we decompose the response into the extensive margin (the total number of employees) and the intensive margin (the number of hours worked per employee). As Panels 3h and 3i indicate, we find that the bulk of the increase is accounted for by the extensive margin. The total number of employees responds in a very similar manner as hours worked. In contrast, hours per worker are barely affected by the regional fiscal spending shock. These findings reconcile with our baseline employment multiplier estimates, which imply that the fiscal stimulus is associated with a significant increase in the employment rate. These results support the evidence by Auerbach et al. (2020b) and Carvalho et al. (2020), who also find that most of the change in hours worked in response to demand shocks is due to adjustments in the extensive margin. Moreover, Serrato and Wingender (2016), Corbi et al. (2019), and Canova and Pappa (2021) also estimate that an increase in regional fiscal spending significantly boosts regional employment. Analogously, Monacelli et al. (2010) show that a positive aggregate government spending shock leads to a significant reduction in the unemployment rate.

To quantify how fiscal spending materializes in jobs created, we do a back-of-the-envelope calculation using the estimated coefficients from the employment impulse response function and the average employment and output series in the sample. Our estimates imply that, if the government increases spending by €1 million, it creates 15 additional jobs in the year of the shock, of which 12 are in the private sector and 3 in the public sector, which is consistent with the low estimates for the public sector by Adelino et al. (2017). Because the build-up in employment is very persistent, the stimulus of €1 million produces a total of 33 new jobs after four years, of which 22 are in the private sector and 11 in the public sector.[34] This corresponds to a cost per job

thus, workers make up the entire labor force. The combination of an increase in labor demand due to additional government expenditures combined with no labor supply response by capitalists implies that the labor share rises.

[33] The inverse of the labor share is a valid measure of the markup when assuming a Cobb-Douglas production function and abstracting from overhead labor.

[34] To calculate the job costs across sectors, we re-estimate the employment response for the private and public sector, respectively. Then we apply a similar back-of-the-envelope calculation as done for total employment.

created of approximately €30,000, in line with the U.S. estimates that range from roughly $25K to $125K as argued in Chodorow-Reich (2019) and in line with European estimates, for example, a cost per job of €24,000 estimated by Carvalho et al. (2020).

Taken together, our impulse response analysis has presented several important insights into the fiscal transmission mechanism in the Eurozone. Higher regional government spending i) crowds in private investment through positive supply side effects (increasing productivity), ii) boosts (durable) consumption expenditure, iii) raises real wages while increasing (lowering) the labor share (markup), and iv) expands hours worked, which is mainly driven by increasing the number of employees.

4.4 Sectoral Analysis

Our main results show that an increase in regional government spending causes a significant crowding-in of private economic activity and employment. The richness of our dataset and, in particular, its sectoral division allows to get a better understanding of which sectors mainly contribute to these strong effects. In doing so, we first re-estimate the baseline multiplier regressions in Equation (1) but replace regional GDP and employment by GVA and employment of the private sector.[35] Second, we decompose these private sector multipliers into the specific components coming from different economic sectors, namely, agriculture, industry, construction, services, and finance.[36]

Table 3 presents the results. While Panel A presents the aggregate multipliers across all sectors, Panel B displays the multipliers for each economic sector separately. On impact, the industry and services sectors mainly contribute to the strong increase in private economic activity. Out of the €1.68 increase in private economic activity, the industry sector contributes with 70 cents and the services sector with 69 cents. Thus, taken together both sectors account for more than 82% of the on-impact increase in private economic activity which is much larger than their combined average share in total private activity (roughly 56%). Higher production in the construction sector adds 27 cents to the total effect and the finance sector only contributes with 5 cents. For all years, the contribution of the agriculture sector is estimated to be negative and increasing over time, reducing the total effect by 14 cents four years after the shock. While the contributions of the industry and services sectors are relatively stable over time, the finance (construction) sector gains (looses) importance in the medium run. At the end of the forecast horizon, the finance sector contributes with 40 cents to the aggregate effects. The stronger impact of the finance sector

[35] We use GVA as the output measure because GDP is not available at the sectoral level. We still normalize the responses such that, on impact, government spending increases by one percent of per capita GDP.

[36] These sectors account on average for 2.7%, 25.7%, 8.2%, 30.6%, and 32.8% of the private economy's regional GVA, respectively.

over time might be explained by a higher credit demand by private firms and households due to the expansionary effects of the fiscal expansion which looses borrowing constraints and reinforces a feedback loop between higher private demand, more credit, and increasing investment and productivity. Moreover, while the fiscal stimulus strongly favors the construction sector in the short-run it stimulates high-productive sectors relatively more over the medium run. In fact, with the exception of agriculture, the construction sector shows, on average, the lowest labor productivity level in our sample.

Table 3: Output and Employment Multipliers: Decomposition by Economic Sectors

	GVA Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification for the private sector										
Multiplier	1.68***	1.87***	1.88***	1.81***	1.72***	1.18***	1.52***	1.56***	1.52***	1.43***
	(0.51)	(0.42)	(0.32)	(0.29)	(0.24)	(0.33)	(0.26)	(0.24)	(0.22)	(0.23)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Multipliers by economic sectors										
Agriculture	-0.04	-0.04	-0.04	-0.09**	-0.14***	-0.04	0.01	0.01	0.02	0.04
	(0.07)	(0.08)	(0.08)	(0.04)	(0.03)	(0.10)	(0.07)	(0.06)	(0.05)	(0.05)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Industry	0.70**	0.66**	0.67***	0.67***	0.66***	0.28***	0.36***	0.39***	0.37***	0.38***
	(0.29)	(0.26)	(0.20)	(0.17)	(0.20)	(0.06)	(0.04)	(0.03)	(0.03)	(0.03)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Construction	0.27**	0.23***	0.23***	0.19***	0.17***	0.33***	0.39***	0.41***	0.35***	0.33***
	(0.11)	(0.06)	(0.05)	(0.05)	(0.04)	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Services	0.69***	0.84***	0.82***	0.75***	0.65***	0.49***	0.63***	0.67***	0.67***	0.60***
	(0.17)	(0.12)	(0.10)	(0.08)	(0.08)	(0.11)	(0.09)	(0.10)	(0.09)	(0.07)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Finance	0.05	0.18	0.19	0.29***	0.40***	0.12*	0.12*	0.08	0.09*	0.08
	(0.21)	(0.13)	(0.13)	(0.10)	(0.07)	(0.07)	(0.07)	(0.07)	(0.05)	(0.06)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: Industry includes all industry with the exception of construction. Services combine wholesale, retail, transport, accommodation and food services, information and communication. Finance refers to financial and business services. Here, all estimated multipliers are expressed in terms of GVA because output series are not available at the sectoral level. Therefore, the total multiplier (including all sectors) shows minor differences compared to the baseline output (GDP) multiplier. Additionally, we also exclude GVA of non-market sector as we want to analyze the private sector response.

In terms of the employment multiplier, the picture slightly differs. The services sector is the single most dominant contributor to the increase in aggregate private employment. This finding makes intuitive sense because the services sector includes particular labor-intensive work like hospitality or food services. The industry and construction sectors contribute by a similar amount, whereas the agriculture and finance sectors display the smallest contributions.

Investigating the sector-specific responses of additional variables further highlights the heterogeneous impact of fiscal policy across economic sectors in the Eurozone. In the appendix, we report the responses of investment, wages, and total hours (see Figures B.8, B.9, and B.10). Investment increases particularly in the industry, services, and with some delay also in the finance sectors, which are the strongest contributors to the aggregate output multiplier as well. While investment in the construction sector also rises in the first two years after the fiscal expansion, the response becomes negative thereafter. These results thus help understanding the different output responses across sectors.

Wages increase in all sectors with the most pronounced increase in the industry and construction sectors. Interestingly, while the responses of output and investment in the construction sector fall over time, wages slowly increase over the forecast horizon which might be due to sluggish wage negotiations in this sector. The industry, construction, and services sectors experience the strongest increases in hours worked, whereas the rise is more limited in the finance sector and hours even fall in the agriculture sector.

Taken together, while the increase in aggregate private economic activity is mainly coming from the industry and services sectors (and to some extent from the finance sector), the services sector is the main contributor to the aggregate increase in private employment. The disproportionate amplification effects of the industry and services sectors might be taken into consideration by policymakers when thinking about adequate fiscal stabilization measures.

4.5 Regional Fiscal Spillovers

The deep regional integration within the European single market has raised particular interest in how fiscal stimuli spill over from one region to another. In particular, in the presence of positive spillover effects, regions with ample fiscal capacity could use additional fiscal stimuli to boost demand from regions facing substantial economic slack (Blanchard et al. 2016).

Moreover, from an econometric standpoint, the existence of positive (negative) spillover effects of one region's spending on another's outcomes could lead to an overestimation (underestimation) of the true effect of the own regional government spending change. For example, relative output might shift if an increase in one region's output is associated with reducing activity in another region. Strong worker flows from relatively weak to relatively strong performing regions can lead to such relative output shifts. Moreover, while our multiplier estimations assume an increase in one region's spending, other states face the burden of financing the regional stimulus. These channels can lead to negative fiscal spillovers, which would imply that our estimated multipliers are an underestimation of the total effect of public spending on a region. On the contrary, close trade and financial linkages might well induce positive fiscal spillovers, which then result in an overestimation of the impact on local and aggregate economic activity. The conventional wisdom underlying several recommendations shared across policy circles is that fiscal spillovers in the EU are positive and strong (In't Veld 2016). In the following, we show that regional fiscal spillovers in the Eurozone are relatively small.

