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The Effects of Government Spending in the Eurozone*

Ricardo Duque Gabriel† University of Bonn

Mathias Klein‡ Sveriges Riksbank

Ana Sofia Pessoa§ University of Bonn

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Abstract

Using a novel rich dataset at the regional level, this paper provides new empirical evidence on the fiscal transmission mechanism in the Eurozone. Our baseline estimates reveal a government spending relative output multiplier of 2.9, an employment multiplier of 1.9, and a cost per job created of €24,000. Moreover, we find that a regional fiscal stimulus leads to a significant increase in private investment, productivity, durable consumption, and real wages 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. We estimate only small regional fiscal spillovers but detect notable state dependencies. Regional fiscal multipliers are larger in economic recessions, during fiscal consolidations, and in the core countries of the Eurozone.

JEL classification: E32, E62, R12.

Keywords: Fiscal policy, Regional government spending multipliers, Eurozone, ARDECO.

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†Bonn Graduate School of Economics and Department of Economics, University of Bonn, ricardo.gabriel@uni-bonn.de.

‡Sveriges Riksbank, Monetary Policy Department - Research, SE-103 37 Stockholm, Sweden, mathias.klein@riksbank.se

§Bonn Graduate School of Economics and Department of Economics, University of Bonn, sofia.pessoa@uni-bonn.de

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. To provide concrete examples, as the main policy interest rate of the European Central Bank (ECB) has reached its lower bound, commentators frequently ask 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). The large-scale fiscal consolidation packages and the dismal growth performances in southern European economies have raised tensions between core and periphery countries about the adequacy and usefulness of austerity programs (Blanchard and Leigh 2013; Fatás and Summers 2018). Moreover, motivated by the close trade linkages among member 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). In this paper, we address these important questions by providing new empirical evidence on the economic impact of fiscal policy and its transmission mechanisms in the Eurozone.[1]

In particular, we follow the approach suggested by, among others, Nakamura and Steinsson (2014), Bernardini et al. (2020), and Auerbach et al. (2020) and use regional variation in government spending to estimate how fiscal policy shapes the Eurozone economy. This approach 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 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.[2]

We use a novel rich dataset, ARDECO, which offers series on output, private investment, employment, hours worked, and wages at different regional aggregations and sectoral divisions. We use regional gross value added of the non-market sector as a measure of regional government spending. To justify this choice, we show that by definition government spending in the national accounts is closely linked to the gross value added of the non-market sector and demonstrate that the statistical properties of the two time series are very similar at the national level. For iden-

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

[2]Nakamura and Steinsson (2014) call this metric the "open economy relative multiplier".

tification, we use a Bartik type instrument, which identifies the effect of government spending on 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 baseline estimates reveal a government spending relative output multiplier of 2.9, which implies a €1.9 increase (decrease) in relative private sector production for every €1 increase (decrease) in relative government production. Moreover, we find an employment multiplier of 1.9, 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 42 new jobs four years after the shock materialized or, in other words, a cost per job created of about €24,000. 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 due to changes in national military spending or professional forecast errors.

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 evidence by Auerbach et al. (2020), 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 the increase in hours 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 conduct an additional sectoral analysis and estimate fiscal multipliers across different sectors of the economy. We find that multipliers are larger in the construction and industry sectors, whereas the impact of a change in regional government spending is somewhat lower in the services and financial sectors. 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.

Finally, we detect significant state dependencies. First, fiscal multipliers are larger in economic recessions than in economic booms. Second, we find that fiscal multipliers associated with fiscal consolidations, that is, a reduction in regional government spending, are larger than fiscal multipliers associated with fiscal expansions. Third, fiscal multipliers are larger in core countries of the Eurozone compared to periphery countries. While the difference in multipliers is also estimated to be significant across states of the business cycle and between core and periphery countries, there is more statistical uncertainty when differentiating between positive and negative spending changes.

Our paper contributes to the recent and fast-growing literature that uses subnational data to estimate the impact of fiscal policy (Nakamura and Steinsson 2014; Dupor and Guerrero 2017; Bernardini et al. 2020; Auerbach et al. 2020). So far, this literature mainly focuses on the U.S. economy; there is only limited evidence for the Eurozone.[3] Two notable exceptions are the studies by Coelho (2019) and Brueckner et al. (2020). While Coelho (2019) investigates the effects of one specific form of regional public expenditures, namely structural funds financed by the European Commission, our analysis is based on a broader measure of government spending. Moreover, whereas Brueckner et al. (2020) show that the size of the fiscal spending multiplier depends on the degree of local autonomy across European regions, 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 novel dataset of our analysis, we are able to zoom into a wide range of fiscal policy effects. In particular, the dataset allows a highly detailed investigation into the underlying driver of our fiscal multiplier estimates, like the influence of fiscal policy on investment, productivity, (public and private) employment, or earnings. Moreover, the dataset enables us to conduct a thorough investigation into regional fiscal spillovers and heterogeneous effects across industries, 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.

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

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.[4] 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. For example, the database provides regional measures for output (gross domestic product (GDP) and gross value added (GVA)), investment, earnings, hours worked or employment for different economic sectors like industry, construction, wholesale services, financial and business services, 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) 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.[5]

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.[6] Our sample thus consists of regions that are part of a monetary union. 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 of 167 European regions, which are broadly comparable to U.S. states.

For our main analysis, we use data on demography (total population), labor markets (em-

[4]It can be found online here.

[5]See Appendix A.1 for more information.

[6]See Table A.1 for more details on the NUTS 2 classification for the countries used in the sample.

ployment, employee compensation, total hours worked), capital formation (gross fixed capital formation) and output (GDP and GVA).[7]

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, we follow Brueckner et al. (2020) and use GVA 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, and other taxes less subsidies on production, where consumption of fixed capital measures the decline in value of fixed assets owned as a result of normal wear and tear and obsolescence. [8] [9] We now explain in detail why GVA of the non-market sector is indeed a good 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.[10] Moreover, these first

[7]The construction of all variables used in the paper is described in the Appendix, Table A.2.

[8]For more details, see the Manual on Regional Accounts from Eurostat.

[9]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.2.

[10]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.

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%.[11] 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.[12] 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. While our baseline estimates will not include intermediate consumption expenditures of the general government, in Section 4.2 we conduct a sensitivity analysis and show that our main findings are robust when using detailed input-output tables to construct regional measures of intermediate consumption of the non-market sector. Taken together, our preferred series on non-market sector GVA is strongly related to the commonly used government expenditure series from the national accounts.

Second, to quantitatively assess the quality of our proxy, we study the time series properties of the national GVA of the non–market sector and government spending.[13] In particular, we use GVA of the non-market sector from the ARDECO dataset 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

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

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

[13] Remember that, at the national level, GVA of the non-market sector and government spending are both available, whereas at the regional level only GVA of the non-market sector is available.

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 always around 0.99. Moreover, Table A.4 shows the estimation results from regressing government spending on the GVA of the non–market sector in levels and logs with and without country and year fixed effects. All six 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) GVA of the non–market sector series from ARDECO to the government final consumption expenditure series from the PBL EUREGIO database, which is discussed in more detail in Appendix A.2. The EUREGIO database provides estimates of regional government spending but only for a subset of our sample (2000 to 2010). Notwithstanding, when compared to the regional GVA of the non-market sector, we find that both series are highly significantly correlated. The correlation coefficient between the two series in levels is 0.90, while the correlation between the two series in logs is 0.99. 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. We will thus refer to GVA of the non-market sector as government spending throughout the rest of the paper.

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 cumulated 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 $t-1$. 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, 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, e.g., global shocks, shocks that originate in another country and spillover to the Eurozone, or changes in the monetary policy stance set by the ECB. 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.

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 NUTS 2 regions used in the sample. There is considerable cross-sectional variation in this measure, ranging from 0.38 to 2.17. We calculate the lowest shares for Mayotte (France, 0.37), Peloponnese (Greece, 0.69), and Low Austria (Austria, 0.73), and the highest shares for Melilla (Spain, 2.17), Ceuta (Spain 2.10), and Brussels Capital District (Belgium, 2.10).[14] There is only small variation in the shares over

[14]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

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.[15]

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).[16] 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. However, we are convinced that the NUTS 2 level we chose in this paper is not subject to this criticism. Notably, we conduct an additional robustness check where we show that our 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.

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

$$\sum_{m=0}^{h} w_{i,t+m} = \beta_h \frac{G_{i,t} - G_{i,t-1}}{Y_{i,t-1}} + \gamma_h(L)X_{i,t-k} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+m} \tag{3}$$

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.

F-statistic compared to the absolute level specification.

[15]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 share s_i instead of the five years preceding Eurozone accession. The results remain unchanged.

[16]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.

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.