Ideally, we would use inter-regional bilateral trade flows to assess the contribution of region j's government spending shock to the spillovers experienced in region i. Unfortunately, these data are not available at the regional European level. However, we use estimates from Thissen et al. (2018), who construct a social accounting matrix with the most likely trade flows between European regions consistent with national accounts.[37] This dataset is the closest proxy for a matrix of bilateral trade between European regions.[38] It contains information for each pair of sector-region on how much each sector in a specific region imported from each individual sector and region. We aggregate this information by region such that we estimate the most likely trade flow between regions in the Eurozone.[39]

We extend the baseline specification (1) to account for regional fiscal spillovers. First, for each region i and horizon $h = 0, ..., 4$, we compute a weighted sum of spillover fiscal shocks as follows:

$$\sum_{j \neq i} \bar{w}_{i,j} (G_{j,t+m} - G_{j,t-1}),$$

where $G_{j,t}$ is government spending in region j in period t and $j \neq i$. $\bar{w}_{i,j}$ is the average trade weight between both regions for the period 2000-2010.

$$\bar{w}_{i,j} = \sum_{t=2000}^{2010} w_{i,j,t} \times \frac{1}{11}, \quad where \quad w_{i,j,t} = \frac{imports_{i,j,t}}{G_{j,t}}.$$

We follow Auerbach and Gorodnichenko (2013) and calculate $w_{i,j,t}$ as the ratio between imports in region j coming from region i and government spending in region j in year t. Hence, we account for both the spillovers from trade linkages and the size of the government in the importing regions. Because the trade data are only available for the period 2000–2010, we use the subsample to calculate average trade weights, $\bar{w}_{i,j}$, and hold them constant for the regressions on the entire sample. To assess the size of spillovers, we either use all trade partners, trade partners from the same country, or only i's top 10% of trade partners with regard to $\bar{w}_{i,j}$. Then, we estimate

[37] Coelho (2019) uses the same dataset to study fiscal spillovers associated with structural funds financed by the European Commission.

[38] The authors use a top-down approach to construct the time series of multiregional input-output tables, where national accounts in the format of national Supply, Use and Input-Output Tables are taken as given.

[39] See Appendix A.3 for more details and Table A.6 for a visualization of our procedure.

the own and spillover multipliers for each horizon $h = 0, ..., 4$:

$$\begin{aligned}\sum_{m=0}^{h} z_{i,t+m} =& \beta_h \sum_{m=0}^{h} \left(\frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} \right) \\ &+ \phi_h \sum_{m=0}^{h} \left(\frac{\sum_{j \neq i} \bar{w}_{i,j} (G_{j,t+m} - G_{j,t-1})}{Y_{i,t-1}} \right) \\ &+ \gamma_h(L) X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \epsilon_{i,t+m}.\end{aligned} \tag{4}$$

For each horizon h, β_h directly yields the output or employment multiplier of a one percent increase in the own region government spending relative to GDP, and ϕ_h represents the spillover multipliers of a one percent change in trade partners' government spending. A positive (negative) ϕ_h implies that an increase in other regions' government spending raises (lowers) economic activity or employment in the own region. We again use Driscoll and Kraay (1998) standard errors to calculate confidence intervals.

Besides using the baseline instrument described in Equation (2) for the own regional government spending change, we now also construct an instrument for the regional spillover spending change. We compute this spillover Bartik instrument as:

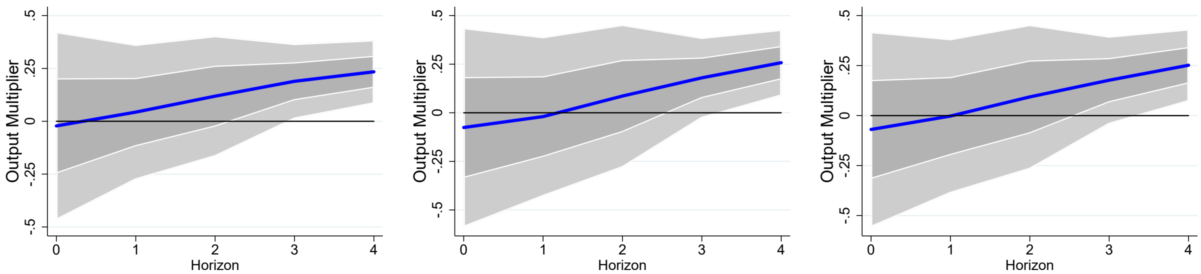
$$\frac{\sum_{j \neq i} \bar{w}_{i,j} \times (G_{J,t} - G_{J,t-1}) \times s_j}{Y_{I,t-1}}, \tag{5}$$

where, similarly to s_i, s_j is the ratio between average per capita government spending in region j belonging to country J.

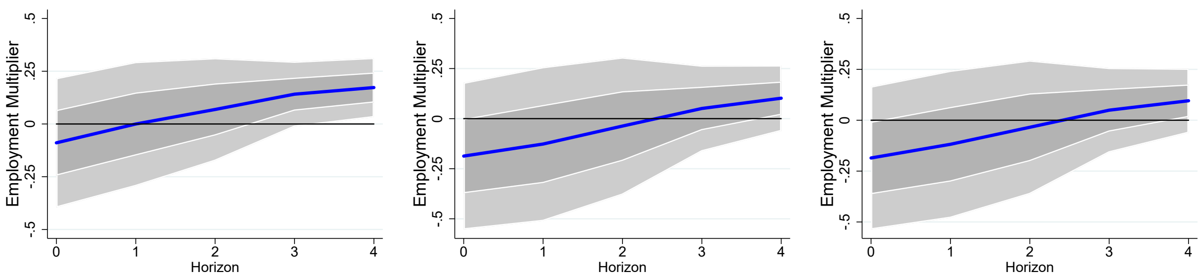
Figure 4 shows the estimated spillover multipliers. Panel 4a shows the output multiplier estimates using all trade partners. The estimated spillover multiplier is small and insignificant for most periods of the forecast horizon. Only at the end of the forecast horizon, the multiplier becomes significant but the point estimate remains to be small with a value below 0.25. This general picture of small and mostly insignificant fiscal spillovers holds for employment (Panel 4d), and also when moving from all regions to only the top 10% trade partners (Panels 4b and 4e) or when restricting to regions within the same country (Panels 4c and 4f).

To put the magnitude of the spillover multipliers into perspective, remember that our baseline own output and employment multipliers were estimated to be around 2.2 and 1.4. Now, the respective spillover multipliers take on values below 0.25 for output and below 0.15 for employment, which implies that only around 1/10 of the baseline multiplier estimates can be explained by fiscal spillover effects. This insight is further supported by the estimated own multipliers according to Equation (4) which we report in the appendix (see Figure B.11). Because the own multiplier estimates barely change compared to the baseline results, fiscal spillovers do not affect

Figure 4: Output and Employment Spillover Multipliers



(a) All Regions (b) Top Trade Partners (c) Same Country



(d) All Regions (e) Top Trade Partners (f) Same Country

Notes: Panels 4a and 4d show the output and employment spillover multiplier taking into account the spillovers from all regions. Panels 4b and 4e consider only the spillovers from the main trade partners (top 10% of the weights). Panels 4c and 4f consider only trade partners from the same country. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.

our main findings.

The finding of small fiscal spillovers also persist when looking at other variables than output and employment. In the appendix, we show the spillover responses when considering all regions for investment, consumption (again measured by the number of motor vehicles), and wages (see Figure B.12).[40] For all these additional variables, the effects are limited even showing some evidence of negative spillovers, although the estimates are mostly insignificant. Thus, the results regarding the fiscal transmission mechanism documented in Section 4.3 should be interpreted as responses mainly originated by changes in government spending in the own region, whereas cross-regional spillovers contribute only to a very small extent to the detected induced dynamics.

Overall, these results reveal relatively small fiscal spillovers for the Eurozone and thus reinforce the existing results on the U.S. economy (Serrato and Wingender 2016; Dupor and Guerrero 2017; Bernardini et al. 2020; Auerbach et al. 2020a) and Italy (Acconcia et al. 2014), but stand in some contrast to the sizeable spillovers reported by Coelho (2019) and McCrory (2020). In addition, our findings do not accord with the conventional policy narrative that government spending

[40]Results are very similar when only considering the top 10% trade partners or when restricting to regions within the same country.

increases are thought to have large and positive spillover effects in the Eurozone (In't Veld 2016). Relatedly, our insights imply that recommendations to jump-start the European economy by increasing public spending in regions with fiscal capacity should be interpreted with caution since the positive spillover effects might be limited despite the European single market.