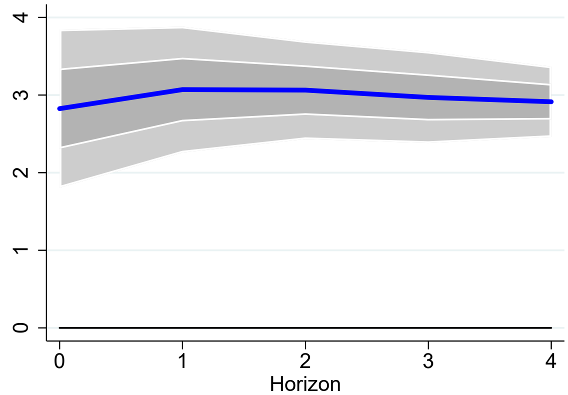
Our baseline estimates reveal an output multiplier of 2.83 on impact, which slowly increases to 2.9 four years after the shock materialized. This implies that a €1 increase (decrease) in relative government production leads to a €1.9 increase (decrease) in relative private sector production. The four-year multiplier is estimated relatively precisely with the 95% confidence band ranging from 2.46 to 3.37. 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 1.46, which then rises slightly to 1.89 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 1.52 to 2.26. As shown in Panel 1d, employment significantly increases on impact and then rises for three years after the shock before slowly decreasing.

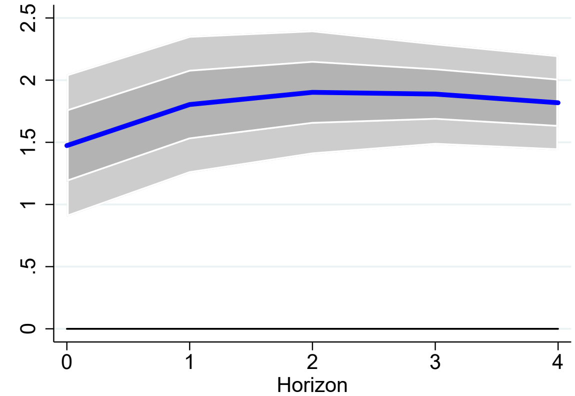
When decomposing the employment multiplier into employment in the private and public

[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).

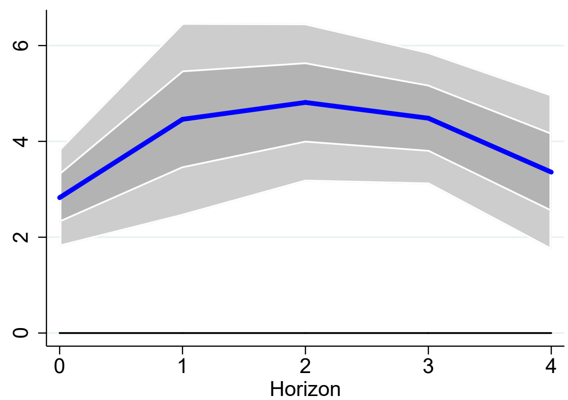
Figure 1: Output and Employment Multipliers



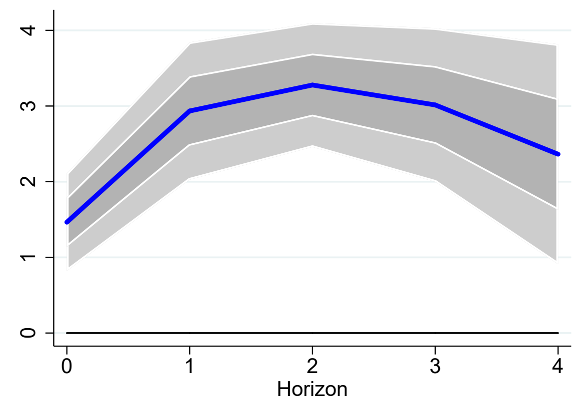
(a) Output Multiplier



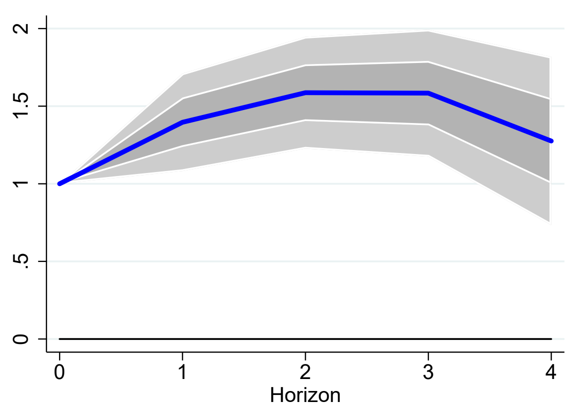
(b) Employment Multiplier



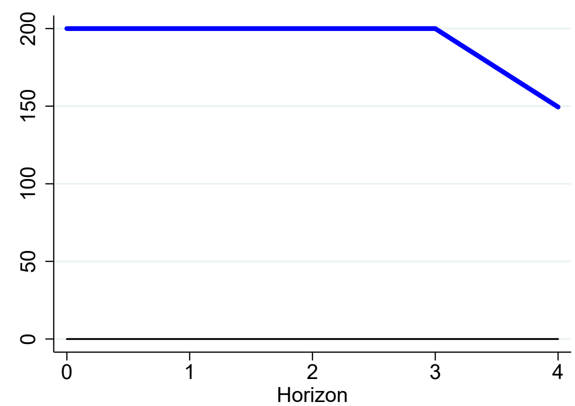
(c) Output Cumulative



(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. Bands are 68% (dark) and 95% (light) confidence intervals.

sector, we find that both contribute to the positive impact of government spending on total employment. Figure C.1 in the Appendix shows the employment multiplier for private and public employment. On average, private employment accounts for around 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.

Our estimated regional fiscal multipliers for the Eurozone are comparable to results from the U.S. and other countries. While Nakamura and Steinsson (2014) find slightly smaller multipliers for their baseline specification (1.4 for output and 1.3 for employment), they report an output (employment) multiplier of 2.5 (1.8) when using a Bartik instrument as we do. 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. Corbi et al. (2019) find an output multiplier around 2 for Brazil, and Coelho (2019) estimates an output multiplier of 4.1 for European regions. McCrory (2020) estimates an output multiplier of 2.8 for the American Recovery and Reinvestment Act.[18]

4.2 Robustness

In this section, we demonstrate that our main Eurozone multiplier estimates are robust to several modifications. The estimates change only a little when applying different ways to construct the Bartik instrument and accounting for intermediate consumption in our government spending series. Moreover, the results remain when using unexpected variation in national government spending due to military spending or professional forecast errors in calculating the regional instrument. Finally, our findings are robust to changes in the sample and to additionally controlling for national tax policies and sovereign spreads.

4.2.1 Instrument Construction and Accounting for Intermediate Consumption

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 gov-

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

ernment 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 GVA of the non-market sector as a 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. Thus, instead of national non-market GVA, we can use government spending data from national accounts to compute the Bartik instrument. To be precise, we measure G_I in Equation (2) as national government spending instead of national GVA of the non-market sector. The results from Panel B in Table 1 (National Accounts) show that the multipliers increase slightly, but the overall dynamics remain unchanged.

Finally, we address the issue that GVA of the non-market sector does not include intermediate consumption of the general government, which is, however, one of the main components of government spending in our sample. To do this, 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.[19] 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. The results are shown in Panel B of Table 1 (Accounting for intermediate cons.). The size of both multipliers decreases somewhat compared to the baseline, with an output multiplier around 2 and an employment multiplier around 1.35. Interestingly, the estimates are also closer to related U.S. evidence, which relies on measures that directly include intermediate consumption of the general government (Nakamura and Steinsson 2014; Bernardini et al. 2020).

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 two alternative ways to extract variation in (unexpected) national spending.

First, 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

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

Table 1: Robustness: Output and Employment 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	2.83***	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
Panel B: Alternative Instrument Construction										
Alternative s_i (I)	2.80***	3.03***	3.03***	2.94***	2.89***	1.44***	1.84***	1.94***	1.88***	1.83***
	(0.51)	(0.40)	(0.32)	(0.30)	(0.23)	(0.32)	(0.20)	(0.18)	(0.18)	(0.19)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Alternative s_i (II)	2.31***	2.52***	2.45***	2.42***	2.42***	1.31***	1.61***	1.62***	1.55***	1.36***
	(0.37)	(0.47)	(0.51)	(0.47)	(0.30)	(0.28)	(0.30)	(0.32)	(0.34)	(0.31)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
National Accounts	3.48***	3.57***	3.58***	3.48***	3.29***	2.09***	2.45***	2.56***	2.52***	2.36***
	(0.73)	(0.38)	(0.22)	(0.24)	(0.19)	(0.37)	(0.29)	(0.27)	(0.24)	(0.21)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Accounting for	2.06 ***	2.23***	2.25***	2.18***	2.12***	1.04***	1.32***	1.40***	1.37***	1.35***
intermdiate cons.	(0.40)	(0.33)	(0.24)	(0.23)	(0.20)	(0.25)	(0.15)	(0.12)	(0.11)	(0.12)
# Obs	2326	2179	2032	1885	1738	2326	2179	2032	1885	1738
Panel C: Exogenous variation in national spending										
Military Spending	4.15***	4.11***	4.11***	3.82***	3.78***	2.06***	2.18***	2.31***	2.15***	2.25***
	(0.84)	(0.35)	(0.23)	(0.19)	(0.19)	(0.71)	(0.29)	(0.35)	(0.33)	(0.36)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Forecast Errors	5.08***	4.49***	3.91***	3.83***	3.66***	2.77***	2.55***	2.43***	2.52***	2.43***
	(1.31)	(0.43)	(0.36)	(0.24)	(0.29)	(1.00)	(0.44)	(0.36)	(0.32)	(0.34)
# 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 national GVA of the non-market sector to compute the Bartik instrument, we use the government spending from National Accounts. Finally, in Panel B, GVA of the non-market sector is scaled by a region-specific time-invariant factor to consider intermediate consumption of the non-market sector. Panel C explores alternative identification strategies. Here, we use first national military spending and then forecast errors to instrument national government spending changes used in the Bartik instrument.

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 aggregate military spending to first estimate unexpected changes in government spending and then compute the Bartik instrument as follows:[21]

$$Bartik_{i,t} = s_i \times \widehat{g_{I,t}}$$

where $\widehat{g_{I,t}}$ is the predicted value from regressing national government spending on military spending, both normalized by lagged aggregate GDP per capita, and country fixed effects. So, instead of using observed national government spending changes directly in Equation (2), we use the variation in national government spending due to changes in military spending.

Second, 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 first regress per capita national government spending normalized by lagged per capita GDP on the forecast errors and country fixed effects.[22] Importantly, the respective first stages are sufficiently strong. In the case of military spending, the F-Statistic is approximately 66, while in the case of the forecast error it is around 20. Thus, both instruments are strong predictors of variations in aggregate government spending.

The results of the regional multiplier estimates when applying both strategies to extract unexpected government spending changes at the national level are presented in Panel C of Table 1. The estimates are somewhat larger than the baseline results. The four-year output multiplier is 3.78 in the case of the military spending instrument and 3.66 in the case of the forecast error instrument; the employment multiplier is 2.25 and 2.43, respectively. However, these estimates still support our main finding: an increase in regional government spending significantly boosts regional output and employment.

[20] Nakamura and Steinsson (2014), Dupor and Guerrero (2017), and Auerbach et al. (2020) 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.3 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.

4.2.3 Alternative Samples and Controlling for the National Fiscal Stance

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 very similar to our baseline estimates. The four-year output multiplier is now above 3, and the four-year employment multiplier is above 2.

Table 2: Robustness: Output and Employment Multipliers (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	2.83***	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
Panel B: Alternative Samples										
NUTS 3 Data	3.45***	3.54***	3.46***	3.36***	3.26***	1.77***	2.10***	2.15***	2.13***	2.07***
	(0.44)	(0.34)	(0.24)	(0.21)	(0.15)	(0.38)	(0.19)	(0.14)	(0.14)	(0.13)
# Obs	14192	13303	12414	11525	10630	14192	13303	12414	11525	10630
Late Adopter	2.80***	3.03***	3.05***	2.96***	2.89***	1.45***	1.86***	1.95***	1.89***	1.86***
	(0.50)	(0.41)	(0.32)	(0.29)	(0.23)	(0.32)	(0.19)	(0.17)	(0.16)	(0.18)
# Obs	2673	2500	2328	2156	1982	2673	2500	2328	2156	1982
Panel C: Controlling for Fiscal Stance										
Country homogeneity	2.60***	2.96***	2.88***	2.73***	2.73***	1.12***	1.52***	1.47***	1.23***	1.18***
	(0.40)	(0.48)	(0.41)	(0.42)	(0.29)	(0.28)	(0.27)	(0.27)	(0.26)	(0.25)
# Obs	2617	2453	2289	2125	1959	2617	2453	2289	2125	1959
Country heterogeneity	2.22***	2.76***	2.76***	2.59***	2.86***	1.02***	1.38***	1.15***	0.69**	0.72**
	(0.27)	(0.33)	(0.30)	(0.35)	(0.27)	(0.20)	(0.22)	(0.29)	(0.30)	(0.30)
# 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.

Second, we add the late Euro adopters to the sample—namely Slovenia, Cyprus, 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 effects absorb heterogeneity across regions and should therefore also capture different national fiscal reactions to the regional government spending change.[23] However, it might be argued that these effects are not constant over time; therefore, 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).[24] In particular, we add the contemporaneous and one-year lag of both variables to the vector of control variables. We estimate two separate specifications. First, we assume 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 fiscal policy stance. 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 lower when controlling for national fiscal policies. Nevertheless, the regional fiscal stimulus still leads to a significant increase in the employment ratio with an employment multiplier around 1.[25]

In the Appendix, we show results for additional robustness checks. First, we address the concern that dynamic heterogeneity may pose a significant threat to cross-sectional multiplier estimates (Canova 2020). Following Bernardini et al. (2020), we estimate output and employment multipliers with a mean group approach that allows for cross-region heterogeneity in the slope coefficients. Since the mean group estimator requires a relatively long period of time, we estimate

[23] Note that regional fixed effects also absorb constant heterogeneity at the national level.

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

[25] 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 26.

only the impact multiplier. We find an output (employment) multiplier of 1.44 (1.08), statistically significant at the 95% (90%) confidence level. Despite being smaller, these estimates are fairly close to the benchmark multipliers.

Second, 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 C.3 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 C.1 in the Appendix and reassure that the baseline multipliers are robust.

Additionally, the baseline multiplier estimates are robust when we closely follow Nakamura and Steinsson (2014) and use as the instrument the residual of regressing regional government spending on time fixed effects and national military spending interacted with region fixed effects (Table C.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 C.1 in the Appendix). Moreover, 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 C.2 in the Appendix).

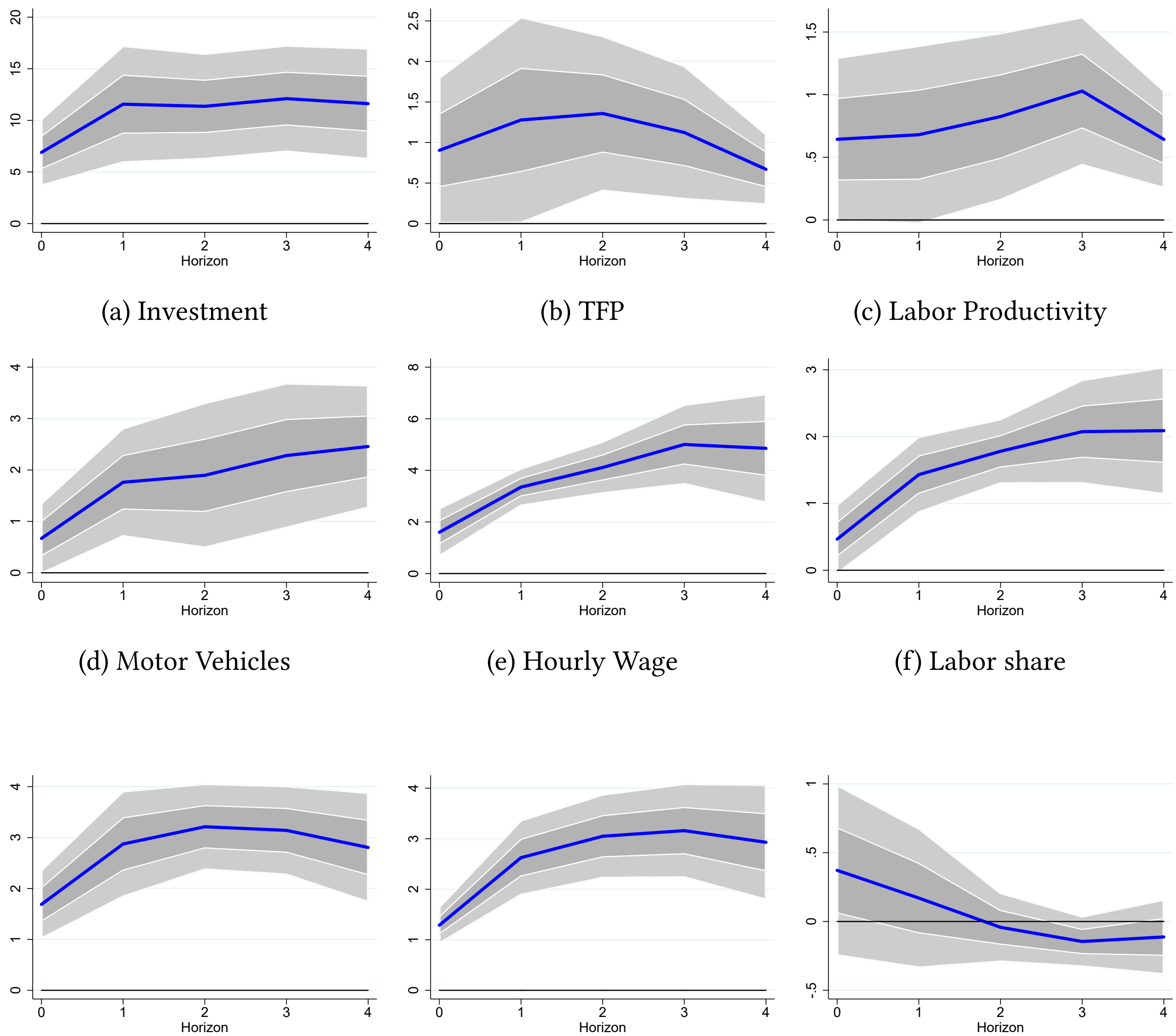
In this section, we have shown that our baseline findings are robust to several modifications. In the following, we will thus rely on our baseline specification to produce additional interesting insights into the fiscal transmission mechanism in the Eurozone.