4.6 State Dependent Multipliers

As a final exercise, we investigate whether regional fiscal multipliers in the Eurozone are characterized by significant state dependencies. In particular, we test whether fiscal multipliers depend on the state of the business cycle, on the sign of the fiscal intervention (consolidation versus expansion), and if they differ between core and periphery countries of the Eurozone.

There is an ongoing debate in the literature concerning business cycle-dependent effects of fiscal policy. While some studies indeed provide evidence that fiscal multipliers are larger in economic recessions than economic booms (Auerbach and Gorodnichenko 2012; Nakamura and Steinsson 2014), others do not find that fiscal multipliers vary across states of the business cycle (Ramey and Zubairy 2018). Concerning the sign of the fiscal intervention, Barnichon et al. (2020) show that, at the aggregate U.S. level, a reduction in government spending is associated with a larger fiscal multiplier when compared to an increase in government spending. Born et al. (2019) find similar results for a panel of advanced and emerging market economies. Finally, the significant fiscal consolidation measures implemented in several European countries in the aftermath of the Great Recession and the dismal growth performances that followed have raised questions about the detrimental effects of austerity programs (Blanchard and Leigh 2013). Thus, testing for a potential non-linearity between core and periphery countries is intended to provide information about significant country heterogeneities within the Eurozone.

To test for potential state dependencies, we extend our baseline specification (1). For each horizon $h = 0, ..., 4$, we estimate the regression:

$$
\begin{aligned}
\sum_{m=0}^{h} z_{i,t+m} =& I_{i,t}\left[\beta_h^A \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h^A(L) X_{i,t-k}\right] \\
&+ (1 - I_{i,t})\left[\beta_h^B \sum_{m=0}^{h} \frac{G_{i,t+m} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h^B(L) X_{i,t-k}\right] \\
&+ \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m},
\end{aligned}
\tag{6}
$$

where $I_{i,t}$ is an indicator variable for the defined state in period t. We now instrument spending changes with the Bartik instrument but interacted with the state indicator. β_h^A and β_h^B directly yield, for each horizon h and states A and B, the fiscal output or employment multiplier, respectively. Here, we use Driscoll and Kraay (1998) standard errors, and compute the Anderson and Rubin (1949) test and the heteroskedasticity and autocorrelation consistent (HAC) test to test for statistical differences in multipliers across states.

To investigate potential state dependencies across the business cycle, we closely follow Nakamura and Steinsson (2014) and define the indicator variable, $I_{i,t}$, based on regional unemployment fluctuations. More precisely, we define that a region is in an economic expansion (recession) in t if the unemployment rate in $t-1$ is below (above) the region's median. We define the state based on lagged unemployment to minimize contemporaneous correlations between fiscal shocks and the state of the business cycle.

Panel B in Table 4 presents the results, where the upper part reports our baseline (state-independent) estimates to allow for a direct comparison. For all years, the multiplier is estimated to be larger when the region experiences a recession compared to an economic boom. This is true for the output and employment multiplier alike. For the employment multiplier, the difference across business cycle states is also estimated to be significant, while for the output multiplier, the difference is borderline insignificant (especially at longer horizons). Thus, our evidence broadly supports the view that fiscal interventions have a larger effect on the economy during periods of economic slack, in line with the empirical evidence by Auerbach and Gorodnichenko (2012) and Nakamura and Steinsson (2014).

Next, we study whether the sign of the fiscal intervention affects the size of the fiscal multiplier. To differentiate between fiscal consolidations and fiscal expansions, we allow for different effects depending on the sign of our Bartik instrument. Whenever the change in national spending takes on a positive value, we treat the fiscal intervention as a spending expansion ($I_{i,t} = 1$), and whenever the instrument takes on a negative value, we assign a fiscal consolidation ($I_{i,t} = 0$).[41]

Panel C of Table 4 shows the estimated fiscal multipliers.[42] For the output multiplier, we do not find clear evidence that the sign of the fiscal intervention considerably influences the size of the multiplier. While for some years the output multiplier associated with a fiscal expansion is larger than the one associated with a fiscal consolidation, the picture flips in other years. For most years of the forecast horizon, the employment multiplier brought by a fiscal consolidation is larger than the one brought by a fiscal expansion. However, the differences are small such that multipliers do not significantly depend on the sign of the fiscal intervention.

Finally, we test for differences in fiscal multipliers between core and periphery countries.

[41] This procedure implies that out of the 2,621 regional shocks considered, 2,207 shocks, or 84%, are treated as fiscal expansions, while the remaining 414 or 16% are treated as consolidations.

[42] The multipliers are positive in both states because a fiscal consolidation is associated with a fall in government spending and a reduction in output (employment), whereas a fiscal expansion leads to an increase in government spending and a rise in output (employment).

Table 4: Output and Employment State Dependent Multipliers

	Output Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline Specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Business Cycle Recessions versus Expansions										
Recessions	2.57***	2.69***	2.76***	2.74***	2.64***	1.44***	1.77***	1.92***	1.97***	1.92***
	(0.56)	(0.34)	(0.25)	(0.21)	(0.15)	(0.33)	(0.15)	(0.11)	(0.18)	(0.20)
Expansions	2.17***	2.45***	2.41***	2.35***	2.33***	0.94***	1.29***	1.38***	1.38***	1.33***
	(0.26)	(0.29)	(0.22)	(0.20)	(0.17)	(0.19)	(0.21)	(0.22)	(0.22)	(0.23)
HAC Test	0.33	0.36	0.16	0.10	0.14	0.01	0.04	0.05	0.10	0.09
AR Test	0.26	0.32	0.11	0.11	0.16	0.01	0.03	0.04	0.09	0.10
# Obs	2428	2266	2104	1943	1783	2428	2266	2104	1943	1783
Panel C: Fiscal Consolidation versus Fiscal Stimulus										
Consolidation	2.16***	2.55***	2.42***	2.33***	2.29***	1.09***	1.47***	1.37***	1.36***	1.32***
	(0.47)	(0.39)	(0.30)	(0.25)	(0.22)	(0.26)	(0.12)	(0.06)	(0.09)	(0.12)
Stimulus	2.33***	2.33***	2.45***	2.26***	2.36***	0.97**	1.25***	1.43***	1.18***	1.27***
	(0.68)	(0.59)	(0.51)	(0.40)	(0.29)	(0.44)	(0.40)	(0.44)	(0.29)	(0.27)
HAC Test	0.77	0.61	0.93	0.79	0.64	0.78	0.57	0.90	0.45	0.83
AR Test	0.78	0.60	0.93	0.79	0.67	0.78	0.57	0.90	0.46	0.82
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel D: Core versus Periphery										
Core	2.63***	2.66***	2.73***	2.92***	2.90***	1.34***	1.68***	1.80***	2.20***	2.28***
	(0.59)	(0.42)	(0.27)	(0.23)	(0.21)	(0.40)	(0.31)	(0.24)	(0.17)	(0.18)
Periphery	1.79***	2.06***	2.10***	2.01***	1.99***	1.04***	1.35***	1.43***	1.34***	1.32***
	(0.28)	(0.29)	(0.27)	(0.25)	(0.20)	(0.20)	(0.13)	(0.13)	(0.13)	(0.16)
HAC Test	0.11	0.09	0.02	0.00	0.00	0.29	0.23	0.13	0.00	0.00
AR Test	0.11	0.14	0.12	0.06	0.09	0.29	0.25	0.21	0.06	0.11
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: In Panel B, we show the results for expansions and recessions. A given region is in the low unemployment state (expansion) if in the previous period the unemployment rate was below the region's median, and it is in high unemployment state (recession) if the rate was above or equal to the region's median. In Panel C, we show state dependencies for fiscal consolidations and stimuli. Precisely, we define fiscal consolidations (stimuli) whenever the Bartik instrument is negative (positive). In Panel D, we study differences between the core and periphery Eurozone countries. The PIIGS countries (Portugal, Ireland, Italy, Greece, and Spain) are considered periphery countries, while Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands belong to the core group. The AR Test presents the p-value of the difference between states using the Anderson and Rubin (1949) test, while the HAC Test indicates the HAC-robust p-values.

Greece, Ireland, Italy, Portugal, and Spain are considered periphery ($I_{i,t} = 1\ \forall t$), while Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands are treated as core countries ($I_{i,t} = 0 \; \forall t$). In this case, the indicator variable is time invariant. Panel D of Table 4 shows that fiscal multipliers in the Eurozone display significant country heterogeneity. Both output and employment multipliers are considerably larger in core countries than in the periphery. Moreover, for most horizons considered, the difference between the multipliers is also estimated to be significant. Thus, specific country characteristics in the periphery seem to reduce the impact of fiscal interventions, whereas the opposite describes the situation in the core countries. The political and legal system, the labor market and pricing frictions or financial developments are all potentially responsible for differences in fiscal multipliers between core and periphery countries. As shown earlier, to a significant amount, fiscal policy in the Eurozone operates via a productivity channel through which higher government spending increases productivity and private investment. Because labor productivity and TFP are, on average, lower in the periphery than in the core countries, productivity differences across member states might rationalize differences in fiscal multipliers. However, understanding in more detail what drives these country heterogeneities could be an interesting avenue for future research.