4.3 Impulse Response Analysis

In this section, we present additional impulse responses to the regional fiscal spending shock in order to better understand the fiscal transmission mechanism in the Eurozone. The responses are calculated based on Equation (3), and we report responses to a one percent increase in regional government spending relative to regional GDP. The solid lines in Figure 2 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 demand following the regional fiscal expansion. Panel 2a of Figure 2 shows that a substantial component of the increase in private demand is higher private investment. The fiscal expansion leads

Figure 2: 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). Bands are 68% (dark) and 95% (light) confidence intervals.

to a significant and persistent increase in regional private investment expenditures. On impact, private investment increases by around 6%, which is roughly twice as large as the output response reported in Figure 1. Investment further increases up until three years after the shock. Another interesting 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 C.2 in the Appendix, and we find that the investment multiplier is less than half the size of the output multiplier. On impact, the investment multiplier is estimated to be around 1.3, and it increases slightly to 1.4 four years after the spending increase. Some empirical studies also find a positive investment response following an increase in fiscal spending at the national level (Ben Zeev and Pappa 2017; D'Alessandro et al. 2019). However, to the best of our knowledge, we are the first to show that higher regional fiscal spending crowds in regional private investment.

Panels 2b and 2c of Figure 2 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 both productivity measures amounts to roughly one percent, while 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. (2020). 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. (2020) 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.[28]

Official data for private consumption expenditures, the second-most important component of private demand, are not available at the regional European level. Nonetheless, we rely on a

[26] More details on the construction of our TFP variable can be found in Appendix A.4.

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

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 2d shows that the number of vehicles rises significantly after a fiscal expansion. On impact, there is an increase of around 1%, which then persistently builds up to more than 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. (2020).

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 2e 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 almost 2% 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. (2020) 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 2f 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 2 percentage points higher. In accordance with our evidence, Cantore and Freund (2020) find that an aggregate government spending shock leads to a rise in the labor share, whereas Auerbach et al. (2020) estimate an acyclical labor share response.[32] The inverse of the labor share is commonly used as a measure for the price-cost markup (Nekarda and Ramey 2020; Auerbach et al. 2020).[33] When following this argument, our evidence implies that

[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 C.4 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, labor share is the ratio between total private compensation and gross value added in the private sector.

[32]Cantore and Freund (2020) 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, 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.

a government spending shock lowers the markup and thus gives rise to 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 2g. On impact, hours worked rise by more than 1.5% and then increase to 3% 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 2h and 2i 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. (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) and Corbi et al. (2019) 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 19 additional jobs in the year of the shock, of which 14 are in the private sector and 5 in the public sector. Because the build-up in employment is very persistent, the stimulus of €1 million produces a total of 42 new jobs after four years, of which 26 are in the private sector.[34] This corresponds to a cost per job created of about €24,000, roughly in line with the U.S. estimates by Serrato and Wingender (2016) and Adelino et al. (2017).

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 expenditures, iii) raises real wages while increasing (lowering) the labor share (markup), and iv) expands hours worked, which is mainly driven by increasing the

[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.

number of employees.

4.4 Sectoral Analysis

Next, we make use of the detailed sectoral division in our dataset and estimate regional fiscal multipliers for different sectors of the economy. In doing so, we re-estimate the baseline multiplier regressions in Equation (1) but replace regional GDP and employment by GVA and employment in one specific economic sector.[35] This allows estimating separate fiscal multipliers for the industry, construction, services, and finance sectors.[36]

Table 3 presents the results. While Panel A repeats the baseline estimates, Panel B presents the multipliers across economic sectors. Both the GVA and employment multipliers are positive and statistically significant for all sectors. However, there is substantial heterogeneity. We find that multipliers are largest in the construction and industry sectors. While the multipliers in the industry sector are slightly larger than the baseline (all sectors) estimates, the multipliers for the construction sector are around twice as large when compared to the baseline. Contrarily, the positive impact of a regional fiscal stimulus is somewhat lower in the services and finance sectors. Interestingly, the estimated multipliers for the services sector are very similar to the baseline estimates. For the finance sector, the output multiplier is insignificant and below 1 on impact but becomes significant from the first year onwards, and, four years after the shock, the multiplier is estimated to be close to 2. Our sectoral estimates corroborate other recent empirical findings. For example, similar to Nakamura and Steinsson (2014), we find the largest multipliers in the construction and industry sectors. In addition, Corbi et al. (2019) also estimate the largest multipliers in the construction sector, and Bredemeier et al. (2020) show that the positive employment effects of the ARRA package were strongest in the construction sector.

We can also decompose the total multiplier including all economic sectors into its relative sectoral contributions. The results are shown in Table C.3 in the Appendix. On impact, the industry and services sector mainly contribute to the strong increase in private economic activity. Out of the €1.96 increase in private economic activity, the industry sector contributes 65 cents and the services sector 76 cents. Higher production in the construction sector adds 30 cents to the total effect and the finance sector only contributes 8 cents. Four years after the shock, the picture slightly changes. The industry and service sectors are still the strongest contributors but the finance sector now adds more to the total multiplier than the construction sector (35 versus 20 cents).

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

[36]These sectors account on average for 19.9%, 6.4%, 23.3%, and 23.3% of total regional GVA, respectively. We exclude agriculture, forestry and fishing from the sectoral analysis since they account for only a very small share (2.4%) of most regional economies.

Table 3: Output and Employment Multipliers by Economic Sectors

	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	2.83***	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
Panel B: Multipliers by Economic Sectors										
Industry	3.14**	2.95***	2.97***	3.06***	3.01***	2.43***	2.94***	3.17***	3.02***	3.07***
	(1.34)	(1.06)	(0.66)	(0.47)	(0.46)	(0.43)	(0.26)	(0.19)	(0.20)	(0.16)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Construction	6.43***	5.56***	5.72***	5.54***	5.46***	4.58***	5.47***	6.08***	5.85***	5.80***
	(2.41)	(1.31)	(0.91)	(0.93)	(0.76)	(0.85)	(0.69)	(0.71)	(0.75)	(0.84)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Services	2.95***	3.31***	3.12***	2.90***	2.65***	1.65***	2.07***	2.18***	2.23***	2.06***
	(0.67)	(0.42)	(0.42)	(0.43)	(0.29)	(0.39)	(0.30)	(0.28)	(0.23)	(0.16)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Finance	0.42	1.01*	1.02*	1.51***	1.98***	1.78***	1.93***	1.72***	1.78***	1.73***
	(1.03)	(0.57)	(0.53)	(0.34)	(0.29)	(0.58)	(0.54)	(0.44)	(0.27)	(0.32)
# 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.

4.5 Regional Fiscal Spillovers

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 expenditures. 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 induce 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 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). However, 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] The data are only available for the period 2000–2010; thus, the following results are based on this shorter sample.

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

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

where $G_{j,t}$ is government spending in region j in period t and $j \neq i$. Following Auerbach and Gorodnichenko (2013) and Coelho (2019), $w_{i,j,t}$ is 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. To assess spillovers, we either use all trade partners or only i's top 10% of trade partners with regard to $w_{i,j,t}$. Then, we estimate the own and spillover multipliers for each horizon $h = 0, ..., 4$:

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

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)

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

[38] See Appendix A.2 for more details.

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

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

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

Figure 3 shows the estimated own and spillover multipliers, β_h and ϕ_h. Panels 3a and 3b show the output multiplier estimates using all trade partners. The own multiplier estimate is very close to our baseline estimate, which suggests that spillover effects are small.[39] This is supported by the spillover multiplier, which is estimated to be insignificant and close to zero. When moving from the full sample of all trade partners to only the top 10% of trade partners (Panels 3c and 3d), we find that the spillover multiplier becomes larger and on impact it is borderline statistically significant. Panels 3e, 3f, 3g, and 3h show the respective employment multipliers. In the case of all trade partners, the employment spillovers are significant and sizeable. The spillover effect amounts to 1/3 of the own multiplier estimate. However, the spillover effect vanishes when focusing solely on top trading partners.

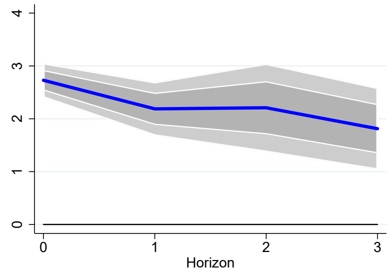
This general picture of relatively small fiscal spillovers in the Eurozone remains when considering, respectively, only the top 1% of trade partners and trade partners from the same country (Figure C.5 in the Appendix). Overall, these findings reveal relatively small fiscal spillovers for the Eurozone and thus reinforce the existing results on the U.S. economy by Serrato and Wingender (2016), Dupor and Guerrero (2017), and Bernardini et al. (2020). Moreover, 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 common European single market.

4.6 State Dependent Multipliers

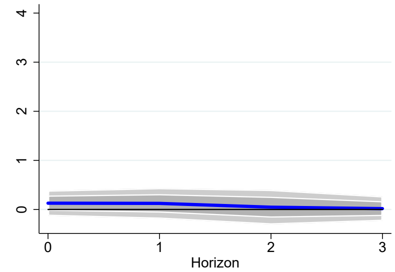
As a final exercise, we investigate whether regional fiscal multipliers in the Eurozone are characterized by significant state dependencies. In particular, we test whether fiscal multipliers depend on the state of the business cycle, on the sign of the fiscal intervention (consolidation versus expansion),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

[39]Note that differences to the baseline estimates might be due to the sample change.

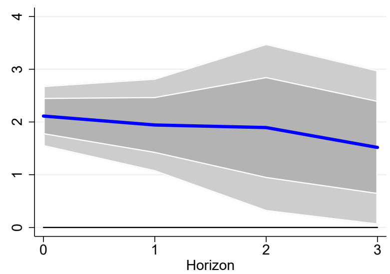
Figure 3: Output and Employment Multipliers and Spillover Multipliers, 2000–2010 — NUTS 2



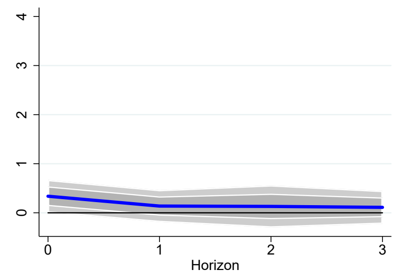
(a) Output Multiplier



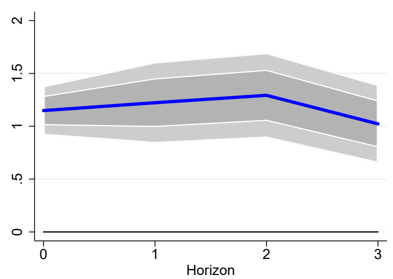
(b) Output Spillover Multiplier



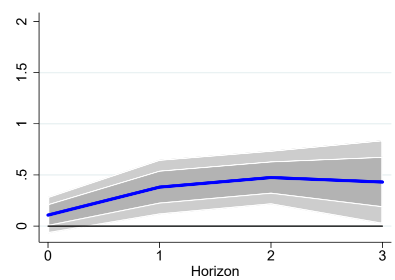
(c) Output Multiplier (top partners)



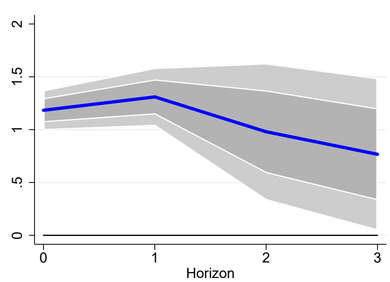
(d) Output Spillover Multiplier (top partners)



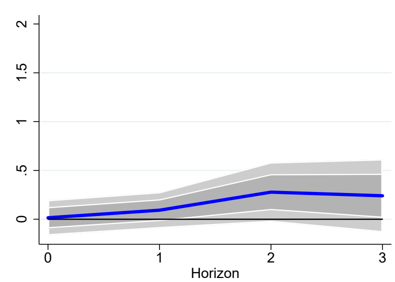
(e) Employment Multiplier



(f) Employment Spillover Multiplier



(g) Employment Multiplier (top partners)



(h) Employment Spillover Multiplier (top partners)

Notes: Panels 3a and 3b show the GDP multiplier and the spillover multiplier taking into account the spillovers from all regions, while Panels 3c and 3d consider only the spillovers from the main trade partners (top 10% of the weights). Panels 3e and 3f show the employment multiplier and the spillover multiplier taking into account the spillovers from all regions, while Panels 3g and 3h consider only the spillovers from the main trade partners (top 10% of the weights). The sample here goes from 2000 to 2010. Bands are 68% (dark) and 90% (light) Driscoll and Kraay (1998) confidence intervals.

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, testing for 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 are using Driscoll and Kraay (1998) standard errors, and we make use of the Anderson and Rubin (1949) 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 A in Table 4 presents the results. 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, and, 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).

Table 4: 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: Business Cycle Recessions versus Expansions										
Recessions	3.37***	3.52***	3.61***	3.57***	3.44***	1.88***	2.30***	2.50***	2.55***	2.50***
	(0.72)	(0.44)	(0.32)	(0.26)	(0.18)	(0.42)	(0.20)	(0.14)	(0.24)	(0.26)
Expansions	2.84***	3.21***	3.16***	3.06***	3.03***	1.23***	1.69***	1.80***	1.79***	1.73***
	(0.34)	(0.37)	(0.28)	(0.25)	(0.22)	(0.25)	(0.27)	(0.29)	(0.28)	(0.30)
AR Test	0.317	0.348	0.153	0.103	0.138	0.008	0.038	0.047	0.103	0.095
# Obs	2428	2266	2104	1943	1783	2428	2266	2104	1943	1783
Panel B: Fiscal Consolidation versus Fiscal Stimulus										
Consolidation	2.75***	3.22***	3.13***	3.07***	3.30***	1.68***	2.13***	2.23***	2.56***	3.72***
	(0.51)	(0.47)	(0.33)	(0.29)	(0.14)	(0.29)	(0.17)	(0.13)	(0.11)	(0.16)
Stimulus	3.03***	3.04***	3.19***	2.98***	3.07***	1.30***	1.65***	1.88***	1.76***	1.85***
	(0.75)	(0.60)	(0.53)	(0.47)	(0.33)	(0.48)	(0.37)	(0.38)	(0.31)	(0.27)
AR Test	0.634	0.687	0.880	0.796	0.336	0.850	0.581	0.995	0.430	0.202
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel C: Core versus Periphery										
Core	3.50***	3.56***	3.68***	3.93***	3.91***	1.78***	2.26***	2.43***	2.99***	3.08***
	(0.77)	(0.55)	(0.35)	(0.30)	(0.27)	(0.53)	(0.41)	(0.30)	(0.22)	(0.23)
Periphery	2.36***	2.70***	2.75***	2.64***	2.61***	1.36***	1.75***	1.85***	1.74***	1.72***
	(0.36)	(0.38)	(0.35)	(0.32)	(0.26)	(0.26)	(0.16)	(0.17)	(0.17)	(0.21)
AR Test	0.089	0.061	0.004	0.000	0.000	0.246	0.160	0.062	0.000	0.000
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963

Notes: In Panel A, 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 B, we show state dependencies for fiscal consolidations and stimuli. Precisely, we define fiscal consolidations (stimuli) whenever the Bartik instrument is negative (positive). In Panel C, 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.

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 Bartik instrument 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 ($I_{i,t} = 0$).[40]

[40] This procedure implies that out of the 2,621 regional shocks considered, 2,207 shocks, or 84%, are treated as fiscal

Panel B of Table 4 shows the estimated fiscal multipliers.[41] 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 respective one associated with a fiscal consolidation, the picture flips in other years. In the case of the employment multiplier, the evidence is a bit stronger. For all years of the forecast horizon, the employment multiplier brought by a fiscal consolidation is larger than the one brought by a fiscal expansion. Four years after the shock, the employment multiplier is around twice as large when government spending is reduced compared to an increase in government spending. However, estimation uncertainty is relatively high such that the difference between both multipliers is not estimated to be significant.