5 Conclusion

The effectiveness of fiscal policy in the Eurozone is a central topic of ongoing debates among economists and policymakers alike. Using a newly assembled dataset at the regional level, this paper investigates the impact of fiscal policy in the Eurozone and provides new evidence on its transmission mechanism. In particular, our baseline estimates reveal a fiscal spending output (employment) multiplier of 2.2 (1.4). Moreover, the regional fiscal stimulus leads to a significant increase in private investment together with a rise in labor productivity and TFP. Furthermore, an increase in government spending causes higher wages and durable consumption expenditure and a rise (fall) in the labor share (markup). Concerning labor margins, we find that higher government spending raises total hours worked, which is driven by changes in the extensive margin (total employment), whereas the intensive margin (hours per worker) barely reacts. Our estimates imply a cost per job created of about €30,000.

We also detect significant sectoral heterogeneity, with the industry and services sectors contributing a disproportionate amount to the aggregate increase in private economic activity. The paper provides further evidence that there are small and mostly insignificant regional fiscal spillovers which stands in contrast to a common view of positive and sizeable fiscal spillovers shared in policy discussions. Finally, we detect notable state-dependencies in regional fiscal multipliers. They are larger in economic recessions and in the core countries of the Eurozone but do not significantly depend on the sign of the fiscal intervention (stimulus versus consolidation).

Our new evidence should contribute to discussions among academics and policymakers about the gains and limitations of fiscal policy in the Eurozone. In particular, our results suggest that fiscal policy is an effective tool to stimulate regional employment, investment, and productivity. Furthermore, despite the deep regional integration within the Eurozone, increased public spending in regions with ample fiscal capacity might have only small spillover effects. Finally, heterogeneous effects across industries, states of the economy, and member states should be taken into account when designing adequate stabilization measures.

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Appendix A Data Description

Table A.1: NUTS Structure

NUTS 0	NUTS 1	#	NUTS 2	#	NUTS 3	#
Austria	Groups of states	3	States (Länder)	9	Groups of districts	35
Belgium	Regions	3	Provinces and Brussels (Verviers split in 2)	11	Arrondissements	44
Finland	Mainland, Åland	2	Large areas (Suuralueet / Storområden)	5	Regions (Maakunnat / Landskap)	19
France	ZEAT Overseas Regions	9	Regions	27	Departments	101
Germany	States (Bundesland)	16	Government regions (Regierungbezirk)	39	Districts Kreis	429
Greece	Groups of regions	4	Regions	13	Prefectures	51
Ireland	-	1	Regional Assemblies	3	Regional Authorities	8
Italy	Groups of regions	5	Regions (Trentino-Alto Adige split in 2)	21	Provinces	110
Luxembourg	-	1	-	1	-	1
Netherlands	Groups of provinces	4	Provinces	12	COROP regions	40
Portugal	Mainland and 2 autonomous regions	3	5 Coordination regions 2 autonomous regions	7	Groups of Municipalities	25
Spain	Groups of communities	7	17 Autonomous communities 2 autonomous cities	19	Provinces, Islands Ceuta, Melilla	59
Total		58		167		922

Table A.2: Variables Description

Variable Name	Computation	Definition [Source]
GDP*pc*	GDP / Population	Regional gross domestic product per capita [ARDECO]
Gov. Spending *pc*	(1+Int. Cons)*Non-Market GVA / Population	Regional proxy for government spending per capita [ARDECO]
Employment		Total employment [ARDECO]
Employment Rate	Employment / Population	Total employment per capita [ARDECO]
Hours		Total hours worked [ARDECO]
Hourly Wage	Compensation / Hours	Regional average compensation per hour (all sectors) [ARDECO]
Investment *pc*	Private GFCF/ Population	Total private (all sectors excluding non-market) investment per capita (fixed gross capital formation) [ARDECO]
Labor Share	Private Compensation / private GVA	Private (all sectors excluding non-market) compensation as a share of private GDP [ARDECO]
Productivity	GVA / Hours	Labor productivity, value added per hour (all sectors) [ARDECO]
TFP	Check A.5 for details	Total factor productivity (private sectors) [ARDECO and Gardiner et al. (2020)]
Motor Vehicles	# motor vehicles / Population	Stock of all motor vehicles (except trailers and motorcycles) per capita [Eurostat]

A.1 ARDECO - Regional European Data

ARDECO is the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy, maintained and updated by the Joint Research Centre. It is a highly disaggregated dataset across both sectoral and sub-regional dimensions. The databasebuilds on the previous Cambridge Econometrics regional dataset and contains a set of long time-series indicators for EU regions at various statistical scales (NUTS 0, 1, 2, and 3 level) using the NUTS 2016 regional classification. The dataset includes data on demography, labor markets, capital formation and domestic product by six sectors. The six sectors are (1) agriculture, forestry and fishing, (2) industry excluding construction, (3) construction, (4) wholesale, retail, transport, accommodation, and food services, information and communication, (5) financial and business services, and (6) non-market services.

ARDECO data is an annual unbalanced panel covering the period of 1980–2017 for the European Union (EU) and some European Free Trade Association (EFTA) and candidate countries. Its main data source is Eurostat (the Statistical Office of the European Commission), complemented, where necessary, by other appropriate national and international sources. ARDECO is constructed in such a way that the country aggregates its various time series equal to the corresponding time series in the AMECO dataset referring to the National Accounts. Starting from 2002, Eurozone countries publish national series in EUR. National currency data for all years prior to the switch of the country to EUR have been converted using the irrevocably fixed EUR conversion rate. Cross-country comparisons and aggregations should continue to be based only on historical series established in ECU up to 1998 and their statistical continuation in EUR from 1999 onward. Exchange rates and purchasing power parities have been converted in the same manner. We thus use the series with real variables expressed in 2015 constant price in ECU/EUR.

A.2 Regional government spending measure

We now explain in detail why our regional measure (GVA plus intermediate consumption of the non-market sector) is indeed a valid proxy for government spending.

First, as previously mentioned, ARDECO's regional data is consistent with the national accounts data by construction. By definition, there exists a close link between government spending and the GVA of the non-market sector, however, they differ in two dimensions: actors and composition. Regarding the first, even though the non-market sector includes other institutional units, the general government is the main actor responsible for changes in non-market GVA.

In particular, the non-market sector consists of six sub-sectors: "Public administration and defense", "Education", "Human health and social work", "Arts, entertainment and recreation", "Other service activities," and "Activities of household and extra-territorial organizations and bodies." The first sub-sector, "Public administration and defense," refers to activities by the general government, but not all government bodies are automatically classified under this sub-sector. For example, a secondary school administered by the central or local government is classified as "Education," and a public hospital is allocated to "Human health and social work." Thus, the two sub-sectors "Education" and "Human health and social work" are also closely linked to the general government in the national accounts, while the last three sub-sectors are linked only loosely.

Relying on Finnish data, we indeed find that 100% of the GVA in the sub-sector "Public administration and defense" is booked as government expenditure in the national accounts. For the second and third sub-sectors, this number is 88% and 75%, respectively.[1] Moreover, for the countries in our sample, these first three sub-sectors, which are most closely linked to activities by the general government, make up the lion's share of the non-market GVA, accounting for 84%.[2]

[1] In our sample, with the exception of Finland, cross-classification tables between NACE and institutional sectors are not publicly available. Statistics Finland's series can be consulted here.

[2] According to data collected from Eurostat and for the sample comprising the first twelve Eurozone countries

Consequently, almost the entire variation in GVA of the non-market sector refers to activities by the general government.

Concerning the second dimension, we now describe the compositional differences between non-market GVA and government spending. In the national accounts, government spending is defined as follows:

Final consumption expenditure of the general government
=Gross value added of the general government
+Intermediate inputs of the general government
+Social transfers in kind purchased market production
-Market output and output for own final use
-Payments for non-market output

GVA of the general government is the major component of government spending and fully accounted in the GVA of the non-market sector. Country level data show that GVA of the general government accounts for almost 70% of government spending.[3] Thus, our proxy measures the single-most dominant source of government expenditures. However, the main difference between government spending and the GVA of the general government is due to intermediate inputs and social transfers in kind. When again looking at country level data, we find that GVA and intermediate consumption account for about 97% of government spending. To include intermediate consumption in our government spending measure, we use input-output tables from the PBL EUREGIO database that provide estimates for intermediate consumption of the non-market sector at the NUTS 2 level from 2000–2010. We find that, on average, intermediate consumption accounts for around 30% of total expenditure of the non-market sector at the regional level, which is very similar to the corresponding number when looking at expenditures of the general government at the national level (27%). Moreover, the variation in this ratio for a given region is rather stable over time.[4] Thus, we adjust regional GVA of the non-market sector by a region-specific time-invariant scaling factor to include intermediate consumption in our government spending measure to obtain our proxy for regional government spending.

Second, to quantitatively assess the quality of our proxy, we study its time series properties comparing them to the actual measure of government spending at the national level.[5] In particu-

between 1999 and 2017.

[3]According to data collected from Eurostat and for the sample comprising the first twelve Eurozone countries between 1999 and 2017.