Finally, we test for differences in fiscal multipliers between core and periphery countries. 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 C 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. 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 novel rich dataset at the regional level, this paper investigates the impact of fiscal policy in the Eurozone. We provide new empirical evidence on the fiscal transmission mechanism. In particular, our baseline estimates reveal a fiscal spending output (employment) multiplier of 2.9 (1.9). 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

expansions, while the remaining 414 or 16% are treated as consolidations.

[41]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).

expenditures 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 €24,000.

We also detect significant sectoral heterogeneity, with the construction and industry (services and finance) sectors showing the highest (lowest) fiscal multipliers. The paper provides further evidence that there are small and mostly insignificant regional fiscal spillovers. Finally, we detect notable state-dependencies in regional fiscal multipliers. They are larger in economic recessions, during fiscal consolidations, and in the core countries of the Eurozone.

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 Appendix

Table A.1: NUTS structure

NUTS 0	NUTS 1	#	NUTS 2	#	NNUTS 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*	Non-Market GVA / Population	Regional Gross Value Added of the Non-Market Sector per capita [ARDECO]
Employment Rate	Employment / Population	Total Employment per capita [ARDECO]
Employment		Total Employment [ARDECO]
Hours		Total Hours worked [ARDECO]
Investment *pc*	Private GFCF/ Population	Total Private (all sectors excluding non-market) Investment per capita (fixed gross capital formation) [ARDECO]
Hourly Wage	Compensation / Hours	Regional average compensation per hour (all sectors) [ARDECO]
Productivity	GVA / Hours	Labor Productivity, value added per hour (all sectors) [ARDECO]
TFP	Check A.4 for details	[ARDECO and Gardiner et al. (2020)]
Labor Share	Private Compensation / private GVA	Private (all sectors excluding non-market) compensation as a share of private GDP [ARDECO]
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 database 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.

In particular, we make use of the non-market sector GVA as a proxy for government spending. As part of our argument in the main text, we produce the following three tables.

Table A.3: Correlation Between Non-market GVA and Government Spending by Country

	Correlation w/ OECD Series		Correlation w/ AMECO Series	
Country	Levels	Logs	Levels	Logs
Austria	0.9899	0.9886	0.9876	0.9859
Belgium	0.9762	0.9786	0.9876	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	0.9980	0.9975	0.9980	0.9988

Notes: This shows, by country, the correlation in levels and log between GVA of non-market sector (from ARDECO) with 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

	Gov Spend			$\ln GovSpend$		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OECD						
GVA^{NM}	0.995***	0.989***	1.022***			
	(0.023)	(0.045)	(0.048)			
$\ln GVA^{NM}$				0.913***	0.860***	0.840***
				(0.039)	(0.063)	(0.072)
# Obs	223	223	223	223	223	223
Panel B: AMECO						
GVA^{NM}	1.016***	1.018***	1.000***			
	(0.028)	(0.037)	(0.032)			
$\ln GVA^{NM}$				1.045***	1.113***	1.111***
				(0.030)	(0.053)	(0.082)
# Obs	212	212	212	212	212	212
Country FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes

Notes: Columns (1) to (3) show the results from regressing government spending series from OECD and AMECO on non-market GVA series from ARDECO at the national level (NUTS 0), while the other columns present the estimates from regressing these series in logs. 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

	Gov Spend			$\ln GovSpend$		
	(1)	(2)	(3)	(4)	(5)	(6)
GVA^{NM}	0.941***	0.976***	0.790**			
	(0.129)	(0.250)	(0.363)			
$\ln GVA^{NM}$				1.007***	1.032***	0.666***
				(0.047)	(0.113)	(0.199)
Country FE	No	Yes	Yes	No	Yes	Yes
Time FE	No	No	Yes	No	No	Yes
# Obs	1604	1604	1604	1604	1604	1604

Notes: Columns (1) to (3) show the results from regressing regional government spending series from EUREGIO on non-market GVA series from ARDECO at the regional level (NUTS 2), while the remaining columns present the estimates from regressing the time series in logs. Data from 2000 to 2010. Robust standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.2 PBL EUREGIO database

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 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 information can be found in Thissen et al. (2018).

A.3 Military Data at the Country Level

Military expenditure data are taken from the Stockholm International Peace Research Institute (SIPRI).[1] 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.4 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).[2] 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.[3]

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

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

[1]Citation: SIPRI Military Expenditure Database 2019, https://www.sipri.org/databases/milex

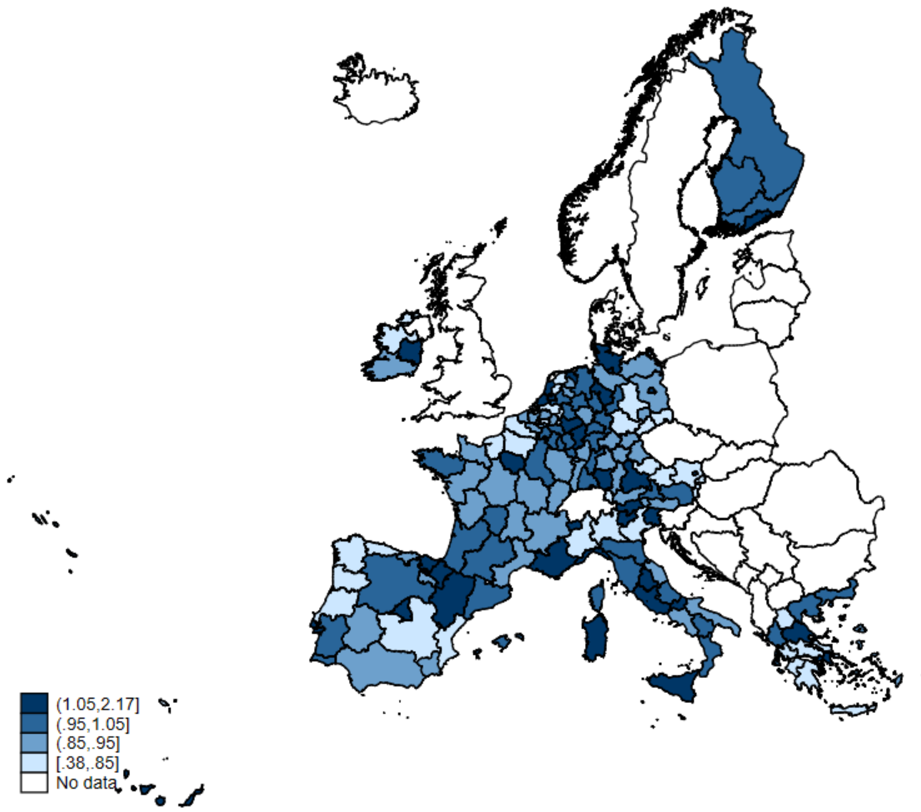
[2]It was necessary to adjust the regional division to be in accordance with the most recent NUTS 2016 version for France, Ireland, Poland and the United Kingdom.

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

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. (2020). 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.

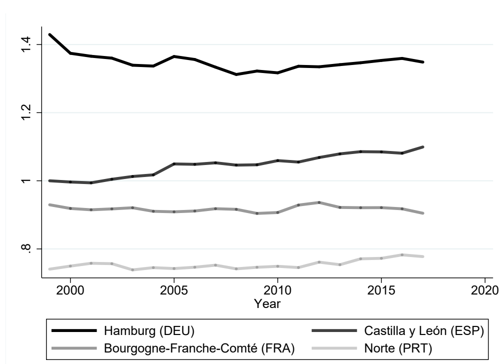
Appendix B Data Description Appendix

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.

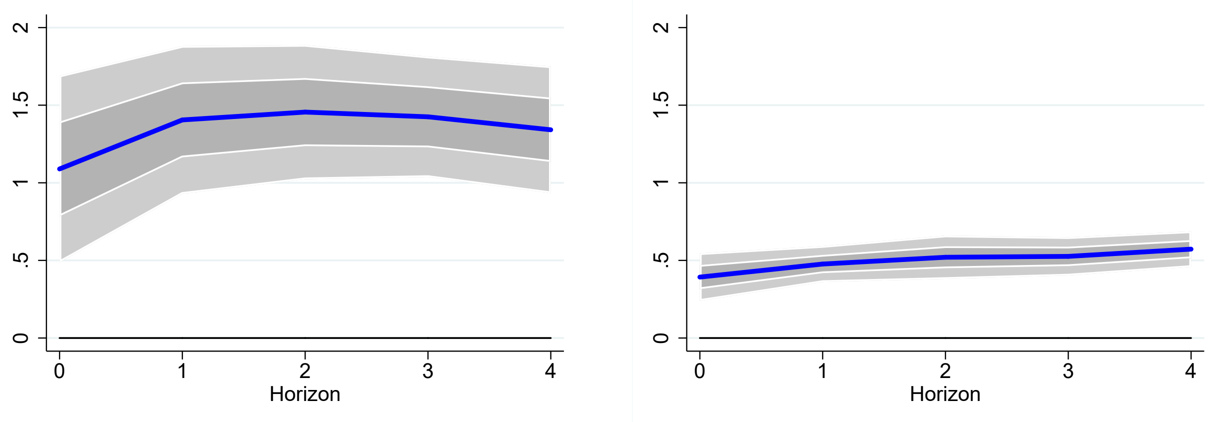
Figure B.2: Ratio between Regional and National per capita Government Sending



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

Appendix C Results Appendix

Figure C.1: Private and Public Employment Multipliers

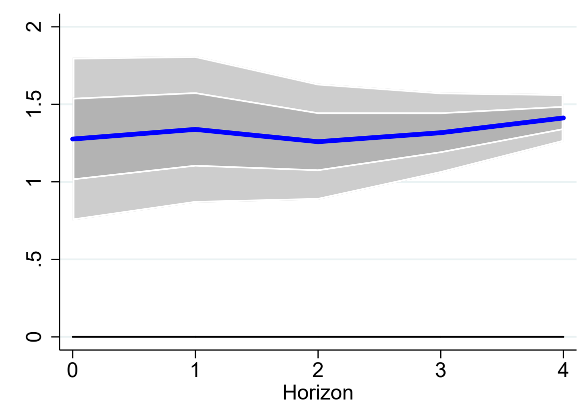


(a) Private Employment Multiplier

(b) Public Employment Multiplier

Notes: Panels C.1a and C.1b show the cumulative employment multipliers for private and non-market sectors relative to total employment, respectively. Bands are 68% (dark) and 95% (light) confidence intervals.

Figure C.2: Investment Multiplier



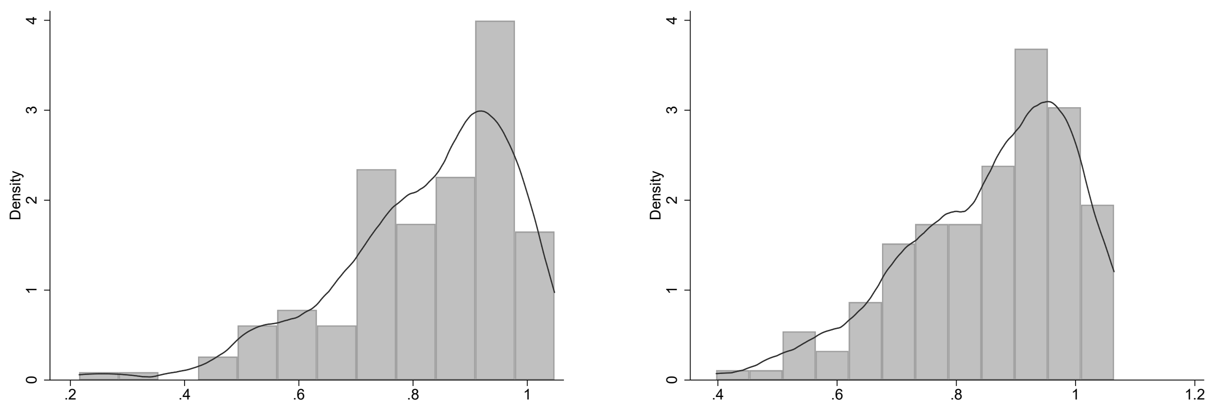
Notes: This figure shows the cumulative relative private investment multiplier (using change in private investment relative to output). Bands are 68% (dark) and 95% (light) confidence intervals.

Table C.1: Output and Employment Multipliers Robustness Checks I

	Output Multiplier					Employment Multiplier				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Baseline Specification										
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
Panel A: Excluding AR(1) Outliers										
Multiplier	2.92***	3.19***	3.21***	3.14***	3.05***	1.38***	1.80***	1.92***	1.85***	1.83***
	(0.55)	(0.42)	(0.30)	(0.26)	(0.23)	(0.31)	(0.19)	(0.17)	(0.15)	(0.19)
# Obs	2112	1979	1846	1713	1579	2109	1977	1845	1713	1579
Panel B: Nakamura and Steinsson (2014) Approach with Military Spending										
Multiplier	1.02*	1.64***	1.95***	2.10***	1.98***	0.45	1.07***	1.29***	1.35***	1.05***
	(0.62)	(0.63)	(0.43)	(0.32)	(0.24)	(0.40)	(0.36)	(0.29)	(0.22)	(0.15)
# Obs	2627	2461	2295	2129	1963	2627	2461	2295	2129	1963
Panel C: No Controls										
Multiplier	2.65***	2.82***	2.78***	2.71***	2.65***	1.70***	1.96***	2.01***	1.97***	1.94***
	(0.51)	(0.40)	(0.32)	(0.27)	(0.20)	(0.33)	(0.25)	(0.21)	(0.16)	(0.11)
# Obs	2953	2789	2625	2461	2295	2953	2789	2625	2461	2295
Panel D: Excluding regions in top 10% of s_i										
Multiplier	2.92***	3.15***	3.12***	3.01***	2.97***	1.44***	1.84***	1.94***	1.91***	1.87***
	(0.52)	(0.42)	(0.32)	(0.29)	(0.21)	(0.32)	(0.20)	(0.19)	(0.19)	(0.22)
# Obs	2365	2217	2069	1921	1771	2365	2217	2069	1921	1771

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%).

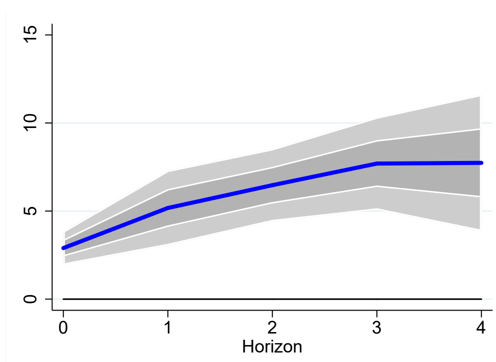
Figure C.3: Distribution of Output and Employment Persistence Parameter