[4]When calculating time-varying intermediate consumption ratios for each region, the average standard deviation is 0.018.

[5]Remember that, at the national level, GVA of the non-market sector, intermediate consumption, and govern-

lar, we use intermediate consumption adjusted GVA of the non-market sector from the ARDECO and EUREGIO datasets at the NUTS 0 (country) level and the series on final consumption expenditures of the general government from the OECD and AMECO. The pooled correlation coefficients between the GVA and the government spending series (both in levels and logs) are about 0.99 and highly significant. Such strong positive correlations also hold at the individual country level as can be seen in Table A.3. With the exceptions of Italy and Portugal, the correlation coefficients are around 0.99. Moreover, Table A.4 shows the estimation results from regressing government spending on our proxy in log level with and without country and year fixed effects. All regressions indicate a significant and strong relationship between the two variables with coefficients very close to 1.

So far, the analysis was conducted at the national (NUTS 0) level. We go one step further and compare our regional (NUTS 2) proxy for government spending to the government final consumption expenditure series from the PBL EUREGIO database, which is discussed in more detail in Appendix A.3. The EUREGIO database provides estimates of regional government spending but only for a subset of our sample (2000 to 2010). Notwithstanding, when doing this comparison, we find that both series are highly significantly correlated. The correlation coefficient between the two series in logs is close to 1. Table A.5 presents the same regressions as before but now at the regional level. There is a strong and significant relationship between the EUREGIO estimated government spending series and our government spending proxy given that the coefficients are estimated to be close to 1.

In sum, we conclude that regional GVA of the non-market sector is a valid proxy for regional government spending. It is closely linked to government spending in the national accounts, and both series share remarkably similar time series properties.

ment spending are available, whereas at the regional level only GVA of the non-market sector and intermediate consumption are available from national accounts data.

Table A.3: Correlation Between Government Spending and our proxy by Country

Country	Correlation w/ OECD Series Levels	Correlation w/ OECD Series Logs	Correlation w/ AMECO Series Levels	Correlation w/ AMECO Series Logs
Austria	0.9899	0.9886	0.9876	0.9859
Belgium	0.9762	0.9786	0.9917	0.9917
Finland	0.9698	0.9728	0.9906	0.9910
France	0.9965	0.9967	0.9931	0.9931
Germany	0.9905	0.9907	0.9848	0.9837
Greece	0.9755	0.9751	0.9851	0.9846
Ireland	0.9581	0.9660	0.9967	0.9972
Italy	0.8335	0.8412	0.8928	0.8976
Luxembourg	0.9950	0.9968	0.9946	0.9961
Netherlands	0.9826	0.9845	0.9912	0.9918
Portugal	0.9753	0.9757	0.9143	0.9100
Spain	0.9905	0.9924	0.9869	0.9904
All	0.9976	0.9977	0.9975	0.9988

Notes: This shows, by country, the correlation in levels and logs between our proxy for government spending (from ARDECO) with actual government spending (from OECD and AMECO). Whenever possible, we use data from 1999 to 2017, with the exception of Greece, for which we use the period 2001–2017.

Table A.4: Proxy for Government Spending at the National Level

	$\log proxy$ (1)	$\log proxy$ (2)	$\log proxy$ (3)
Panel A: OECD			
$\log GovSpend$	0.920^{***}	0.860^{***}	0.840^{***}
	(0.038)	(0.063)	(0.072)
# Obs	223	223	223
Panel B: AMECO			
$\log GovSpend$	1.049^{***}	1.113^{***}	1.111^{***}
	(0.031)	(0.053)	(0.082)
# Obs	212	212	212
Country FE	No	Yes	Yes
Time FE	No	No	Yes

Notes: Columns (1) to (3) show the results from regressing the log of the government spending series from OECD and AMECO on the log of our proxy for government spending at the national level (NUTS 0). We use data from 1999 to 2017 and display robust standard errors clustered at the country level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Proxy for Government Spending at the Regional Level

	$\log proxy$		
	(1)	(2)	(3)
$\log GovSpend$	1.020***	1.032***	0.666***
	(0.045)	(0.113)	(0.199)
Regional FE	No	Yes	Yes
Time FE	No	No	Yes
# Obs	1604	1604	1604

Notes: Columns (1) to (3) show the results from regressing the log of the regional government spending series from EUREGIO on the log of our proxy for government spending from ARDECO at the regional level (NUTS 2). Data from 2000 to 2010. Robust standard errors clustered at the region level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.3 PBL EUREGIO database

To include intermediate consumption in our government spending proxy and for the fiscal spillover analysis in Section 4.5, we use the PBL EUREGIO database. This is the first time-series (annual, 2000–2010) of global IO tables with regional detail for the entire large trading bloc of the European Union. This database allows for a regional analysis at the NUTS 2 level consistent with our baseline method. The tables merge data from WIOD (the 2013 release) with regional economic accounts and inter-regional trade estimates developed by PBL Netherlands Environmental Assessment Agency and complemented with survey-based regional input-output data for a limited number of countries. All data used are survey data, and only non-behavioral assumptions have been made to estimate the EUREGIO dataset. These two general rules of data construction allow empirical analyses focused on impacts of changes in behavior without endogenously having this behavior embedded already by construction. More detailed information can be found in Thissen et al. (2018).

Table A.6 shows an example of the type of information provided by the IO tables from Thissen et al. (2018). For each pair of sector-region we have information about how much a specific sector in a specific region imported from each individual sector from each individual region, all measured in million dollars. Given this information, we aggregate all sectors within a given region so that we have an estimate of the most likely trade flows between regions in the Eurozone. This means that we have an estimate of how much million dollars worth of goods and services a specific region imported from all other individual regions. Finally, we convert this measure into euros using a yearly average of the euro-dollar exchange rate.

Table A.6: Example of IO table from Thissen et al. (2018)

			Burgenland (AT11)													
			ss1	ss2	ss3	ss4	ss5	ss6	ss8	ss9	ss10	ss11	ss12	ss13	ss14	ss15
Burgenland (AT11)	ss1	Agriculture	44.4	0.1	59.0	1.3	0.6	0.2	13.2	1.2	0.8	5.2	0.3	0.1	0.5	0.7
	ss2	Mining quarrying and energy supply	2.8	47.8	4.2	0.8	7.1	2.2	14.3	9.6	5.3	3.9	3.6	1.4	8.7	17.6
	ss3	Food beverages and tobacco	5.9	0.2	18.9	0.9	1.1	0.7	1.7	0.8	2.3	12.0	0.8	0.4	0.6	5.6
	ss4	Textiles and leather	0.1	0.0	0.1	1.0	0.2	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.1
	ss5	Coke refined petroleum nuclear fuel and chemicals etc	2.4	0.8	2.5	1.0	6.8	5.4	9.0	5.2	4.8	0.6	2.8	0.6	1.8	4.2
	ss6	Electrical and optical equipment and transport equipment	0.6	1.4	1.0	0.3	0.9	8.2	4.4	4.9	3.2	0.4	1.8	0.9	2.7	2.8
	ss8	Other manufacturing	4.8	2.4	6.8	1.1	6.5	19.8	94.0	50.4	14.3	1.4	4.2	2.9	9.0	11.7
	ss9	Construction	3.0	1.8	1.5	0.4	1.4	1.9	5.3	35.9	3.4	3.5	5.1	3.7	40.4	20.2
	ss10	Distribution	16.6	4.8	26.5	10.4	20.0	32.1	53.6	30.0	31.9	8.0	12.8	3.1	9.4	23.6
	ss11	Hotels and restaurant	0.1	0.0	0.2	0.1	0.1	0.1	0.3	0.2	0.4	0.5	5.9	0.5	0.3	0.3
	ss12	Transport storage and communication	1.6	2.9	5.6	1.4	4.7	4.0	16.6	5.3	17.0	1.5	38.0	5.4	6.2	11.4
	ss13	Financial intermediation	5.1	4.6	5.3	1.5	4.5	6.5	15.6	13.1	24.1	5.5	9.9	39.1	24.2	30.4
	ss14	Real estate renting and business activities	2.5	4.1	10.7	2.1	7.6	11.4	24.7	18.7	47.7	9.6	17.8	20.4	65.5	38.6
	ss15	Non-Market service	3.7	0.9	3.2	0.8	1.7	1.4	9.5	1.6	6.6	3.0	2.4	3.4	25.7	47.8

Notes: This Figure shows an example of an input-output table for just one region from Thissen et al. (2018) (Burgenland, Austria). Each column states the amount of inputs a sector from Burgenland receives from another sector from another (or the same in this case) region. For example, the agricultural sector in Burgenland (first row) gives as inputs 44.4 million dollars worth of goods/services to the agricultural sector in Burgenland and gives 59.0 million dollars to the Food and Beverages and Tobacco sector in Burgenland (first row, third column).

A.4 Military Data at the Country Level

Military expenditure data are taken from the Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database 2019. SIPRI collects military spending data from several sources, including government agencies and international organizations. The military spending data include all spending on current military forces and activities such as personnel, procurement, operations, military research and development, and construction. The largest component is usually salaries to and benefits of military personnel. The data are at an annual frequency.