(a) Output (b) Employment

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

Figure C.4: Impulse Response of Disposable income



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

Table C.2: Output and Employment Multipliers Robustness Check 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	2.83***	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
Panel B: Excluding Individual Countries Iteratively										
Multiplier Austria	2.84***	3.08***	3.07***	2.95***	2.90***	1.47***	1.88***	1.97***	1.91***	1.88***
	(0.53)	(0.42)	(0.33)	(0.31)	(0.23)	(0.34)	(0.20)	(0.19)	(0.18)	(0.19)
# Obs	2477	2322	2167	2012	1855	1.50***	1.92***	2.01***	1.96***	1.93***
Multiplier Belgium	2.87***	3.12***	3.10***	2.99***	2.94***	1.50***	1.92***	2.01***	1.96***	1.93***
	(0.50)	(0.40)	(0.32)	(0.30)	(0.23)	(0.33)	(0.19)	(0.18)	(0.18)	(0.20)
# Obs	2445	2292	2139	1986	1831	2445	2292	2139	1986	1831
Multiplier Germany	2.33***	2.65***	2.72***	2.61***	2.54***	1.35***	1.72***	1.81***	1.71***	1.68***
	(0.40)	(0.33)	(0.29)	(0.28)	(0.22)	(0.22)	(0.15)	(0.18)	(0.17)	(0.21)
# Obs	2013	1887	1761	1635	1507	2013	1887	1761	1635	1507
Multiplier Greece	2.48***	2.64***	2.62***	2.41***	2.37***	1.45***	1.94***	2.08***	1.89***	1.66***
	(0.49)	(0.36)	(0.36)	(0.44)	(0.33)	(0.31)	(0.28)	(0.35)	(0.43)	(0.47)
# Obs	2439	2288	2137	1986	1833	2439	2288	2137	1986	1833
Multiplier Spain	2.99***	3.16***	3.09***	3.07***	3.00***	1.54***	1.92***	1.99***	2.09***	2.09***
	(0.52)	(0.44)	(0.34)	(0.30)	(0.23)	(0.32)	(0.18)	(0.14)	(0.11)	(0.11)
# Obs	2317	2172	2027	1882	1735	2317	2172	2027	1882	1735
Multiplier Finland	2.81***	3.06***	3.07***	2.99***	2.93***	1.46***	1.86***	1.96***	1.92***	1.87***
	(0.53)	(0.42)	(0.33)	(0.30)	(0.24)	(0.34)	(0.20)	(0.18)	(0.18)	(0.20)
# Obs	2541	2382	2223	2064	1903	2541	2382	2223	2064	1903
Multiplier France	2.89***	3.14***	3.09***	3.02***	2.97***	1.45***	1.87***	1.98***	1.95***	1.93***
	(0.55)	(0.48)	(0.40)	(0.36)	(0.28)	(0.36)	(0.23)	(0.19)	(0.17)	(0.19)
# Obs	2189	2052	1915	1778	1639	2189	2052	1915	1778	1639
Multiplier Ireland	2.98***	3.23***	3.24***	3.15***	3.07***	1.50***	1.92***	2.03***	1.99***	1.95***
	(0.54)	(0.41)	(0.29)	(0.27)	(0.24)	(0.35)	(0.20)	(0.18)	(0.17)	(0.19)
# Obs	2582	2419	2256	2093	1930	2582	2419	2256	2093	1930
Multiplier Italy	2.82***	3.05***	3.07***	3.00***	2.95***	1.41***	1.82***	1.92***	1.89***	1.87***
	(0.54)	(0.43)	(0.31)	(0.27)	(0.21)	(0.34)	(0.21)	(0.18)	(0.17)	(0.19)
# Obs	2285	2142	1999	1856	1711	2285	2142	1999	1856	1711
Multiplier Luxembourg	2.84***	3.08***	3.08***	2.98***	2.92***	1.48***	1.89***	1.99***	1.94***	1.91***
	(0.52)	(0.41)	(0.32)	(0.30)	(0.23)	(0.33)	(0.19)	(0.18)	(0.17)	(0.19)
# Obs	2605	2442	2279	2116	1951	2605	2442	2279	2116	1951
Multiplier Netherlands	2.96***	3.23***	3.20***	3.04***	2.99***	1.48***	1.93***	2.05***	1.98***	1.94***
	(0.54)	(0.40)	(0.31)	(0.28)	(0.20)	(0.35)	(0.19)	(0.17)	(0.16)	(0.18)
# Obs	2429	2277	2125	1973	1819	2429	2277	2125	1973	1819
Multiplier Portugal	2.88***	3.13***	3.11***	3.02***	2.96***	1.51***	1.88***	1.96***	1.93***	1.89***
	(0.54)	(0.42)	(0.32)	(0.29)	(0.22)	(0.34)	(0.20)	(0.17)	(0.16)	(0.17)
# Obs	2509	2352	2195	2038	1879	2509	2352	2195	2038	1879

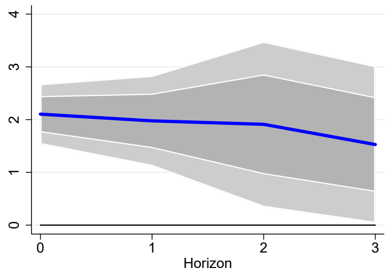
Notes: This table shows the output and employment multiplier estimates using the baseline specification but excluding individual countries iteratively from the base sample.

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

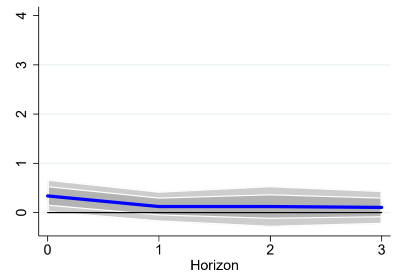
	Output Multiplier					**Employment Multiplier**				
	Impact	1 Year	2 Years	3 Years	4 Years	Impact	1 Year	2 Years	3 Years	4 Years
Panel A: Baseline Specification										
Multiplier	2.83***	3.07***	3.06***	2.97***	2.91***	1.46***	1.87***	1.97***	1.93***	1.89***
	(0.52)	(0.41)	(0.32)	(0.30)	(0.23)	(0.33)	(0.19)	(0.18)	(0.17)	(0.19)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
GVA Multiplier	2.96***	3.14***	3.15***	3.14***	3.11***	1.73***	2.15***	2.29***	2.27***	2.21***
	(0.52)	(0.46)	(0.36)	(0.30)	(0.23)	(0.32)	(0.19)	(0.18)	(0.18)	(0.20)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Panel B: Multipliers by Economic Sectors										
Industry	0.65**	0.59***	0.59***	0.54***	0.51***	0.32***	0.39***	0.42***	0.40***	0.41***
	(0.26)	(0.21)	(0.13)	(0.09)	(0.10)	(0.06)	(0.04)	(0.03)	(0.03)	(0.02)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Construction	0.30**	0.24***	0.25***	0.22***	0.20***	0.32***	0.40***	0.43***	0.39***	0.39***
	(0.12)	(0.06)	(0.06)	(0.06)	(0.05)	(0.09)	(0.08)	(0.06)	(0.06)	(0.06)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Services	0.76***	0.88***	0.84***	0.77***	0.70***	0.59***	0.75***	0.81***	0.83***	0.76***
	(0.16)	(0.10)	(0.11)	(0.11)	(0.08)	(0.12)	(0.09)	(0.08)	(0.07)	(0.04)
# Obs	2621	2457	2293	2129	1963	2621	2457	2293	2129	1963
Finance	0.08	0.19	0.18	0.27***	0.35***	0.17***	0.17***	0.13**	0.14***	0.14***
	(0.22)	(0.13)	(0.12)	(0.08)	(0.07)	(0.06)	(0.06)	(0.06)	(0.04)	(0.04)
# 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.

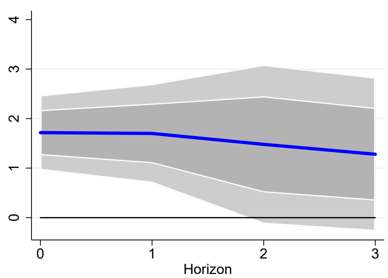
Figure C.5: Robustness Check: Spillover Multipliers, 2000-2010



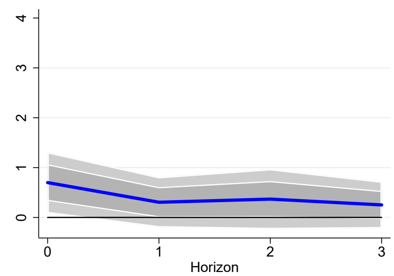
(a) Output Multiplier



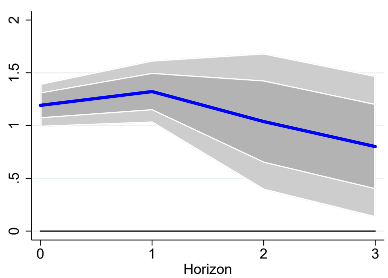
(b) Output Spillover Multiplier (own country)



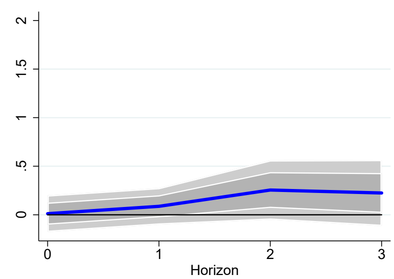
(c) Output Multiplier



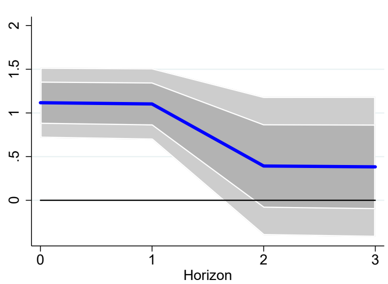
(d) Output Spillover Multiplier (top 1%)



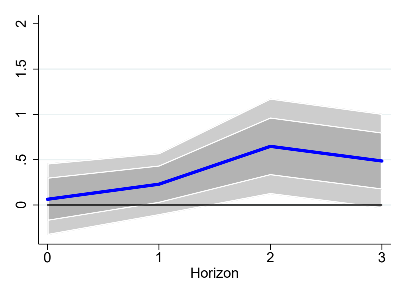
(e) Employment Multiplier



(f) Employment Spillover Multiplier (own country)



(g) Employment Multiplier



(h) Employment Spillover Multiplier (top 1%)

Notes: Panels 3a and 3b show the GDP multiplier and the spillover multiplier taking into account the spillovers from all regions, while panels C.5c and C.5d consider only the spillovers from the main trade partners (top 1% of the weights). Panels 3e and 3f show the employment multiplier and the spillover multiplier taking into account the spillovers from all regions, while panels C.5g and C.5h consider only the spillovers from the main trade partners (top 1% of the weights). Sample here goes from 2000 to 2010. Bands are 68% (dark) and 90% (light) confidence intervals.

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Visiting address: Brunkebergs torg 11
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Website: www.riksbank.se
Telephone: +46 8 787 00 00, Fax: +46 8 21 05 31
E-mail: registratorn@riksbank.se