A.5 Total Factor Productivity

Contrary to the remaining dependent variables, for which we only use data from ARDECO, TFP measures make use of capital stock estimates from Gardiner et al. (2020).[6] Its construction hinges on the methodology used by Derbyshire et al. (2013), which makes use of the Perpetual Inventory Method using regional investment series from ARDECO and data from EU KLEMS for the national depreciation rate and national initial capital stock.[7]

TFP is then calculated as a residual with a labor share of two-thirds as is common in the literature. Precisely, we estimate

$$TFP_{i,t} = exp\Big(ln(GVA_{i,t}) - 1/3 \times ln(K_{i,t}) - 2/3 \times ln(L_{i,t})\Big) \tag{A.1}$$

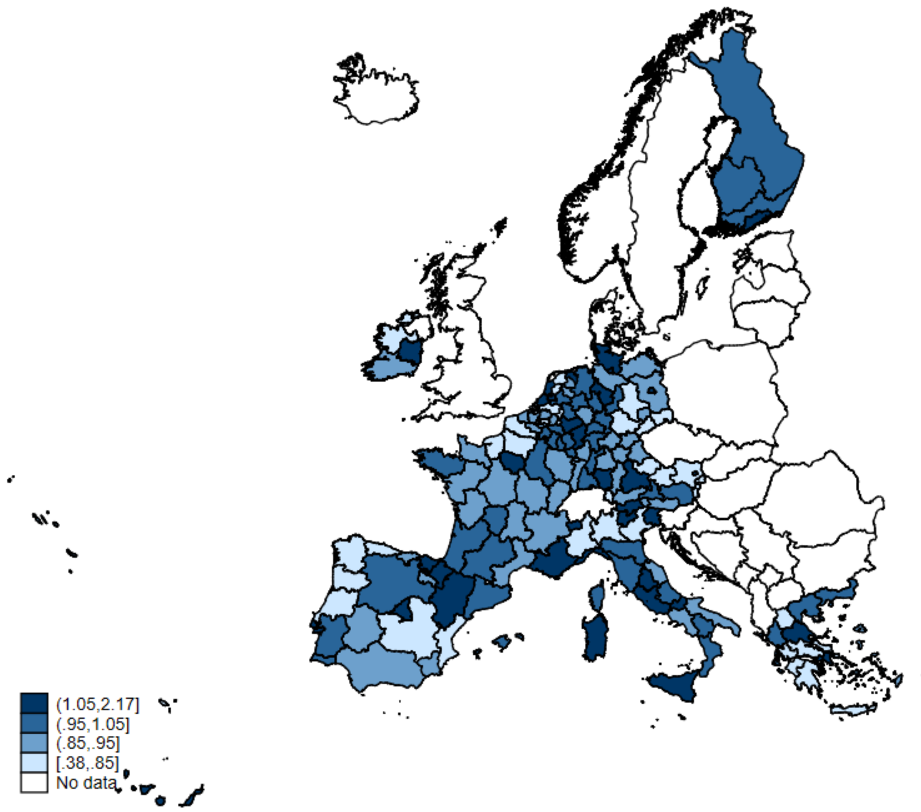
where GVA is total Gross Value-Added, K is capital stock adjusted to constant 2015 EUR using national CPI data from the World Bank, and L is total hours worked. All variables are measured at the regional level i and at year t. We use all measures in private sector terms and obtained them by subtracting the non-market sector values from their total. Hence, there is no need to remove the government spending component as in Brueckner et al. (2019). We take the exponential of this expression to compute TFP growth rate in the exact same way as we compute it for the remaining variables, instead of taking log differences.

[6] It was necessary to adjust the regional division to be in accordance with the most recent NUTS 2016 version for France, Ireland, Poland and the United Kingdom.

[7] More details on its construction can be found here.

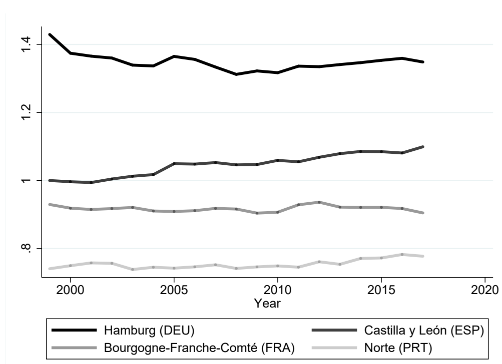
Appendix B Additional Results

Figure B.1: Sample Regions and the Share s_i



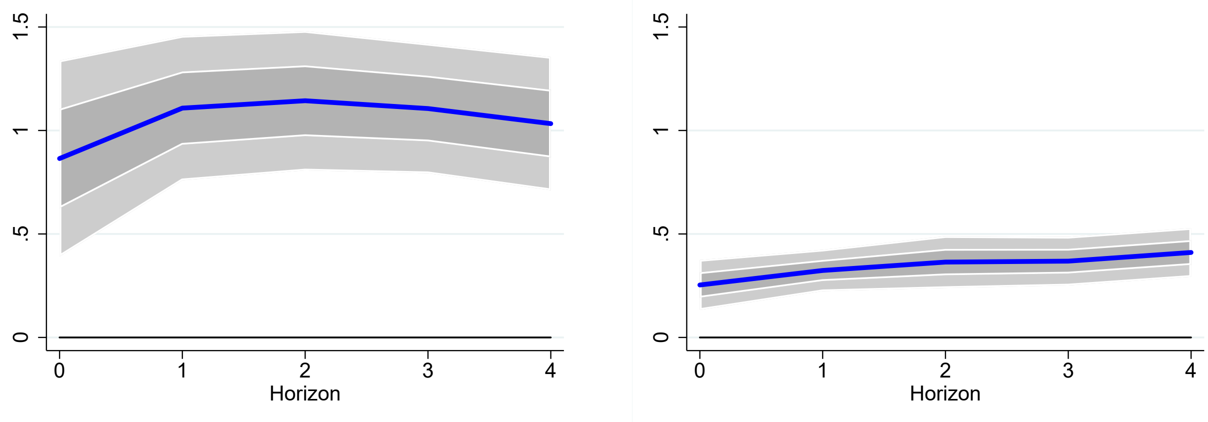
Notes: The Figure depicts the map of European NUTS 2 regions with the share s_i used in Bartik instrument construction.

Figure B.2: Ratio between Regional and National per capita Government Sending



Notes: This Figure plots the ratio between regional and national per capita government sending over time for selected regions in the sample.

Figure B.3: Private and Public Employment Multipliers

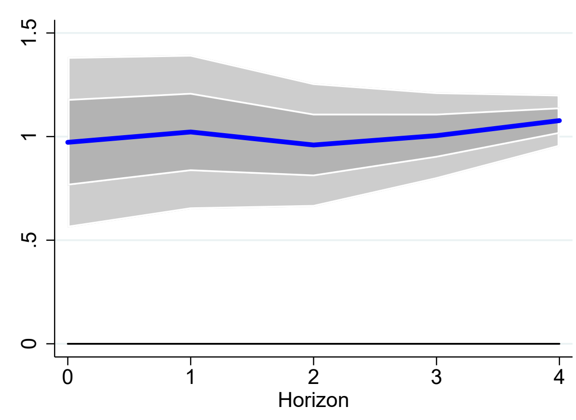


(a) Private Employment Multiplier

(b) Public Employment Multiplier

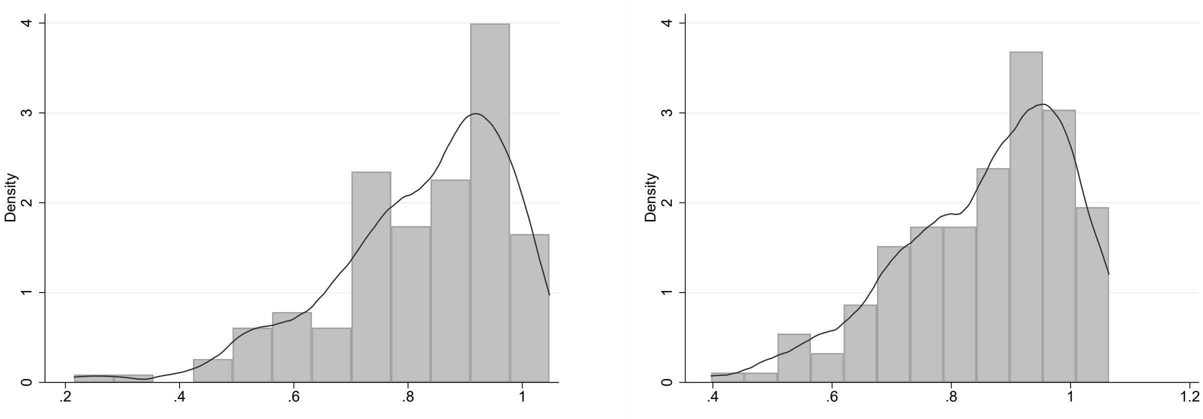
Notes: Panels B.3a and B.3b show the cumulative employment multipliers for private and non-market sectors relative to total employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

Figure B.4: Investment Multiplier



Notes: This figure shows the cumulative relative private investment multiplier (using change in private investment relative to output). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

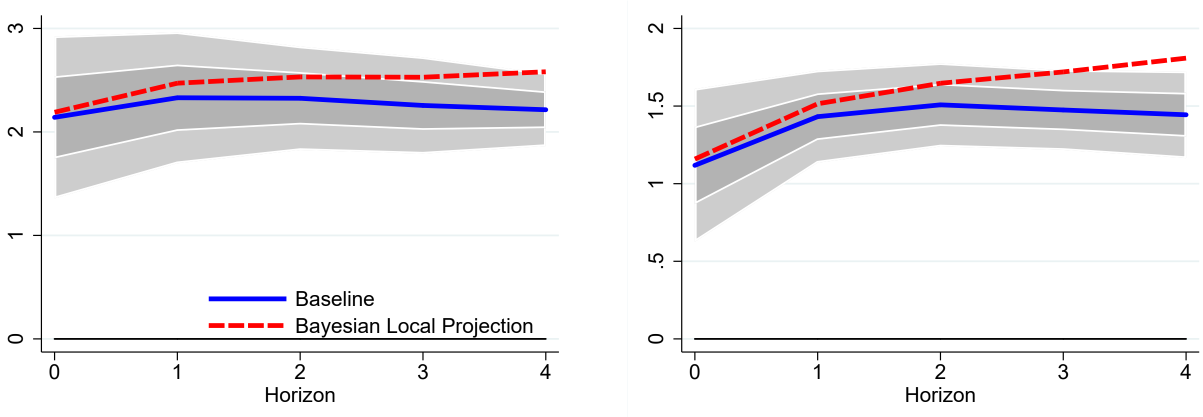
Figure B.5: Distribution of Output and Employment Persistence Parameter



(a) Output (b) Employment

Notes: This Figure plots the distribution of output and employment persistence parameter from an AR(1) process.

Figure B.6: Output and Employment Multipliers: Baseline and Bayesian Local Projection



(a) Output Multiplier (b) Employment Multiplier

Notes: Panels 2a and 2b show the baseline (blue solid) and the Bayesian local projections (red dashed) fiscal and employment multipliers. Normal prior with variance 2 and means 1.9 and 1.4 for output and employment, respectively. Shaded areas are 68% (dark) and 95% (light) confidence intervals of the baseline estimation.

Table B.1: Output and Employment Multipliers: Robustness I

	Output Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel A: Excluding AR(1) outliers										
Multiplier	2.22***	2.43***	2.44***	2.40***	2.33***	1.06***	1.38***	1.47***	1.41***	1.40***
	(0.42)	(0.33)	(0.24)	(0.20)	(0.17)	(0.24)	(0.15)	(0.13)	(0.12)	(0.14)
# Obs	2112	1979	1846	1713	1579	2109	1977	1845	1713	1579
Panel B: Nakamura and Steinsson (2014) approach with military spending										
Multiplier	0.78*	1.25***	1.49***	1.59***	1.51***	0.35	0.82***	0.98***	1.03***	0.81***
	(0.47)	(0.48)	(0.33)	(0.24)	(0.18)	(0.31)	(0.27)	(0.22)	(0.17)	(0.11)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Panel C: No controls										
Multiplier	2.01***	2.14***	2.11***	2.06***	2.02***	1.30***	1.49***	1.53***	1.51***	1.48***
	(0.39)	(0.31)	(0.25)	(0.21)	(0.16)	(0.25)	(0.20)	(0.16)	(0.13)	(0.09)
# Obs	2953	2789	2625	2461	2295	2953	2789	2625	2461	2295
Panel D: Excluding regions in top 10% of s_i										
Multiplier	2.22***	2.39***	2.37***	2.30***	2.27***	1.09***	1.40***	1.48***	1.47***	1.44***
	(0.40)	(0.33)	(0.25)	(0.23)	(0.16)	(0.24)	(0.16)	(0.14)	(0.14)	(0.16)
# Obs	2349	2202	2055	1908	1759	2349	2202	2055	1908	1759
Panel E: Excluding intermediate consumption										
Multiplier	2.83***	3.07***	3.06***	2.97***	2.91***	1.46***	1.87***	1.97***	1.93***	1.89***
	(0.52)	(0.41)	(0.32)	(0.30)	(0.23)	(0.33)	(0.19)	(0.18)	(0.17)	(0.19)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

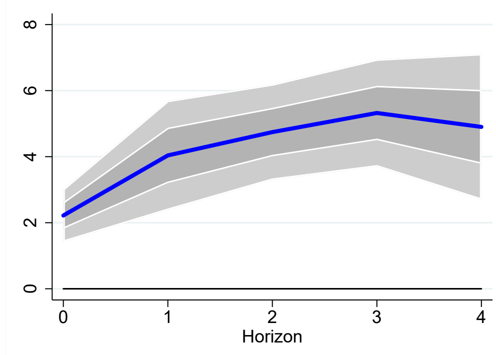
Notes: Panel A excludes regions which present very large or small (top and bottom 10%) persistence coefficient from an AR(1) regression. Panel B shows estimates for output and employment multipliers following Nakamura and Steinsson (2014) approach and using as the instrument the interaction between aggregate military spending and regional fixed effects. The results in Panel C show that the estimates are robust to excluding the controls from the baseline regression (lags of government spending and variable of interest). Panel D excludes the regions with the largest shares s_i (top 10%). Panel E shows the results when excluding intermediate consumption from our government spending proxy.

Table B.2: Output and Employment Multipliers: Robustness II

	Output Multiplier					Employment Multiplier				
	Impact	1-Year	2 Years	3 Years	4 Years	Impact	1-Year	2 Years	3 Years	4 Years
Panel A: Baseline specification										
Multiplier	2.14***	2.33***	2.33***	2.26***	2.21***	1.12***	1.43***	1.51***	1.47***	1.44***
	(0.40)	(0.32)	(0.26)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Excluding individual countries iteratively										
Multiplier Austria	2.15***	2.34***	2.33***	2.24***	2.20***	1.12***	1.43***	1.50***	1.46***	1.43***
	(0.41)	(0.33)	(0.26)	(0.24)	(0.18)	(0.26)	(0.16)	(0.14)	(0.14)	(0.14)
# Obs	2477	2322	2167	2012	1855	2477	2322	2167	2012	1855
Multiplier Belgium	2.17***	2.36***	2.35***	2.27***	2.23***	1.14***	1.47***	1.54***	1.50***	1.47***
	(0.38)	(0.31)	(0.25)	(0.24)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.15)
# Obs	2445	2292	2139	1986	1831	2445	2292	2139	1986	1831
Multiplier Germany	1.76***	2.01***	2.06***	1.98***	1.93***	1.03***	1.32***	1.38***	1.31***	1.28***
	(0.30)	(0.26)	(0.23)	(0.22)	(0.17)	(0.17)	(0.12)	(0.14)	(0.13)	(0.16)
# Obs	2013	1887	1761	1635	1507	2013	1887	1761	1635	1507
Multiplier Greece	1.84***	1.96***	1.94***	1.77***	1.74***	1.08***	1.44***	1.54***	1.38***	1.20***
	(0.37)	(0.28)	(0.28)	(0.33)	(0.26)	(0.24)	(0.21)	(0.27)	(0.32)	(0.36)
# Obs	2439	2288	2137	1986	1833	2439	2288	2137	1986	1833
Multiplier Spain	2.28***	2.41***	2.35***	2.34***	2.29***	1.18***	1.47***	1.52***	1.60***	1.61***
	(0.40)	(0.35)	(0.28)	(0.24)	(0.18)	(0.25)	(0.15)	(0.11)	(0.08)	(0.08)
# Obs	2317	2172	2027	1882	1735	2317	2172	2027	1882	1735
Multiplier Finland	2.13***	2.33***	2.34***	2.28***	2.24***	1.12***	1.43***	1.50***	1.47***	1.43***
	(0.41)	(0.33)	(0.26)	(0.24)	(0.18)	(0.26)	(0.16)	(0.14)	(0.14)	(0.15)
# Obs	2541	2382	2223	2064	1903	2541	2382	2223	2064	1903
Multiplier France	2.19***	2.38***	2.34***	2.29***	2.26***	1.11***	1.43***	1.51***	1.48***	1.47***
	(0.43)	(0.38)	(0.31)	(0.28)	(0.22)	(0.27)	(0.18)	(0.15)	(0.13)	(0.14)
# Obs	2189	2052	1915	1778	1639	2189	2052	1915	1778	1639
Multiplier Ireland	2.27***	2.46***	2.47***	2.41***	2.35***	1.15***	1.47***	1.56***	1.53***	1.50***
	(0.41)	(0.32)	(0.23)	(0.22)	(0.19)	(0.26)	(0.15)	(0.13)	(0.13)	(0.14)
# Obs	2582	2419	2256	2093	1930	2582	2419	2256	2093	1930
Multiplier Italy	2.14***	2.32***	2.33***	2.28***	2.25***	1.08***	1.39***	1.47***	1.44***	1.43***
	(0.41)	(0.33)	(0.25)	(0.22)	(0.16)	(0.26)	(0.16)	(0.14)	(0.13)	(0.14)
# Obs	2285	2142	1999	1856	1711	2285	2142	1999	1856	1711
Multiplier Luxembourg	2.15***	2.34***	2.33***	2.26***	2.22***	1.13***	1.44***	1.52***	1.48***	1.46***
	(0.40)	(0.32)	(0.25)	(0.23)	(0.18)	(0.25)	(0.15)	(0.14)	(0.13)	(0.14)
# Obs	2605	2442	2279	2116	1951	2605	2442	2279	2116	1951
Multiplier Netherlands	2.25***	2.46***	2.43***	2.32***	2.28***	1.13***	1.48***	1.57***	1.51***	1.48***
	(0.41)	(0.31)	(0.25)	(0.22)	(0.15)	(0.27)	(0.15)	(0.13)	(0.12)	(0.14)
# Obs	2429	2277	2125	1973	1819	2429	2277	2125	1973	1819
Multiplier Portugal	2.18***	2.37***	2.36***	2.30***	2.25***	1.15***	1.43***	1.50***	1.47***	1.44***
	(0.41)	(0.33)	(0.25)	(0.23)	(0.17)	(0.26)	(0.15)	(0.13)	(0.12)	(0.13)
# Obs	2509	2352	2195	2038	1879	2509	2352	2195	2038	1879

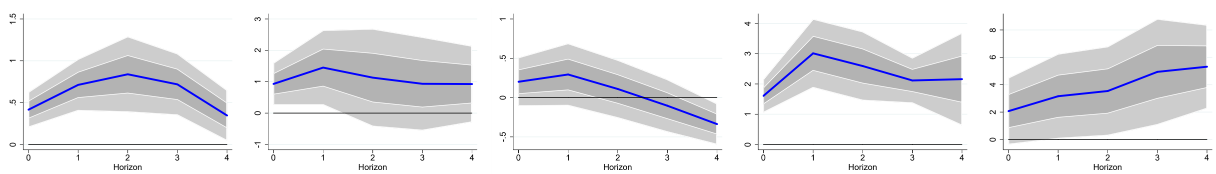
Notes: This table shows the output and employment multiplier estimates using the baseline specification but excluding individual countries iteratively from the base sample.

Figure B.7: Impulse Response of Disposable Income



Notes: The figure plots the response of per capita disposable income to a one percent increase in per capita government spending relative to per capita GDP. The impulse response is expressed in percent changes (growth rates). Shaded areas are 68% (dark) and 95% (light) confidence intervals.

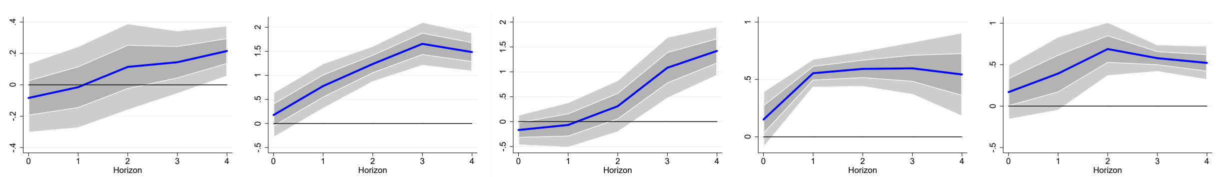
Figure B.8: Impulse Responses of Investment per Sector



(a) Agriculture (b) Industry (c) Construction (d) Services (e) Finance

Notes: These figures plot the decomposition of the impulse response of private investment across private sectors. All responses are expressed in percent changes (growth rates) relative to private investment. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

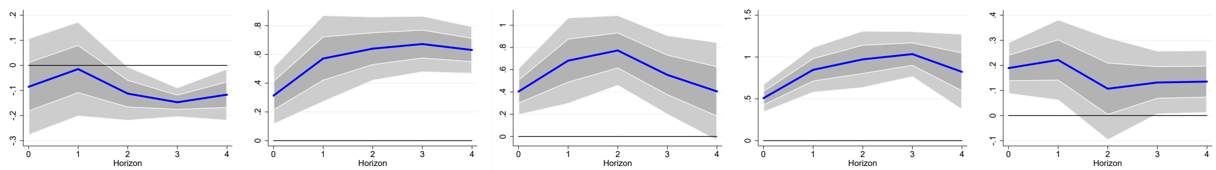
Figure B.9: Impulse Responses of Hourly Wage per Sector



(a) Agriculture (b) Industry (c) Construction (d) Services (e) Finance

Notes: These figures plot the decomposition of the impulse response of compensation across private sectors. All responses are expressed in percent changes (growth rates) relative to hourly wages in the private sector. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

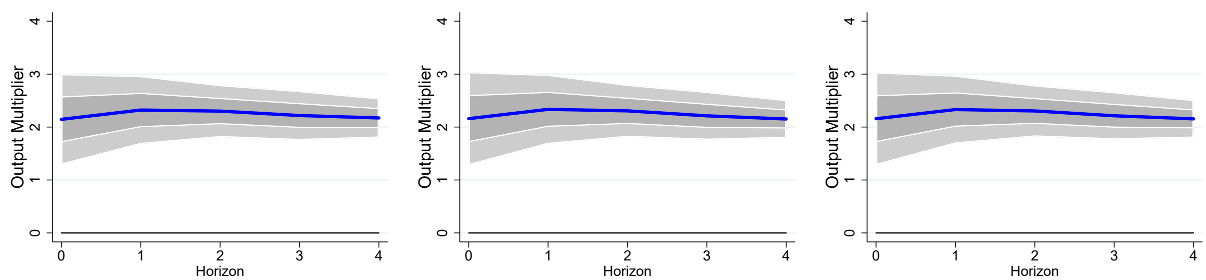
Figure B.10: Impulse Responses of Total Hours per Sector



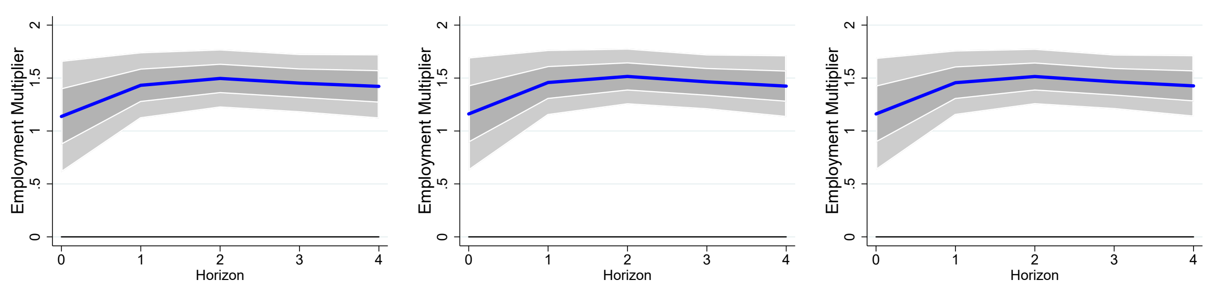
(a) Agriculture (b) Industry (c) Construction (d) Services (e) Finance

Notes: These figures plot the decomposition of the impulse response of hours worked across private sectors. All responses are expressed in percent changes (growth rates) relative to total hours in the private sector. Shaded areas are 68% (dark) and 95% (light) confidence intervals.

Figure B.11: Output and Employment Multipliers: Spillover Analysis



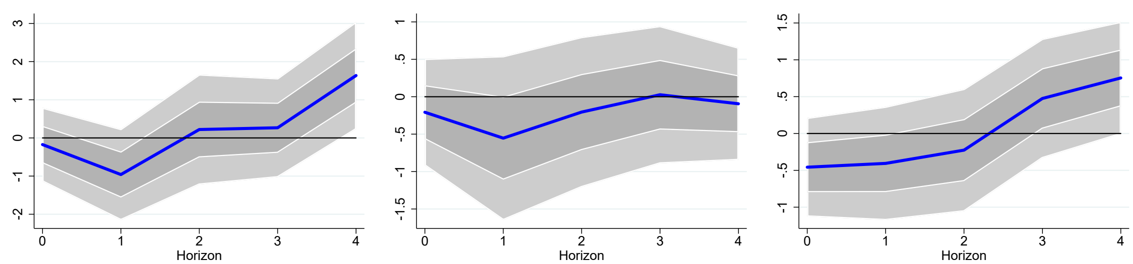
(a) All Regions (b) Top Trade Partners (c) Same country



(d) All Regions (e) Top Trade Partners (f) Same country

Notes: Plots in the top row refer to output multipliers, while those in the bottom row refer to employment multipliers. Panels B.11a and B.11d show the multipliers taking into account the spillovers from all regions, Panels B.11b and B.11e consider only the spillovers from the main trade partners (top 10% of the weights), and Panels B.11d and B.11f account for the spillovers from all regions within the country. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.

Figure B.12: Spillover Impulse Responses



(a) Investment (b) Motor Vehicles (c) Hourly Wage

Notes: Figures show the spillover impulse responses of private investment, registered motor vehicles, and hourly wage. Shaded areas are 68% (dark) and 95% (light) Driscoll and Kraay (1998) confidence intervals.